Economic Development Potential of Renewable Energy in China

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Abstract. The economy is growing quickly, and the demand for energy is rising daily. The third energy transformation that human society is undergoing is only possible through fostering the growth of renewable energy sources. When it comes to the study, creation, and utilization of renewable resources, China's socioeconomic and geographic conditions are superior. This study examines the utilization rate and cost of renewable energy over various time periods and breaks down the growth of renewable energy in China into three stages. Finally, the author looks for a path that will best serve China's development and make use of renewable energy sources. Renewable energy will have enormous economic potential in China in the future as science and technology advance.

Keywords: Renewable Energy, Energy Strategy, Economic Geography, Energy Cost, Carbon Emission.

1. Introduction

Energy is the lifeblood of a country and the cornerstone of the development and stability of human society. As the world's population grows and economies develop, countries need to expand production while using more energy. In economics, energy demand directly or indirectly affects marginal cost and wage level, as shown in fig.1 [1].

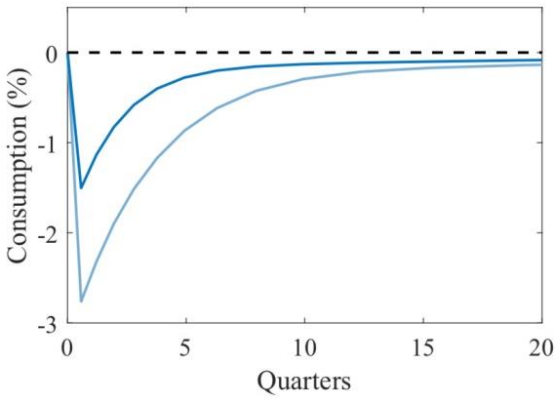

Figure 1. Energy dynamics and aggregate consumption [1]

All nations are currently aggressively supporting the creation and use of renewable energy. The world invests sufficient time and resources in the creation of renewable energy sources. Global energy demand is expected to increase by roughly 30% by 2040. In 2020, the global share of renewable energy in electricity generation will be 28%, up from the first quarter of 2019. The principal sources are hydropower, wind power, and solar power. One of the countries that has had rapid economic expansion and produces renewable energy is China. The transition from dirty, non-renewable energy sources to clean, renewable energy sources is another issue that most developing countries face [2].

In 2021–2022, there was a global energy crisis. The lack of fossil resources, the COVID-19's devastation, the worldwide push to reduce carbon emissions, and the conflict between Russia and Ukraine are all contributing factors to the current energy crisis [3]. The energy crisis has indirectly raised the costs of other products and services in the global supply chain, which has somewhat hampered economic growth. This is especially true for nations that rely heavily on imports and lack certain resources, as the cost of production and living will rise significantly. In addition to the current

energy crisis, the use of fossil fuels is the main cause of carbon dioxide emissions. Nearly 65 percent of the greenhouse gas emissions that keep the earth warm enough for life to exist are made up of carbon dioxide. This adds to global warming, and the use of fossil fuels like coal and oil is a significant source of carbon dioxide emissions [4]. Since glaciers hold 68.7% of the world's fresh water supplies, the earth's water supply is under jeopardy due to global warming, which will reduce the area of glaciers that melt. It also has an impact on how quickly animals and plants grow on earth.

It is obvious that environmental pollution and energy scarcity are having a greater and greater impact on the global economy. Countries started actively developing and utilizing renewable energy as a result. China has also declared national goals of reaching "carbon peak" in 2030 and "carbon neutrality" in 2060, demonstrating China's resolve to save energy and reduce emissions in the context of the global community where nations around the world are actively promoting a green economy. According to China's existing energy structure, coal still holds a dominant position, and there is still a great deal of pressure to cut carbon dioxide emissions. The reason is that new energy sources such as wind energy and solar energy have a certain degree of instability, and the vulnerability of the new energy system will be particularly prominent under extreme weather. In the absence of breakthroughs in large-scale, low-cost energy storage technology, it is difficult for new energy to be fully or highly integrated into existing resources. Coal resources are still required for new energy as a stabilizer [5]. The efficiency of energy consumption is still relatively poor, despite the fact that renewable energy is growing quickly and that China has become a key country in the use and investment of renewable energy. Future energy production and use must go by the rules of energy development as well as the needs of economic and social progress. There is still a long way to go.

2. Current Status of Renewable Energy in China

2.1. Humanistic Policy

China currently has various forms of renewable energy development policy tools, including overall target planning, cost sharing, tax incentives and other policies, which can promote the development of China's renewable energy to a certain extent. But at the same time, the planning lacks forward-looking and wrongly measures the actual power generation, which will lead to waste of resources and increased costs. And the implementation of tax cuts and cost-sharing policies will inevitably bring about some conflicts in capital transactions [6]. China is facing a dilemma. Even with certain legal and policy support, the cost of renewable energy in China can be reduced in the short term, but new opportunity costs will be generated after a period of actual implementation. Therefore, China should conduct sufficient research and practice before determining targeted legal policies that can significantly reduce costs, and at the same time strengthen the legal supervision and punishment system.

2.2. Regional Geography

Energy strategy research includes three major issues: the quantity and quality of energy demand, the source and destination of energy, and the efficient use of energy. The integration of these three issues in geographical space will also help to realize the efficient implementation of the renewable energy laws and policies mentioned by the author above, and effectively reduce costs. China consumes a large amount of energy, and China's terrain is complex and diverse. The development of different types of renewable energy in different regions according to their geographical advantages can reduce the cost of energy collection and transportation. China can be roughly divided into two regions, and the power supply and demand are not balanced between regions. The densely populated east has a large demand for power, and there is less idle land, making it difficult to build large-scale equipment to collect renewable energy. However, due to the advantages of terrain, the west is rich in renewable energy, and has a small population and a lot of idle land, so the power supply is greater than the demand. However, limited by the structure and layout of the power grid, the wind power, hydropower and other renewable energy sources in the west are insufficient to be connected to the

grid, and the surplus power in the west cannot be transported to the east [7]. China is still in a situation of resource inequality among regions. While collecting renewable energy in the west can effectively reduce costs, there is still a transportation cost to be considered in shipping from west to east.

