

Research on the High-Quality Development of Shantou's New Energy Industry under the Background of the "Dual Carbon" Strategy

Jiayi Xu¹, Yangsheng Zheng²

(1.Guangdong Mechanical & Electrical Polytechnic, Guangdong, Guangzhou 510550, China;

2.Guangdong Mechanical & Electrical Polytechnic, Guangdong, Zhaoqing 526020, China)

Abstract: Profound structural realignment is unfolding across the global energy system, and China has integrated carbon peaking and carbon neutrality frameworks into governance practices at all administrative levels. For regional economies, advancing the new energy sector transcends purely environmental imperatives — it has evolved into a core engine underpinning sustained economic expansion and a vital pathway to strengthening domestic energy supply resilience[1]. Shantou stands out as the primary hub for the offshore wind power infrastructure in eastern Guangdong, boasting exceptional marine wind resources and benefiting from various supportive industrial policies. A new energy ecosystem centered around offshore wind power has been preliminarily established. Nevertheless, it encounters significant practical hurdles such as incomplete industrial chain extension, limited innovation capacity in key technologies, and constrained power consumption capabilities. This study delves into the foundational aspects of Shantou's new energy sector and systematically examines the factors impeding its high-quality advancement. It also puts forth development recommendations encompassing enhancements to the policy framework, facilitation of coordinated industrial chain growth, bolstering of technological innovation, augmentation of consumption capacity, assurance of essential resources, and promotion of holistic development. These efforts aim to assist Shantou in establishing a new energy industry cluster valued at 100 billion yuan and attaining regional "dual carbon" objectives.

Keywords: Dual carbon strategy;Newenergy industry;High-quality development Offshore wind power; Shantou

1 Introduction

The year 2020 marked the formal announcement of China's dual carbon strategic goals: reaching peak carbon dioxide emissions before 2030 and achieving carbon neutrality by 2060. This major policy adjustment has driven comprehensive green transformation in all fields of China's economy and society[2]. The energy sector stands out as a significant contributor to carbon emissions. Enhancing the energy mix and substituting conventional fossil fuels with renewable energy sources are crucial strategies in attaining the "dual carbon" targets. The emerging new energy sector embodies eco-friendly and low-carbon attributes and holds strategic importance. It serves as a primary driver of the energy transition, ensuring national energy security, fostering novel development impetus, and stimulating economic expansion.

Shantou, one of China's first special economic zones, hosts the core area of eastern Guangdong's wind power base — one of the country's five key offshore wind power clusters [3]. Its offshore waters contain abundant high-quality wind resources, with developable capacity exceeding 60 million kilowatts, accounting for more than half of Guangdong's total planned offshore wind scale. Recently, Shantou has prioritized a development strategy focused on "industrializing the city and strengthening it through industries," integrating the new energy industry into the industrial framework of "three new, two special, and one large" for strategic development. Simultaneously, significant efforts are underway to establish an international wind power innovation port, propelling the local offshore wind power sector from inception to substantial advancement. By the conclusion of 2025, Shantou had erected three large-

scale offshore wind farms with a combined installed capacity of 1.2 million kilowatts, propelling the local wind power equipment manufacturing capacity into the forefront nationally.

With the deepening of the dual carbon strategy, Guangdong has explicitly prioritized the vigorous development of marine new energy in its 15th Five-Year Plan, bringing unprecedented development opportunities to Shantou's new energy industry. However, it has also encountered practical development bottlenecks, such as insufficient synergy of the industrial chain, weak technological innovation capabilities, and an imperfect power consumption system. A systematic study of the path for the high-quality development of Shantou's new energy industry can not only help Shantou leverage its resource advantages and establish a world-class offshore wind power industrial cluster but also offer practical cases for reference in the energy transformation and green economic development of the eastern Guangdong region and the entire southeast coastal area. This study holds significant theoretical value and practical significance.

