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Strategic Opportunities and Key Challenges for China's Marine Energy Resource Development under the Framework of the 15th Five-Year Plan

Sicheng Liu

College of Chemical Engineering and Environment, China University of Petroleum-Beijing at Karamay, Karamay, China
2826862007@qq.com

Abstract. The 15th Five-Year Plan period represents a critical window for China's transition from a maritime nation to a maritime power. This paper, guided by the outline of the 15th Five-Year Plan and related policy documents, employs a combination of policy text analysis and industrial empirical analysis to systematically explore pathways and strategies for the efficient development and utilization of marine energy resources. The study finds that the 15th Five-Year Plan provides a clear top-level design for marine energy development, with three major strategic opportunities emerging: the "100-million-kilowatt" target for deep-water offshore wind drives leapfrog industrial growth, with China's exploitable deep-water wind resources exceeding 1.2 billion kilowatts and key technologies such as floating wind turbines having achieved major breakthroughs; deep-water oil and gas have become the core replacement area for reserve and production increases, with the South China Sea containing 35 billion tons of oil and gas resources, and China having systematically mastered the full suite of exploration and development technologies in the deep-water domain; the large-scale utilization of marine energy opens a new track, aiming for an installed capacity of 400,000 kilowatts by 2030, with overall levels entering the world's first tier. At the same time, challenges cannot be ignored: deep-water technologies and equipment face "bottleneck" risks, with high dependence on foreign core components; deep-water project costs remain high, with fixed foundations costing approximately RMB 12,000–13,000 per kilowatt and floating foundations exceeding RMB 20,000, while operation and maintenance costs are 5 to 10 times those of onshore wind power, compounded by declining bidding prices for electricity, putting severe pressure on returns; inter-departmental coordination mechanisms are inadequate, and marine use approvals face obstacles; and risks of ecological conflicts and spatial competition are emerging. In response to these challenges, it is recommended to intensify research on key core technologies to enhance equipment self-reliance; explore diversified "offshore wind +" integration models to achieve multiple benefits through multi-use of marine space; improve coordination mechanisms for deep-water development and streamline approval processes; and uphold ecological priority by improving environmental impact assessment systems for deep-water development, thereby promoting a comprehensive leap of marine energy development from nearshore to deep-water areas and from demonstration projects to large-scale deployment.

Keywords: Marine Energy Resource Development, 15th Five-Year Plan, Strategic opportunities, Key Challenges

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1. Introduction

1.1. Research background

In today's world, with profound adjustments to the geopolitical landscape and the reshaping of the global economic system, the ocean, as a source of strategic resources, a national security barrier, and a high ground for future development, continues to highlight its strategic value in resource security, national security, and green transformation. A new round of technological revolution is giving rise to new "smart ocean" business models, dual-carbon goals are accelerating the implementation of low-carbon transformation in the ocean, the polar regions and the deep sea have become key areas of competition among nations in the ocean, the competition for global ocean governance rules is intensifying, and the marine economy has become a key dimension for measuring a nation's comprehensive strength and global competitiveness.

During the "14th Five-Year Plan" period, my country's marine economy achieved leapfrog development, with the gross marine product continuing to rise, the industrial structure being continuously optimized, the marine science and technology innovation capability steadily improving, significant results achieved in marine ecological protection, and the initial form of a modern marine industrial system emerging, laying a solid foundation for the construction of a maritime power. However, at the same time, my country's marine economic development still faces many practical bottlenecks: there are shortcomings in core technologies in fields such as high-end marine equipment, marine biomedicine, and deep-sea resource development, and some key components and navigation systems have a high degree of dependence on foreign countries; regional marine economic development is uneven, and the land-sea coordination mechanism is not yet sound; the marine ecological base is fragile, and the nearshore ecological pressure is prominent; the marine economic statistics, policy coordination, and cross-departmental governance system and mechanism still need to be improved, the marine industry is large but not strong, the proportion of traditional industries is too high, and the scale of emerging industries has not been fully released [1].