3. Efficient Utilization of Renewable Energy in China

3.1. Development Costs

Efficient use of energy requires consideration of development costs. Comprehensive consideration of the current socio-economic status, energy distribution, geographical environmental barriers and other factors, a reasonable layout of energy collection equipment, energy transmission systems and energy bases should be carried out. First, consider the geographical distribution of renewable energy resources and the geographical conditions required for energy conversion [5]. Large-scale hydropower resources are concentrated in relatively remote mountain canyon areas, and hydropower uses water level differences to cooperate with hydroelectric generators to generate electricity. It also requires a large net flow of the river and a large storage capacity, so the location of hydropower stations is generally in the upstream reaches. A large amount of wind energy resources is found in the Gobi Desert, coastal beaches and grassland areas. China's eastern coast and its islands are China's largest wind energy resource area, while Inner Mongolia and northern Gansu have become China's second largest wind energy resource area under the control of westerly winds. Solar energy resources are most abundant in the western region. The total annual solar radiation and total annual sunshine in western provinces are large, and they have vast land where solar panels and other equipment can be placed to collect solar energy. Biomass energy resources are concentrated in major agricultural and forestry producing areas. Therefore, it is necessary to conduct a scientific and comprehensive assessment of the site selection of renewable energy development projects.

3.2. Administrative Cost

Efficient use of energy requires consideration of administrative costs. Deal with the coordination of interests between different space themes. Achieve the integration of total energy consumption, energy consumption intensity, and carbon dioxide emission reduction goals. Promote refined and intelligent energy management. Although dual carbon targets have been promulgated, carbon peaking is not energy peaking, and carbon neutrality is not zero carbon. In the process of new energy development, the coal industry must still play a role in stabilizing the energy system on the basis of fully implementing energy security [5]. Use traditional fossil energy to make up for the intermittency and instability of clean energy, achieve complementary optimization of multiple energy sources, form a mutually coordinated energy supply system, and improve the overall operating efficiency of the energy system [7].

3.3. Technology Cost

3.3.1. Technical optimization of single energy sources

Among various renewable energy sources, nuclear energy does not emit greenhouse gases during its production process, has many advantages such as high energy density, no intermittency, and is less subject to natural weather conditions. Under China's dual-carbon goals, the development of nuclear energy is crucial, but nuclear energy is also a relatively new energy source and its safety has attracted public attention [8]. Nuclear safety plays an important role in the national security system. Compared with developed countries with nuclear power, China's nuclear safety technology started late and has a weak foundation. At present, China has made significant progress in the nuclear safety legal system, regulatory system, nuclear safety software independence, equipment independence and cultural construction [9]. Nuclear power plants convert the energy released by nuclear fission into electrical energy for power generation. With the development of technology, the fourth-generation nuclear energy system technology has gradually matured, and the safety factor of nuclear power generation

has increased. At the same time, nuclear energy is no longer limited to power supply, but is also used in hydrogen production, It plays a role in various fields such as heating and seawater desalination [8]. The development of individual energy technologies significantly reduces economic and environmental costs.However, there are still some technical barriers to nuclear energy technology. Highly radioactive waste will be produced during fission reactions, which requires long-term safe storage and processing. Although fusion is more efficient and cleaner, fusion cannot maintain a stable and sustained reaction under current technical conditions, and it has not yet been commercially applied [10].

3.3.2. A combination of energy technologies

China's current energy systems, such as power systems and thermal systems, are basically planned and operated independently, lacking coordination and mutual transformation between systems. Based on the characteristics of different energy sources, fossil fuel thermal power units and clean renewable energy power generation units are associated and unified intelligently controlled. When renewable energy power generation is sufficient, the combined heat and power unit can play a peak-shaving role. When the combined heat and power unit cannot meet the required energy demand, it is supplemented by renewable energy. Form the mutual transformation between various energy forms and the complimentary benefits of many energy sources. At the same time, multiple dimensions like the economy, politics, and environmental protection have an impact on the integrated energy system. Therefore, some academics have suggested building an accurate evaluation system using the analytical hierarchy process (AHP) and the entropy weight method (EWM) in order to thoroughly analyze the impact of technological, economic, environmental, and social aspects on the energy system.

4. Conclusion

With the development of human society, the demand for energy quantity and quality is increasing day by day. The over-exploitation and utilization of traditional fossil energy has led to the emergence of world energy security problems. At the same time, the production cycle of fossil energy is extremely long, and the world is facing a shortage of energy. The development of new energy is expected to solve the energy security problem of the international community, help countries get rid of their dependence on energy imports, and promote peace, stability and green development of the international community. Under the general trend of world energy transformation, China, as a major energy consumer, has also joined the ranks of energy transformation. Shifting from traditional fossil energy to clean renewable energy is an inevitable choice for China's energy development. China uses dual-carbon goals as a driving force to actively promote large-scale and low-cost production of new energy. In this process, China must first clarify its own advantages and constraints in developing new energy, and cannot copy other countries' energy models. We should comprehensively consider economic costs and environmental costs, adapt to local conditions, formulate policies based on the situation, and find an energy development path suitable for China.

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