2 Relevant Concepts and Theoretical Basis

2.1 The Connotation and Requirements of the Dual Carbon Strategy

Two interlinked goals make up the dual carbon framework: carbon peaking and carbon neutrality. It is oriented toward driving systemic economic and social transformation, ensuring that carbon dioxide emissions peak and enter a downward trajectory by 2030, and ultimately achieve net zero by 2060 through a combination of measures including afforestation, energy conservation, emission reduction, and carbon capture, utilization and storage. This strategy entails a comprehensive economic and social overhaul involving energy structure, industrial systems, technological innovation, and institutional frameworks. A key mandate of the strategy is to expedite the transition from traditional fossil fuels to a new energy system characterized by cleanliness, low carbon footprint, safety, and efficiency[4].

2.2 The Connotation of High-Quality Development of the New Energy Industry

High-quality development of the new energy industry represents the application of China's new development philosophy in the energy field. It goes far beyond the simple expansion of industrial scale, and places more emphasis on structural upgrading, independent breakthroughs in core technologies, modernization of industrial and supply chains, green and sustainable operation modes, and improvement of overall economic efficiency. To achieve high-quality development in the new energy sector, several requirements must be met. First, a comprehensive industrial system is essential, facilitating coordinated development across the entire value chain, from upstream equipment manufacturing to downstream application services. Second, it is crucial to harness innovation effectively to ensure independent control over core technologies and key components. Third, the efficient consumption and utilization of new energy must be prioritized, guaranteeing that electricity generated from new energy sources can be reliably integrated into the power grid and utilized effectively. Finally, further promotion of integrated development is necessary, fostering deeper connections between new energy and sectors such as manufacturing, transportation, construction, and the marine economy to expand value creation opportunities.

2.3 Theory of Coupled Coordination of Energy, Economy and Environment

The energy-economy-environment (3E) coupling coordination theory holds that the three systems are inherently interconnected, interacting with and restricting each other. The advancement of the new energy sector can mitigate carbon emissions through energy structure optimization, thereby enhancing environmental quality and stimulating economic growth by nurturing associated industries, generating employment opportunities, and tax revenues. Conversely, economic progress and environmental amelioration can offer financial, technological, and market backing for the new energy sector, fostering a virtuous cycle leading to coordinated development. The core of the dual carbon strategy lies in dismantling the conflicting dynamics among energy, economy, and environment inherent in the conventional high-carbon development paradigm. By substituting conventional energy sources with new energy alternatives, these three elements can evolve harmoniously and advance collectively.

3 Basic Conditions and Current Situation of the Development of New Energy Industry in Shantou

3.1 Shantou's Endowment of New Energy Resources

Located on the western side of the Taiwan Strait, Shantou has a 400-kilometer coastline and 10,000 square

kilometers of high-quality sea areas, making it one of the regions with the most abundant wind resources along China's southeast coast. The annual average wind speed in the Shantou sea area reaches between 9 and 10 meters per second, with an effective utilization time for wind energy approaching 4,000 hours per year, thereby meeting the criteria for a Class I offshore wind farm. Additionally, the local seabed is characterized by gentle and stable conditions, which contribute to relatively low construction costs and facilitate development in contiguous areas. These factors provide Shantou with a distinct advantage for large-scale offshore wind power development. According to relevant plans, the long-term offshore wind power capacity that Shantou can develop exceeds 60 million kilowatts, representing approximately 53% of the total capacity in Guangdong Province. Consequently, it stands as the most significant development area within the 10 million kilowatt-level offshore wind power base in eastern Guangdong.

Wind resources are far from the only advantage Shantou possesses. The city also has considerable solar energy potential, with an average of about 2,000 hours of sunshine per year, which is suitable for the construction of both distributed and centralized photovoltaic power stations. Furthermore, leveraging its abundant offshore wind power resources, Shantou enjoys a natural cost advantage in hydrogen energy development projects, including wind power hydrogen production and seawater hydrogen production. This advantage has established a resource foundation for the local advancement of the green hydrogen industry. Additionally, Shantou's extensive marine space offers ample application scenarios for integrated development models, such as "offshore wind power combined with marine ranching" and "offshore wind power coupled with energy storage."

