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Research on the Characteristics, Problems and Countermeasures of Land Use for Wind Power Generation in China

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Abstract. The development of wind power generation can promote the transformation of energy structure and the green development of the economy. The land is the spatial carrier of wind power generation projects, which has a basic supporting role for wind power generation. This paper analyzes the situation of land utilization for wind power generation, sorts out relevant national policy documents, and summarizes the problems existing in the implementation of wind power projects, which is of great significance for promoting the development of the wind power industry. The results showed that the installed capacity of wind power and electricity generation increased rapidly in the past decade. The land supplied area for wind power generation reached its peak in 2016 and then fluctuated, with the land supplied area decreasing but the power generation efficiency improving. In the process of wind power land utilization in China, there are some problems, such as the insufficient connection between industry planning and territorial spatial planning, lack of coordination mechanism between government departments for examination and approval, lack of land standards, prominent problems in the use of stock land and the renewal and renovation of old wind farms, and complicated land requisition compensation. Based on this, the paper puts forward corresponding countermeasures and suggestions from the aspects of territorial space planning, land use examination and approval, land use standard, utilization of stock land, popularization and application of land saving technology and land saving mode.

Keywords. Wind power generation, land supply, project landing, policy suggestion

1. Introduction

Wind energy is an important green energy source [1], and China has abundant and widely distributed wind resources. Compared with traditional thermal power generation, wind power generation has advantages such as low carbon, clean, efficient, and sustainable [2]. Developing wind power generation can optimize energy structure, reduce carbon emissions, and promote the achievement of the "dual carbon" goal. China vigorously develops new energy. At the United Nations Climate Ambition Summit in 2020, China announced and committed to the 2030 non fossil fuel energy proportion target, as well as the development goals for wind and solar power generation. In 2021, at the leaders' summit of the 15th Conference of the Parties to the Convention

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on Biological Diversity, we will further make space arrangements and guidance for the development of renewable energy.

The research on wind power generation by relevant scholars mainly focuses on the distribution of wind resources, the potential of wind resources, the utilization situation of wind resources, and the improvement of wind power generation efficiency [3-9]. There is relatively little research on land policies related to wind power generation, and wind power projects must be carried out on land, and problems with land acquisition will directly lead to the establishment of the project. Therefore, this article analyzes the land use for wind power generation, summarizes the difficulties and obstacles in the implementation of wind power projects, and proposes practical and feasible solutions, which are conducive to promoting the development of the wind power industry.

2. Policies Related to Wind Power Generation Land Use

In recent years, the State Council and various ministries have issued a series of policy documents related to wind power generation. The "14th Five Year Plan for Modern Energy System" plans for the proportion of non fossil energy consumption and power generation, with requirements of reaching 20% and 39% respectively. The 14th Five Year Plan for the Development of Renewable Energy also includes a plan for the annual power generation of renewable energy in 2025, with a requirement to reach around 3.3 trillion kilowatt hours, especially with a significant increase in wind and solar power generation, achieving the goal of doubling. The former Ministry of Land and Resources and six other ministries issued the Land and Resources Regulations [2015] No. 5 document, which stipulates that for projects such as wind power generation that use unused land such as Gobi, desert, and grassland, the land that does not occupy land and does not change the surface form can be recognized according to the original land category without changing the land use. In 2022, the National Development and Reform Commission and the National Energy Administration made detailed regulations on improving the approval efficiency of new energy projects such as wind power, improving land use control rules, and improving the efficiency of land and space resource utilization. In 2018, the National Energy Administration stipulated that, development enterprises can use their construction land (such as parkland) or rent construction land from other units to develop decentralized wind power projects; With the consent of the original land owner and user, the right to use construction land can be obtained through agreements and other means.

3. Installed Capacity and Power Generation of Wind Power

From 2011 to 2021, China's cumulative installed capacity increased from 62.36 million kilowatts to 328.48 million kilowatts, an increase of 4.3 times, with a significant increase. The newly added installed capacity shows a fluctuating upward trend every year, doubling in 2020 compared to 2019, and slightly decreasing in 2021 (Figure 1). The amount of wind power generation has increased from 70.33 billion kilowatt hours to 652.6 billion kilowatt-hours, an increase of 8.3 times. The proportion of wind power generation in total power generation has increased rapidly from 1.5% to 7.6%. Power generation develops faster than installed capacity, showing the improvement of power generation efficiency.

