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The Contribution of the New Energy Industry(NEI) to Economic Growth: Direct, Indirect, Environmental and Social Effect

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Abstract: This study investigates how the new energy industry (NEI) contributes to the economy's growth. As time went on, more and more countries gradually accepted the concept of new energy development. Evidence shows that NEI helps economic growth and indicates significant benefits including job creation, technological advancements, and enhanced productivity. Besides make direct contributions to the economic growth, the application of NEI also have some positive indirect effect on the economy. NEI increases long-term profits by reducing health care costs and environmental maintenance caused by pollution. However, current research reveals gaps, particularly in the long-term economic impacts of cleaner energy, regional disparities, and the integration of social well-being metrics. Future studies are proposed to address these gaps, including detailed analyses of the impacts on small and medium enterprises, comparative policy effectiveness, and the effects on rural and remote areas. By advancing research in these areas, policymakers and stakeholders can better understand and leverage the economic benefits of the NEI to support sustainable development and global financial stability.

Keywords: NEI, Environmental sustainability, Social sustainability, Employment, Social welfare.

1. Introduction

Nowadays, the lack of fossil fuels and their unrenewable characteristics bring a worldwide problem to countries. To solve this problem, many countries developed programs to put new energy into use. Unlike traditional fossil fuels, new energy resources can be restored quickly and not contaminate the ecosystem. Moreover, some kinds of new energy are more efficient than fossil fuels. Renewable electricity can be generated from various sources. As economic and social energy demands continue to rise, along with the push for a low-carbon society focused on environmental preservation, a significant transition from traditional fossil fuels to non-fossil new energy sources will become inevitable.

Today, people still use fossil fuels in large quantities. A large amount of greenhouse gas enters the air because of the burning of fossil energy, leading to a hole in the ozone layer and global warming. Due to the immaturity of science and technology and the problem of fuel, fossil energy is relatively inefficient and very wasteful of resources. Burning fossil fuels to produce electricity usually leads to

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heat losses of over 50% and in cars even 75% [1]. This inefficiency results in a significant waste of resources and higher greenhouse gas emissions. As a result, The negative effects brought about by global warming are becoming more and more serious. Rather than relying on fossil fuels, we can utilize new energy sources to effectively reduce carbon emissions. New energy technologies like solar panels and wind turbines convert energy more efficiently, resulting in minimal losses. Research shows that a 1% increase in renewable energy consumption per capita decreases the CO2 emissions per capita by 0.259% in the long run [2]. This demonstrates the substantial impact that renewable energy can have on mitigating climate change. The construction of NEI is conducive to reducing and decelerating the negative effects of carbon emissions on global warming.

As the demand for creating an environmentally friendly industry grows, the deployment of NEI in the overall energy structure is expected to rise further. This study aims to explore how NEI contributes to the development and economic growth. Furthermore, this paper will explain the relevance of understanding the economic contributions of the NEI for policymakers, investors, and environmental stakeholders. Direct economic effect, indirect economic effect, environmental and social effect are discussed in the paper to get the conclusion.

2. Literature Review

The NEI includes a wide range of technologies and practices aimed at generating, storing, and distributing energy from renewable and sustainable sources. NEI aims to create environmentally friendly industries while addressing the dilemma of increasingly scarce fossil fuels. With the globalization of the world and the development of science and technology, people gradually realize that excessive carbon emission negatively affect the environment and economy.As a result, new energy technology is gradually being paid attention to and developed. Both governments and corporations are committing to ambitious sustainability goals. This shift is crucial for mitigating climate change. Also, it presents opportunities for economic revitalization and technological innovation.

As people are gradually realizing the importance of protecting the environment, NEI's development has already become an inevitable global trend. Instead of using coals, electricity collected from wind energy and hydro energy is becoming a dominant source of energy. For the NEI to be put into use, some advanced technologies need to be developed. As technology advances and costs continue to decline, the adoption of wind and hydro energy is expected to accelerate, leading the global transition to a more sustainable energy future.

To illustrate the contributions made by the NEI, various theories are required to provide a comprehensive explanation.: endogenous growth theory and the Solow growth model. Endogenous growth theory refers that economic growth is the result of internal forces. On the contrary, the Solow growth model, or exogenous growth model, focuses on the impact of internal forces like capital accumulation, labor, and technological progress on economic growth [3]. These two models explain the contribution of the energy industry internally and externally.

The adoption of new energy sources offers numerous advantages. Investing in the utilization of the new energy sector is crucial for achieving sustainable social progress. To achieve development of sustainable, the NEI makes contribution in three topics: sustainable environment, sustainable economy and sustainable society. The use of wind energy, hydro energy is conducive to reducing emissions of greenhouse gas such as carbon dioxide. Cutting the utilization of traditional fuels can also minimize environmental degradation. On the contribution to economic sustainability, the construction of wind turbines and water projects help offer job opportunities, thus reducing unemployment and increasing productivity. The reduction of carbon emission can effectively reduce the mortality of diseases caused by environmental contamination, thus achieving social sustainability.