3.2 Current Situation of the Development of New Energy Industry in Shantou

3.2.1 The scale of offshore wind power development has grown rapidly

Shantou is one of the earliest regions in China to develop wind power; as early as the 1980s, it built one of the country's first onshore wind farms on Nan'ao Island. Since the beginning of the 14th Five-Year Plan period, the city's offshore wind power industry has entered a stage of rapid large-scale expansion[5]. By the end of 2021, the Datang Nan'ao Lemen I Offshore Wind Farm achieved full capacity grid connection and commenced power generation, signifying a significant advancement in Shantou's offshore wind power from a state of non-existence to operational status.

Huaneng Lemen II Offshore Wind Farm was put into operation in 2023, and the expansion project of Datang Lemen I is scheduled to be put into operation in 2025. This project represents the first batch deployment of 13 MW wind turbines in eastern Guangdong, and is also the first benchmark project in the region to adopt 16 MW ultra-large-capacity wind turbines.

By the end of 2025, Shantou had put three large offshore wind farms into operation, with 116 turbines installed and a total installed capacity of 1.2 million kilowatts. The cumulative power generation surpassed 6.1 billion kilowatt-hours, an amount of electricity that is roughly equivalent to conserving 1.86 million tons of standard coal and mitigating approximately 5.04 million tons of carbon dioxide emissions[6]. This achievement significantly contributes to energy supply security and carbon reduction efforts in the eastern region of Guangdong Province. Concurrently, Shantou is actively advancing a 3 million kilowatt project in the near-sea deep water area, aiming for its inclusion in the initial batch of national pilot projects for deep-sea and far-sea offshore wind power. There remains substantial potential for the future development of local offshore wind power.

3.2.2 The industrial chain of wind power equipment manufacturing has taken initial shape

Taking advantage of the upsurge in offshore wind resource development, Shantou has intensified efforts to introduce leading wind power equipment manufacturers, and initially formed an industrial chain model integrating "resource development, equipment manufacturing and service support". Prominent domestic wind turbine manufacturers, including Shanghai Electric Wind Power and Goldwind Science & Technology, have successfully established factories in Shantou. These companies have created an intelligent manufacturing base that facilitates local production of wind turbines with capacities ranging from 8 megawatts to 20 megawatts, consistently setting new records for single-unit capacity of wind turbines in Asia[7].

The construction of Shantou International Wind Power Innovation Port has formed the world's first offshore wind power equipment manufacturing cluster integrating R&D design, manufacturing, testing and certification. All four wind turbine positions at the Linhai Wind Power Test Base in Guangdong Province are operational, with each turbine capable of testing up to 24 megawatts, positioning it among the global elite. Furthermore, there is swift progress in constructing a 40-megawatt wind turbine electrical and dynamic six-degree-of-freedom experimental platform. This platform, designed to replicate intricate force scenarios of a 400-meter rotor diameter turbine, offers essential

experimental backing for the advancement of large-scale wind turbines in deep-sea and remote areas. Moreover, companies specializing in components like blades, bearings, generators, and towers are gradually congregating in this area, leading to a steady rise in the local industrial chain's support rate.

3.2.3 Coordinated development of diverse new energy business forms

In addition to the core offshore wind sector, Shantou is also cultivating photovoltaic, energy storage, hydrogen energy, lithium battery materials and other new energy sectors, forming a multi-pillar industrial development pattern. The promotion of distributed photovoltaic power is gaining momentum in industrial parks, public buildings, and rural areas. Companies like Huaneng and Datang are exploring the co-location of wind and solar power. In energy storage and battery sectors, Lekai New Energy has mastered aluminum-plastic film technology for lithium battery soft packs, achieving domestic self-sufficiency in this critical material. Guanghua Technology is engaged in recycling retired power batteries, operating a disassembly line with a 40,000-ton annual capacity, with a core metal recovery rate exceeding 99%, establishing an industrial ecosystem for power battery recycling and reuse.