The 15th Five-Year Plan period was a crucial window of opportunity for my country to transition from a major maritime power to a maritime superpower. It was also a critical stage for the marine economy to shift from scale expansion to prioritizing quality and efficiency, achieving effective qualitative improvement and reasonable quantitative growth. Domestically, increasingly tight resource and environmental constraints necessitate a transformation of the marine economic development model, promoting the transformation and upgrading of traditional marine industries, cultivating and strengthening emerging marine industries, and coordinating marine development with ecological protection. Internationally, the global ocean governance system is undergoing profound changes, with intensified competition in deep-sea, polar, and high seas governance, placing higher demands on my country's participation in shaping global maritime rules and enhancing its voice in the maritime domain. Against this backdrop, based on the current realities of my country's marine economic development during the 14th Five-Year Plan period, analyzing the historical position of high-quality development of the marine economy, identifying existing shortcomings, and systematically exploring the path to achieving high-quality development of the marine economy during the 15th Five-Year Plan period have become essential.

At the same time, under the dual-carbon strategy, the development and utilization of marine clean energy such as marine geothermal and offshore wind power have gradually received attention. Marine geothermal resources are huge and are a stable and continuous renewable energy source that can serve the power supply of islands and the development of deep-sea oil and gas, and help reduce the consumption of fossil energy. However, my country's marine geothermal exploration and

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development is still in its initial stage. The resource endowments of different sea areas vary significantly, and practical problems such as development technology, economic constraints, and environmental risks need to be solved. The collaborative development model of marine resources needs to be further explored [2-4]. Under the new development pattern, how to properly handle the relationship between marine resource development, industrial upgrading, spatial coordination, ecological protection and institutional guarantee, solve the structural contradictions in the development of marine economy, and promote the coordinated advancement of the construction of a maritime power and Chinese-style modernization has very important contemporary value.

1.2. Research significance

Based on the new historical stage of the "15th Five-Year Plan", this paper combines the characteristics of the times, such as global ocean governance reform, cross-border integration of science and technology industries, and integrated land and sea development, to sort out the internal logic of high-quality development of the marine economy, and to analyze the current historical position of marine economic development. This can further expand the contemporary connotation of the theory of high-quality development of the marine economy and improve the theoretical analysis framework related to the construction of a maritime power. Combining cases of marine resource development such as marine geothermal energy, this paper analyzes the constraints of resource endowment, technological constraints, and institutional environment on marine economic development, clarifies the internal relationship between technological innovation, industrial system, spatial layout, institutional mechanism, and ecological security, and provides theoretical reference and literature foundation for subsequent academic research in the field of marine economy. In addition, existing research mostly focuses on the summary of marine economic development during the "14th Five-Year Plan" period, and the results of systematic sorting out the "15th Five-Year Plan" period are relatively limited. This paper systematically sorts out the realistic foundation, constraints, and strategic thinking, which can provide research support for academic discussions related to medium- and long-term marine economic planning [5].

This article systematically summarizes the achievements of marine economic development during the 14th Five-Year Plan period, identifies practical challenges such as constraints on core technologies, insufficient regional collaboration, institutional and mechanism shortcomings, and near-shore ecological pressure, and outlines development strategies from the dimensions of industrial system, spatial layout, institutional mechanisms, technological innovation, and ecological security. This can provide practical reference for local marine economic planning and industrial policy formulation. Under the dual-carbon goal, balancing marine industry upgrading, clean energy development, and marine ecological security, adhering to ecological priority, and exploring green transformation paths for the marine economy will help promote the unity of marine economic, ecological, and social benefits, and contribute to the implementation of the marine dual-carbon goal. Research focusing on deep-sea, polar, and blue economy cooperation considers how to enhance my country's ability to participate in shaping global maritime rules through technological and institutional innovation, which has practical value for promoting the construction of a maritime community with a shared future and safeguarding my country's maritime rights. Taking marine geothermal energy as an example, this article analyzes the development potential and technological bottlenecks of new marine resources, explores localized collaborative development models, and provides practical reference value for promoting the development of the marine clean energy industry and expanding energy security solutions for island and deep-sea development.

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1.3. Research methodology

This paper adopts a method that combines policy text analysis with industry empirical analysis. Taking core policy documents such as the "15th Five-Year Plan" outline and the "15th Five-Year Plan for the Construction of a New Energy System" as the main lines of analysis, it combines industrial development data and typical cases to carry out the discussion according to the logical framework of "policy-current situation-opportunities-challenges-suggestions".