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In 2019, International Renewable Energy Agency (IRENA) found that the renewable energy sector employed 11 million people worldwide in 2018[4]. It highlighted the significant job creation potential of renewable energy, particularly in the solar and wind industries. The report also noted that states with robust renewable energy policies experienced higher economic growth rates. These studies show the great importance the NEI has on job creation and long-term economic growth. Comparing between NEI and traditional fossil fuel industry, the economic contributions of renewable energy are seen in increased investment flows, enhanced energy security, and reduced energy costs. Fossil fuel industries have long been major contributors to national GDPs, especially in resource-rich countries. However, these industries are vulnerable to market volatility and environmental regulations, which can impact their economic stability.

3. Direct Economic Contributions

GDP is a crucial factor in assessing the NEI's direct economic impact. The production of NEI directly contributes to GDP. According to the data, clean energy accounted for 9.0% of China's GDP in 2023, up from 7.2% in 2022[4,5]. With the development of NEI, China's GDP has grown constantly. Compared with the traditional manufacturing sector, the growth of the new energy sector has been robust, driven by increasing demand for clean energy technologies. Governments and corporations around the world are working to cut carbon emissions and boost the proportion of renewable energy in their energy portfolios. Policies such as renewable portfolio standards, subsidies, and tax incentives are carried out by governments to drive demand for renewable energy equipment.

NEI not only directly promote the development of the economy, but also generate employment. The construction and maintenance of energy facilities such as wind turbines and water projects offer new career opportunities for citizens. In China, the new energy sector has been a major job creator. The results show that the development of renewable energies has created about 11.5 million jobs in the world by 2019[6]. Type of job varies depends on personal capabilities. Construction jobs, operation and maintenance jobs, and manufacturing jobs are offered in NEI. Solar photovoltaic (PV) installers and wind turbine technicians often earn higher-than-average wages due to the highly advanced technical skills required for these positions. For solar PV installers, the median annual wage was $48,800 as of May 2023[5]. This competitive salary highlights the increasing need for skilled workers in the renewable energy sector. Investing in training and education for these positions can create significant economic opportunities and support the sustainable development of the industry. Furthermore, wind turbine technicians earn a median annual wage of $61,770 as of May 2023. The job outlook for wind turbine technicians is particularly promising, with an anticipated growth rate of 45% from 2022 to 2032[5].

The level of investments in NEI project is very substantial. Both private and public sectors make contribution to such great investments. Also, these investments are very important and necessary to the expansion and development of NEI. According to data provided by IRENA, International investment in the NEI reached $330 billion in 2020[4]. This significant investment highlights the growing commitment of governments and private sectors to transition towards a sustainable energy future. The increase in funding has accelerated the development of renewable technologies, making clean energy more accessible and affordable. Moreover, this investment is crucial for meeting international climate goals and reducing the reliance on fossil fuels.

While governments are vigorously promoting the construction of the NEI, private vectors are also making a lot of contributions. Data indicates that Amazon's solar and wind farms have contributed to over $12 billion in estimated global investment in economy from 2014 to 2022[7]. These endeavors not only aid in cutting down carbon emissions but also significantly impact local economic growth, fostering development and prosperity within communities. By investing in the new energy sector, Amazon serves as a compelling model for other companies, highlighting the critical role of corporate

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responsibility in promoting economic growth and combating climate change. Technologies like grid modernization, energy storage system, Electric vehicle (EV) infrastructure, and renewable energy facilities are developed related to the NEI. For EV infrastructure, Vehicle-to-Grid (V2G) Technology id developed to improve the efficiency of the transportation. Facilities such as charge station are built along highways to form a network of EV. In 2019, the electric vehicle (EV) market was worth about $162.34 billion. By 2027, it is expected to grow to $802.81 billion, with a compound annual growth rate (CAGR) of 22.6%[8]. The electric vehicle industry is very important in the near future to help mitigate and reduce excess carbon emissions caused by vehicle emissions. Because of its superior performance and environmental friendliness, electric vehicles are gradually being respected and popular all over the world.

4. Indirect Economic Contributions

The production of facilities used in NEI requires a great amount of raw materials such as steel, aluminum, silicon and some rare earth elements. For instance, the International Energy Agency (IEA) reports that the demand for minerals, promoted by the new energy transition, is expected to grow substantially. Specifically, nickel demand alone is expected to grow over 140 times from 2020 to 2040[9]. Moreover, rare earth elements are important in the renewable energy industry. The need for these materials boosts the mining sector, leading to increased activities in mining elements like neodymium, praseodymium, dysprosium, and terbium, which are essential for manufacturing efficient EV motors and other renewable energy components. As a result, the production of facilities in NEI contribute to the growth of other sectors, thus making contributions to the economic growth. As there are more jobs, there will be an influx of workers, causing local populations to increase. The increasing population causes local spending to increase, leading to further job creation in local good and service sectors. Moreover, higher employment and business profit created by NEI result in higher tax revenue, thus the governments have more financial budgets to reinvest in developing the NEI.