In the hydrogen energy sector, Shantou is promoting an integrated development strategy of "wind power+hydrogen energy". It is currently planning offshore wind hydrogen production demonstration projects and supporting hydrogen refueling station infrastructure to promote the application of hydrogen energy in port logistics, public transportation and other fields. In terms of integrated development, Shantou has pioneered the "wind-fishery integration" model utilizing a suction cylinder foundation truss type, becoming the first in the nation to do so. The "Sheng Tang No.1" Marine ranch has successfully commenced operations in the Nan'ao waters, achieving a three-dimensional development approach that synergizes "blue granary plus green energy," thereby enhancing overall comprehensive benefits.

3.3 Policy Support System for Shantou's New Energy Industry

Shantou regards the new energy industry as an important starting point for industrial revitalization and urban development, and has established a multi-level policy support system. The "14th Five-Year Plan for Energy Development in Shantou City" outlines these objectives. Furthermore, the new energy industry has been identified as a strategic focus for the upcoming "15th Five-Year Plan" period during the 10th Plenary Session of the 12th Municipal Committee of the Communist Party of China. The proposed aim is to transform Shantou into a modern Marine city with unique characteristics and to foster a new energy industry cluster valued at hundreds of billions of yuan.

In terms of industrial support, Shantou has issued special policies for the offshore wind power industry, providing support in sea and land use, tax incentives, investment attraction, technological innovation and other aspects. The Haojiang Industrial Park was designated as one of the inaugural national zero-carbon parks. Leveraging the advantage of "dual-park linkage," it emphasizes the development of industries including offshore wind power equipment manufacturing and new energy vehicle components. During the "14th Five-Year Plan" period, this park secured a total of 3.851 billion yuan in various loans, of which 3.637 billion yuan was allocated for carbon reduction projects, facilitating a reduction of approximately 589,200 tons of carbon emissions. This initiative has established a demonstration model for financial support in the advancement of green industries.

In terms of infrastructure support, China Southern Power Grid Shantou Power Supply Bureau has completed the ± 160 kV multi-terminal flexible DC transmission project in Nan'ao. This project represents the world's first demonstration of the commercial application of multi-terminal flexible direct current transmission technology, effectively addressing the stability challenges associated with wind power grid integration and providing essential technical support for the large-scale connection of offshore wind power to the grid. Concurrently, the construction of supporting facilities, including a dedicated wind power wharf and an international wind power training center, is progressing rapidly, thereby enhancing the local industrial service capacity.

4 The Predicament of High-Quality Development of Shantou's New Energy Industry under the Background of Dual Carbon Goals

4.1 Insufficient industrial chain collaboration and weak downstream extension

At present, Shantou's new energy industry is mainly concentrated in wind turbine manufacturing, project installation and power generation, showing an obvious pattern of "strong midstream, weak upstream and downstream" in the whole industrial chain. The supporting capacity for key components and core materials in the upstream sector remains inadequate. For example, high-end bearings, control systems, and specialized materials continue to be

sourced externally. There is considerable potential for enhancing the local supporting rate. In addition, downstream production-oriented service industries, such as operation and maintenance services, testing and certification, and financial consulting, have progressed relatively slowly and have yet to establish a comprehensive industrial ecosystem.

On the upstream side, the supporting capacity of key components and core materials is still weak. High-end bearings, control systems, special materials and other links still rely on external procurement, and there is much room for improvement in the local matching rate. Consequently, the entire hydrogen production, storage, transportation, and refueling chain has yet to establish an effective closed loop. The energy storage industry primarily concentrates on battery materials and recycling, while system integration and large-scale applications are still in their nascent stages. Furthermore, the integration of new energy with sectors such as the marine economy, manufacturing, and transportation is insufficiently advanced, and the various application scenarios for "wind power plus" have not been fully realized. As a result, the added value and comprehensive benefits of the industry remain largely untapped.