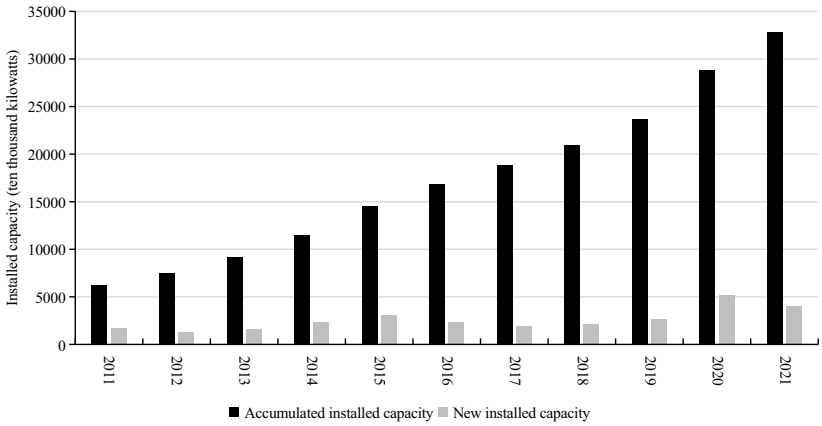

Figure 1. Installed capacity of wind power generation in 2011-2021.

4. Land Supplied for Wind Power Generation

4.1. Land Supplied Scale for Wind Power Generation

From 2011 to 2021, the cumulative supply of wind power generation land in China exceeded 10000 hectares. From 2011 to 2016, there was a slight increase in supply, but after 2016, there has been a decreasing trend year by year. Although the supplied area in 2021 was more than that in 2020, it was only 80% of that in 2019, less than half of that in 2016. The newly added installed capacity has increased, while the supply of land has decreased. This is mainly due to the progress of wind power technology, the gradual increase of wind turbine capacity, and the improvement of wind power generation efficiency. At the same time, according to the Land and Resources Regulations [2015] No. 5 issued in 2015, projects such as wind power generation that use several types of unused land can be classified as original land without changing the land use. Therefore, the data on unused land is not reflected, indicating a trend of less occupation of construction land.

The degree of land marketization has been strengthened. From the perspective of land supply mode, in 2011-2021, the area of wind power land granted in China accounted for 56% of the total supplied area, of which the area granted through listing accounted for 32%, the area granted through agreement accounted for 24%, and the area granted through auction accounted for 1%; The allocated area accounts for 42%; The rental area accounts for 2% (Figure 2). From an annual perspective, before 2016, the allocated area was more than that of other supplied methods. After 2016, the allocated area gradually decreased, with the largest area listed for sale.

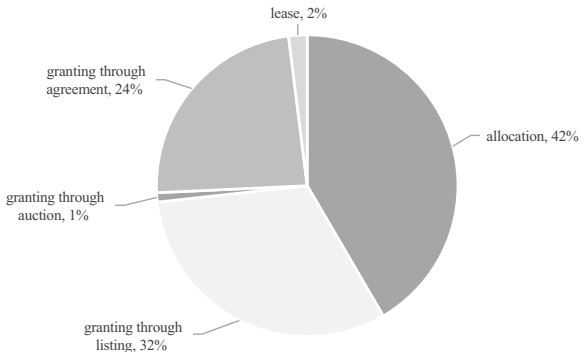

Figure 2. The proportion of various supply methods for wind power generation land.

4.2. Layout of Wind Power Generation Land

The main layout of wind power generation land is in the west. From 2011 to 2021, the land supplied area for wind power generation in the western region accounted for two-thirds of the total supply in China, with Xinjiang, Gansu, and Inner Mongolia accounting for more than half of the total supply in the country; The land area for wind power generation in Northeast China accounts for 16%; The area of wind power generation land in the eastern region accounts for 10% of the total supplied; The central region only accounts for 7% of the country's total supplied.

From the perspective of land supplied methods, from 2011 to 2021, the eastern, central, and western regions were mainly supplied through transfer, accounting for 73%, 69%, and 60%, respectively. The supply in Northeast China is mainly through allocation, accounting for 76%.

5. Problems in the Utilization of Wind Power Generation Land

5.1. Insufficient Connection with the National Space Planning

It is expected that by 2030, China's wind power grid-connected installation will reach 800 million kilowatts, and by 2060, it will reach 2.5 billion kilowatts. According to the land supply level from 2011 to 2021, under current technological conditions, to achieve the 2060 target, about 100000 hectares of land will need to be supplied. In addition, wind power projects can seriously affect ecological security and biodiversity, but current wind power projects have received little attention [10]. There are many related studies both domestically and internationally indicating that the biodiversity around wind farms is destroyed. The closer the wind farm is, the lower the biodiversity. On the contrary, the closer the wind farm is, the higher the biodiversity.