In the renewable energy sector, research and development(R&D) is required to create newly advanced technologies. As the NEI is still a new model, some technologies are not yet mature enough to be put into the market in a short time.As a result, R&D is crucial and necessary to develop new technologies and the imperfect technology that exists. For instance, existing technologies produce solar panels that are not as efficient as expected and are fragile and require frequent replacement and maintenance. Research are required to find a more efficient way to improve the efficiency of energy transition in solar panels. R&D has led to the development of high-efficiency photovoltaic cells that significantly increase the amount of solar energy captured. Advancements in technology will significantly reduce the costs associated with facility maintenance and energy conversion, which means corporations can earn more profit per unit of their product. In addition to reducing costs and increasing profits, technological innovation can help enterprises become more competitive in the international market. The better performance and quality of the products means that the company can gain a greater advantage over the competition. By leading in energy technology innovation, businesses and nations can capture new markets and promote economic growth. For example, wind turbine technology developed through R&D can help a company to be positioned as a global leader in the renewable energy sector. New energy products, including solar panels, batteries, and wind turbines, are crucial in diversifying a nation's export portfolio. Exporting these advanced technologies allows countries to lessen their reliance on traditional sectors and improve their economic stability. Processing companies from different countries can cooperate with each other to form a new energy industrial chain. Such practice would lead to increased imports and exports between countries. The exportation of new energy products can enhance a country’s reputation as a technological leader in the new energy sector. This leadership is conducive to attracting further investment, research collaboration, and cooperations with other countries.

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5. Environmental and Social Contributions

The deployment of wind and water has led to a significant reduction in the world's carbon emissions. Decreasing emission of greenhouse gas protect the ecosystem and biodiversity by minimizing the negative impact of climate change cause by global warming and pollution. In addition, cleaner energy practices contribute to the health of forests, wetlands, and oceans, which in turn support industries dependent on these environments such as agriculture and tourism. Reduction in carbon emissions cause by NEI can slows soil erosion and allows the soil to retain nutrients for agriculture. Nutrient-rich land and less polluted air encourage crops to grow more vigorously, thus promoting the development of agriculture and the growth of the economy.

According to the data, a 1% rise in carbon emission adds 0.298% more outpatients and 0.162% more inpatients [10]. In some highly developed cities and countries, increasing carbon emissions will cause more serious health problems. Because of the air pollution produced by traditional fossil fuel industry, human deaths from lung infections have increased dramatically. Furthermore, An estimated 125 million additional vulnerable adults were exposed to heatwaves between 2000 and 2016[11, 12]. This combination of air pollution and extreme heat events exacerbates public health crises. Effective policies and investments in renewable energy are essential to reduce these health risks and improve overall quality of life. Nowadays, the development of NEI can reduce the chance of people getting sick by reducing pollution to the environment. Thus, expense on medical care will be lower, which means government can have more financial budgets to develop economy and the society. Reduced pollution levels decrease the frequency of doctor visits, hospitalizations, and medication use. This reduction in medical expenses translates into significant long-term savings for both individuals and public health systems. For instance, improved air quality from cleaner energy sources can lead to fewer emergency room visits and long-term treatments for chronic conditions.

6. Conclusion

In conclusion, the NEI significantly contributes to economic growth through job creation, innovation, technological advancements, export revenues, and enhanced productivity. By generating employment opportunities across various sectors, the NEI supports local economies and helps reduce unemployment rates. Investing in research and development (R&D) within the new energy sector drives technological progress, resulting in more efficient and cost-effective energy solutions. This technology innovation fosters economic competitiveness and help countries to save costs from building more efficient new energy technologies. In addition, new energy products play a significant role in national export strategies to help countries and private firms to earn revenues. Countries that excel in clean energy technology can leverage this advantage to improve their trade balance and attract foreign investment to develop better economy. Because of the technology innovation, highly advanced new energy technology help people to finish their work more efficiently, thus enhancing their productivity. This productivity boost can contribute to growth of economy and competitiveness.

NEI brings benefits to both economic growth and ecosystem in several ways. For economic growth, NEI can reduce health cost, make economy stable, and provide social well-being. New energy can significantly improve air quality, which reduces the incidence of pollution-related health issues. This significant reduction helps communities and individuals to have long-term economic savings by lowering healthcare costs and increasing workforce productivity. The enhancement of living conditions and property values caused by better environmental quality results in economic stability that supports long-term growth and provides a more attractive environment for investment and development.

Because people have only a short time to explore the NEI, the available data is still limited for further research. So far, there are still many countries that have not discovered the importance of a

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NEI for economic development and environmental protection. Furthermore, to track the long-run growth of economy under contribution of NEI, more time is needed to do the research to get a more general conclusion. In the future, the study can focus on long-term economic savings from NEI on healthcare system and technology innovations. By exploring long-term impacts, regional disparities, and specific technological innovations, researchers can provide valuable insights that push further advancements into the new energy sector.

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