4.2 The core technological innovation capacity needs to be enhanced

Shantou has achieved an advanced domestic level in the manufacturing and testing of complete wind turbine systems; however, its capacity for fundamental research and original innovation remains relatively weak. The reserves of cutting-edge technologies, including deep-sea wind power generation, efficient hydrogen production, and intelligent operation and maintenance, are still inadequate. The first issue is the limited number of high-end R&D platforms. The availability of national and provincial key laboratories and engineering technology centers is restricted, and the mechanisms for collaborative innovation among industry, academia, and research institutions are not sufficiently effective. The second issue pertains to the low degree of autonomy in core technologies. High-end chips, core algorithms, and essential sealing components used in offshore wind power still pose a risk of being "strangled." The third issue is the immaturity of development technologies for deep and far-sea areas. Technical challenges such as floating wind power, underwater foundation construction, and long-distance power transmission remain to be addressed. Collectively, these issues have hindered the development and utilization of deep-sea wind power resources in Shantou.

4.3 Consumption and grid connection bottlenecks restrict development

With the continuous expansion of offshore wind installed capacity in Shantou, the problems of power consumption and grid connection have become increasingly prominent. The primary concern is the limited local consumption capacity. In comparison to the Pearl River Delta region, Shantou's industrial electricity consumption is relatively modest. Consequently, when large-scale wind power is generated centrally, the local power grid is likely to face saturation in its absorption capacity. A second issue is the inadequate capacity of power transmission channels. The development of ultra-high voltage and cross-regional power transmission infrastructure in eastern Guangdong Province has progressed slowly, hindering the efficient transmission of surplus clean energy to external markets. Additionally, wind power is characterized by intermittency and volatility. The large-scale integration of wind energy into the power grid necessitates enhanced peak shaving capacity and grid stability. However, the current development of supporting energy storage and peak shaving resources lags behind, indicating a need for improved regulation capacity within the power grid.

4.4 Insufficient investment and financing mechanisms and talent support

The new energy industry is typically capital-intensive and technology-intensive, with strong demand for capital and talents. Offshore wind power projects, in particular, require large investment scale, long construction cycle and slow return[8]. Traditional bank credit often fails to adequately address the financial needs of these projects, and the development of innovative green financial products remains inadequate. Additionally, alternative financing avenues, including industrial funds, equity investments, and carbon finance, are not yet sufficiently streamlined. Consequently, the challenges of securing affordable financing for small and medium-sized enterprises persist without effective resolution.

The rapid growth of Shantou's new energy sector outpaces the local talent supply, leading to a conspicuous mismatch. The region lacks skilled professionals adept in both technology and management, alongside a surplus of proficient operational, maintenance, and manufacturing workers. Educational institutions in the area lag in establishing new energy-focused programs, resulting in graduates ill-equipped to meet industry demands. Additionally, limitations in urban development and public services hinder the recruitment of top-tier talent. The prevalent issue of "talent attraction and retention incapacity" stands as a critical barrier to the industry's high-quality advancement.

On the talent side, the rapid expansion of Shantou's new energy industry has far exceeded the supply of local

talents, resulting in a prominent structural mismatch. Local educational institutions are slow in establishing new energy-related programs, resulting in graduates who do not meet industry requirements. Additionally, the recruitment of top talents is hindered by the city's level of development and the adequacy of public services. The challenge of attracting and retaining talents is a notable obstacle limiting the high-quality advancement of the sector.

4.5 The institutional mechanisms and standard systems are not perfect

The development of the new energy industry involves multiple departments such as energy, ocean, natural resources and environmental protection. The approval process is complicated and cross-departmental coordination is difficult. Preliminary tasks, such as sea use approval, environmental assessments, and military coordination for offshore wind power projects, are time-consuming and involve numerous steps, thereby impacting project efficiency. Furthermore, for emerging industries like hydrogen energy, energy storage, and “wind-fishery integration,” the relevant industry standards, safety regulations, and regulatory frameworks remain inadequately established. The absence of a cross-departmental collaborative supervision mechanism hampers the standardized growth of the industry. Additionally, market mechanisms, including green power trading and carbon emission reduction trading, are still underdeveloped. The environmental value of new energy projects has yet to be fully translated into economic benefits, and the internal impetus for enterprise development requires further enhancement.