5.2. Lack of Approval Collaboration Mechanism between Departments

Before applying for land use approval, wind power projects need to go through various procedures such as land pre-examination and site selection opinions, project approval, preliminary design approval, geological hazard assessment, as well as feasibility assessment, environmental impact assessment, and bird impact assessment for the use

of forest land in construction projects. Project initiation, evaluation, land use, and other policies are strong, involving multiple departments, long approval times, high approval levels, a large number of application materials, and a long cycle. Some elements are prone to expiration issues during the approval process. Therefore, the lack of coordination and linkage between departments is not conducive to the implementation of wind power projects.

5.3. Lagged Land Standards for Wind Power

With the update and optimization of wind power generation equipment, the demand for project land has correspondingly changed, resulting in the current "Power Engineering Project Construction Land Index (Wind Farm)" no longer meeting the requirements of wind power generation project construction standards. Firstly, the capacity of wind turbines is increasing, larger capacity units above 5MW in China are gradually being applied, and the current standards do not specify land use indicators for large capacity units; Secondly, with the development of technology, various energy sources such as wind, photovoltaic, and hydrogen production have integrated power generation and wind power has added new demands such as energy storage functional zones. However, the "Land Control Indicators for Wind Farm Construction Projects" do not have comprehensive energy generation and new energy storage facility construction land control indicators, resulting in no land standards for reference when applying for construction land; Thirdly, the development of offshore wind power is getting faster and faster [11], but there are currently no relevant specifications such as sea use standards for offshore wind power, and there is no relevant basis for project approval.

5.4. Difficulty in Using Existing Land

Wind power projects mainly use newly added land, with less use of existing construction land. Utilizing existing land to develop wind power projects involves adjusting planning. Currently, most places adopt a periodic and unified planning approach, and individual projects cannot be adjusted and planned. In addition, in terms of the current development stage of wind power in China, it is not only necessary to face the problem of large-scale new project land use, but also the retirement, renewal, and renovation of wind turbines. The land used for wind turbines is mainly used for installing wind turbines and belongs to permanent land use. It should be managed according to the construction land management, and the corresponding land use rights for construction should be obtained. During the process of updating and renovating wind turbines, it is unclear how to approve its scale adjustments (such as "capacity expansion and renovation" and "more retirement and less use").

5.5. Complex Compensation for Land Acquisition

The scope of wind farms is large, and the tower foundations are arranged in a scattered manner. The land used for wind farms often involves multiple tower foundations, and each tower foundation machine occupies a small area, resulting in low compensation amounts and difficulties in signing relevant land compensation and security agreements.

6. Countermeasures and Suggestions

6.1. Connection with National Spatial Planning

We should integrate special plans such as renewable energy planning with territorial space planning, coordinating new energy land use space, and reasonably arranging wind power industry land. Under the "dual carbon" goal, comprehensively considering factors such as ecological security and biodiversity, and reasonably arranging wind power industry land.

6.2. Land Use Approval Effectiveness

Multiple departments such as natural resources, forestry and grass, development and reform, energy, ecological environment, and industry and information technology have established a joint and collaborative approval mechanism, providing full chain services for new energy projects such as wind power generation, simplifying land use pre-approval and change approval procedures, optimizing the approval process, and improving approval efficiency.

6.3. Standard for Wind Power Generation Land

In response to the new situation in the approval process of wind power generation large capacity units and energy storage stations, we will accelerate the research and formulation of wind power generation land standards, strictly control the scale of construction project land, and meet the current needs of wind power project land approval work.

6.4. Development and Utilization of Existing Construction Land

Developing wind power projects on existing land can alleviate the contradiction of insufficient land supply. It is recommended to provide corresponding preferential policies for the use of existing land for wind power generation, and adjust the planning scientifically, reasonably, and in a timely manner while ensuring the seriousness of the planning. Hebei has clearly proposed to make reasonable use of collective idle land to construct low wind speed centralized wind power projects, fully utilize scattered land resources, and construct decentralized wind power projects in industrial parks, field plots, oil and gas mining areas, and surrounding areas. This can activate idle and inefficient construction land and improve land efficiency.

6.5. Land Saving Technology and Mode

Exploring and promoting various land conservation technologies and models [12]. For example, the ground-saving technology for prestressed steel pipe wind power towers. The prestressed frame type steel pipe wind power tower technology increases the height of the tower, which can better utilize wind resources, increase the effective hours of power generation, and improve power generation efficiency; Adopting a four-point load-bearing distribution can reduce the impact on crop cultivation or vegetation under the tower, reduce the actual land area of the tower, and be beneficial for saving land

resources. Data shows that the land area for prestressed frame towers is equivalent to 1/5 of that of traditional towers. Encourage the use of large-capacity units. With the same total installed capacity, large-capacity units can save more land, thus achieving the demand for intensive land conservation.

Acknowledgments

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