5 The Path for High-Quality Development of Shantou’s New Energy Industry under the Background of Dual Carbon Goals

5.1 Extend the industrial chain and build a full industrial ecosystem

Taking Shantou International Wind Power Innovation Port as the core carrier, the city should consolidate the foundation of wind power equipment manufacturing, increase efforts to introduce key supporting enterprises in complete machines, blades, gearboxes, bearings and submarine cables, and continuously improve the local matching rate of the industrial chain[9]. The focus should be on developing high-end products, such as ultra-large capacity wind turbines exceeding 20 megawatts and floating wind turbines, to establish a world-class industrial cluster for high-end equipment manufacturing in offshore wind power. Additionally, promoting the intelligent upgrade of manufacturing processes, constructing smart factories and lighthouse factories, will enhance both production efficiency and product quality.

Production capacity alone is far from sufficient; the city also needs to make up for the shortcomings of producer services. Industries such as wind power testing and certification, R&D design, construction and installation, operation and maintenance services, financial leasing and legal consulting should be developed on a larger scale. Utilizing the Guangdong Wind Power Coastal Test Base, a national-level wind power testing and certification center will be established to offer comprehensive testing and certification services to enterprises. Additionally, it is important to cultivate specialized offshore wind power operation and maintenance companies, promote advanced services such as remote intelligent operation and maintenance, fault early warning, and blade detection, thereby increasing the added value of these services.

Further downstream, more application scenarios and emerging business formats need to be expanded. Accelerating the cultivation of the hydrogen energy industry and promoting the implementation of “offshore wind power + hydrogen production” demonstration projects will help build a complete green hydrogen industry system of production, storage, transportation and utilization focusing on port logistics, industrial decarbonization, marine propulsion and other scenarios. Enhance the energy storage sector, innovate new energy storage technologies and system integration enterprises, and propel the holistic progression of “renewable energy coupled with energy storage.” Foster the sector of circular utilization of power batteries, enhance the framework of “secondary utilization coupled with recycling,” and establish regional hubs for the recycling and utilization of power batteries.

5.2 Strengthen scientific and technological innovation and break through core technological bottlenecks

First, Building high-level innovation platforms is the foundation for improving the overall technological innovation capability of the industry. The city should accelerate the construction of major innovation infrastructures such as the 40 MW wind turbine six-degree-of-freedom experimental platform and the World Wind Energy Research Institute, and strive to build a national offshore wind power technology innovation center. Leading enterprises should be supported in collaborating with universities and research institutes to jointly develop key laboratories, engineering technology research centers, and bases for industry-university-research cooperation. Additionally, technological

research and development should be conducted in areas such as deep-sea wind power, efficient hydrogen production, smart grids, and digital energy.

Second, Breaking through core technologies is the central task of innovation-driven development. R&D breakthroughs should focus on deep-sea floating wind power technology, ultra-large-capacity wind turbine technology, flexible DC transmission technology, low-cost electrolytic water hydrogen production technology and other directions, so as to solve a number of technical bottleneck problems. It is important to promote the comprehensive integration of digital technology with new energy, fostering applications such as smart wind farms, digital twins, and 5G-enabled industrial Internet processing, thereby enhancing the levels of digitalization and intelligence across industries. Additionally, efforts should be directed toward strengthening the research and development of integrated technologies for wind power and marine ranches, as well as exploring optimal models and relevant technical standards for three-dimensional development.

Third, A sound incentive mechanism provides institutional guarantee for sustained technological innovation. Policies such as super deduction of R&D expenses, tax incentives for high-tech enterprises and R&D expense tax refunds should be implemented to reduce innovation costs for enterprises. Furthermore, we will establish an incentive mechanism for the transformation of scientific and technological achievements, improve the intellectual property protection system, and assist enterprises in applying for patents and developing industry standards. Additionally, we will encourage enterprises to acquire advanced technologies and talent from abroad, engage in international scientific and technological cooperation, and elevate the internationalization of industries.

5.3 Improve the consumption system and enhance the resilience of the energy system

On the supply side, a multi-energy complementary peak shaving system should be established. The coordinated development of wind power, photovoltaic, natural gas, energy storage and other energy sources should be promoted, and a new power system integrating source, grid, load and storage should be constructed. We will expedite the establishment of pumped storage power stations and new energy storage projects, while encouraging new energy initiatives to incorporate energy storage facilities as essential components. This approach aims to enhance the system's peak shaving capacity. Additionally, we will promote the clean and flexible transformation of coal-fired and gas-fired power, maximizing the peak shaving and supply assurance roles of traditional energy sources to ensure a safe and stable energy supply.

On the demand side, the power consumption market needs to be further expanded. Active participation in green power trading and carbon trading markets will promote the market-oriented consumption of renewable energy and improve the economic benefits of projects[10]. There should be a vigorous promotion of green electricity substitution within the industrial sector, encouraging industrial parks and high-energy-consuming enterprises to adopt green electricity, thereby fostering the development of zero-carbon factories and zero-carbon parks. The construction of the national zero-carbon park in Haojiang must be deepened, with relevant experiences summarized and gradually disseminated to increase the proportion of local green electricity consumption. Furthermore, it is important to explore local consumption models, such as “offshore wind power combined with seawater desalination” and “offshore wind power coupled with hydrogen production,” to alleviate the consumption pressure on the power grid.

5.4 Innovation element guarantee, strengthening talent and financial support

In terms of talent support, a multi-level talent training and introduction system should be established. Local colleges and universities such as Shantou University and Shantou Polytechnic should be supported to set up new energy-related majors and courses to meet the industry's demand for technical and skilled talents. Develop a vocational skills training base for wind power alongside an international wind power training center to facilitate on-the-job skills training and vocational qualification certification, thus enhancing the overall quality of the industrial workforce[11]. Strengthen the recruitment of high-end talent by implementing more competitive talent policies. Provide support in areas such as housing, children's education, and research funding to attract leading experts and innovative teams in the new energy sector to Shantou. Refine the talent evaluation and incentive mechanisms to foster a conducive environment for talent development.

In terms of financial support, a diversified investment and financing mechanism needs to be improved. The leveraging role of government guidance funds should be brought into play to guide social capital to invest in the new energy industry[12]. Banking institutions should be encouraged to innovate green credit products such as carbon emission reduction loans and project income right pledge loans to reduce financing costs for enterprises. Facilitate qualified new energy firms to conduct initial public offerings and bond issuances to expand avenues for

direct financing. Introduce novel financial instruments such as carbon finance and green insurance to mitigate risks in industrial development diversely. Channel overseas Chinese capital and expertise into the new energy industry development, capitalizing on Shantou's status as a hub for overseas Chinese, to attract foreign capital and technology.

5.5 Strengthen top-level design and improve the policy support system

Scientific formulation of industrial development plans is the premise for guiding the orderly development of the industry. In line with the 15th Five-Year Plan for national economic and social development, a special plan for the high-quality development of Shantou's new energy industry should be formulated to clarify the development goals, spatial layout and key tasks of sub-industries such as offshore wind power, photovoltaic, hydrogen energy and energy storage, and make overall arrangements for resource development, industrial layout and infrastructure construction. At the same time, efforts should be made to include major projects such as Shantou deep-sea wind power and the International Wind Power Innovation Port into the national and provincial overall planning, and strive for higher-level policy support.

Improving supporting fiscal and tax policies provides important support for industrial development. On the basis of existing policy practices, preferential measures such as timely refund of value-added tax on new energy power generation and "three exemptions and three halves" of enterprise income tax should be implemented, and the income tax preference period for offshore wind power enterprises should be appropriately extended to reduce the tax burden of enterprises. The investment of special financial funds should be increased to support key technology research and development, demonstration project construction and the growth of small and medium-sized enterprises. Green financial products should be innovated, and financial instruments such as carbon emission reduction support tools, green bonds and industrial investment funds should be actively developed to explore the asset securitization model of offshore wind power projects and broaden financing channels for enterprises[6].

6 Conclusion

Against the background of the dual carbon strategy, vigorously developing the new energy industry is a strategic choice for Shantou to promote energy structure transformation, cultivate new development momentum and achieve high-quality economic development. Leveraging its abundant offshore wind energy resources and ongoing policy support, Shantou has begun to establish a new energy industry system focused on offshore wind power, thereby laying a robust foundation for advancing toward high-quality development. Nevertheless, the new energy sector in Shantou continues to encounter significant challenges, including insufficient coordination within the industrial chain, limited technological innovation capabilities, constrained consumption capacity, and inadequate support for essential resources.

During the "15th Five-Year Plan" period, Shantou must seize the strategic opportunities presented by the country's energy transition and the advancement of the Marine economy. The objective is to establish an international wind power innovation hub and a new energy industry cluster valued at hundreds of billions of yuan. This entails enhancing top-level planning, refining policy direction, expanding and optimizing the entire industrial supply chain, overcoming key technological barriers, boosting power consumption capacity, ensuring an adequate supply of talent and funding, and fostering industry integration. By optimizing pathways systematically and innovating policies, Shantou can capitalize on its resource strengths to create a world-class offshore wind power hub. This endeavor can not only propel the realization of regional "dual carbon" objectives but also drive the green transformation of the economy and society.

References

- [1] Zhang Jinliang The Development of China's New Energy Industry from a Global Perspective [J]. People's Forum, 2024, (22):73-77.
- [2] Office of the People's Government of Shantou City. 2023. Interpretation of the "14th Five-Year Plan for Energy Development in Shantou City" [EB/OL]. (2023-03-23)[2026-06-17]. https://www.gdlonghu.gov.cn/lh/jdhy/zzjd/content/post_2352423.html.
- [3] Liu Jun, Huang Xuejia. Fang Lixu, Secretary of the Shantou Municipal Committee of the Communist Party of

- China: To win the new round of the race, one must have "Shantou Determination" [J]. Chao Shang, 2018, (5):4-7.
- [4] Hao Yu. The Significance and Construction Path of the New Energy System [J]. People's Forum, 2022, (21):34-37.
- [5] Deng Jinxiang. Research on the Influencing Factors and Countermeasures of Carbon Emissions from Land Use in Guangdong Province from the Perspective of Public Policy [D]. Guangdong university of finance and economics, 2024. DOI:10.27734/d.cnki.ggdsx.2024.000830.
- [6] MiaoXueFeng. Vehicle power battery recycling model research in China [D]. North China electric power university (Beijing), 2019. DOI:10.27140/d.cnki.ghbbu.2019.000513.
- [7] Wang Zheng. Strategic Thoughts on Strengthening International Cooperation in the Field of Floating Offshore Wind Power [J]. Wind Energy, 2025, (10):64-68+2
- [8] Xu Ying. Research on the Development Path of Zhoushan's Clean Energy Industry under the Background of "Dual Carbon" [J]. Economist, 2024, (4):145-147+153.
- [9] Mingyang Group is building a 1,500MW three-dimensional Marine energy innovation and development demonstration project integrating "offshore wind power+Marine ranch+seawater hydrogen production" [J]. Navigation, 2023, (2):47.
- [10] Sun Lijie. Double carbon targets under the green electricity trading synergy management research [D]. North China electric power university (Beijing), 2023. DOI:10.27140/d.cnki.ghbbu.2023.000183.
- [11] Zhao Liang. Entering Shantou, Entering the International Wind Power Innovation Port [J]. Wind Energy, 2024, (12):34-36.
- [12] Gong Li, Guo Jiarui. Research on the Development Path of Green Finance of Commercial Banks in Yunnan Province under the Background of "Dual Carbon" [J]. Collective economy in China, 2025, (7):105-108. DOI:10.20187/j.cnki.cn/11-3946/f.2025.07.050.