2. Policy framework

During the "15th Five-Year Plan" period, the development of marine energy resources received unprecedented policy support. At the top-level design level, in 2026, the National Development and Reform Commission and the National Energy Administration jointly issued the "15th Five-Year Plan for Renewable Energy Development", which proposed to "accelerate the large-scale development and utilization of marine energy and promote the large-scale utilization of tidal energy, wave energy, and thermal energy according to local conditions", and clearly stated that by 2030, the national marine energy installed capacity should strive to reach 400,000 kilowatts; the "15th Five-Year Plan for National Economic and Social Development" also emphasized "improving the ability to enter, explore, develop, and ensure safety in the deep sea" [5]. At the level of industrial layout, the "15th Five-Year Plan for Renewable Energy Development" made special arrangements for offshore wind power. During the "15th Five-Year Plan" period, the newly started scale of offshore wind power in the country was about 100 million kilowatts, and the cumulative installed capacity reached more than 100 million kilowatts by 2030. It clarified the key construction areas of the Bohai Sea, Yellow Sea, East China Sea, and South China Sea, and encouraged the integrated development of offshore wind power with marine oil and gas, marine ranching, seawater desalination and other industries. At the local level, coastal provinces such as Guangdong, Shandong, and Fujian have actively deployed: Guangdong has promoted the integrated development of offshore wind power with marine ranching and marine oil and gas, and released the first provincial group standard for blue finance in the country, setting up five core support sectors; Shandong regards offshore wind power as an important growth pole for renewable energy; Fujian has used the high-quality wind energy resources of the Taiwan Strait to create an efficient industrial cluster, and launched the trial work of blue finance standards [6].

Since the beginning of the 14th Five-Year Plan, my country has made significant breakthroughs in offshore oil and gas exploration and development. In 2024, CNOOC's capital expenditure reached RMB 132.7 billion; my country has become the third country in the world, after the United States and Norway, to have the capability to independently develop deep-sea oil and gas resources. The deep-sea oil and gas field clusters such as "Deep Sea No. 1" have produced more than 10 million tons of oil equivalent, doubling the output compared to the end of the 13th Five-Year Plan. The increase in offshore oil production accounts for about 80% of the increase in national oil production [7]. At the same time, marine energy equipment technology has entered the world's first echelon, with an installed capacity of about 9 megawatts in operating power stations and demonstration projects, ranking fourth in the world. However, the development of deep-sea mineral resources still faces many challenges - according to the prediction of the U.S. Geological Survey, by 2065, deep-sea minerals can meet 35%-45% of the world's demand for key metals, while my country's dependence on foreign sources for 12 key minerals such as copper, manganese, nickel, and cobalt exceeds 70% [8]. Zhang Laibin, a member of the Standing Committee of the National Committee of the Chinese People's Political Consultative Conference and an academician of the Chinese Academy

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of Engineering, suggested strengthening policy guidance, increasing exploration efforts for deep-sea and seabed mineral resources both domestically and internationally, establishing a cross-ministerial coordination mechanism, issuing medium- and long-term development plans, coordinating local marine economic plans, and guiding industrial clusters to gather in Guangdong and Hainan.

3. Strategic opportunities

3.1. The goal of achieving 100 million kilowatts of deep-sea wind power is driving the industry's leapfrog development

The 15th Five-Year Plan clearly states that by 2030, my country's cumulative grid-connected offshore wind power capacity should reach over 100 million kilowatts. This goal means that in the next five years, my country's offshore wind power installed capacity will more than double from 47 million kilowatts by the end of 2025, with the new installed capacity equivalent to the total installed capacity of "rebuilding two Three Gorges Dams," indicating extremely broad prospects for industry expansion.

From a resource perspective, my country's technically exploitable deep-sea wind energy resources exceed 1.2 billion kilowatts, 3 to 4 times that of near-shore resources. Furthermore, deep-sea wind speeds are about 25% higher than onshore winds, resulting in higher power generation efficiency and greater stability, providing a solid resource guarantee for large-scale development. At the same time, available near-shore waters are becoming increasingly scarce, making expansion into deep-sea areas an inevitable choice.

In terms of technological support, several recent major breakthroughs have paved the way for deep-sea development: the "Three Gorges Leading Ship," the world's largest single-unit floating wind power platform with a capacity of 16 MW, has been installed; and the "Heart of the Sea Wind," the world's largest offshore converter station, has been put into operation, marking my country's mastery of key core technologies such as floating wind power and long-distance flexible DC transmission. Furthermore, the average single-unit capacity of offshore wind turbines has jumped from 3 MW a decade ago to over 10 MW, and the batch application of large units (14 MW and above) is accelerating, which is expected to significantly reduce the unit construction cost and cost per kilowatt-hour of deep-sea projects.

In terms of the industrial ecosystem, the integrated development model of "offshore wind power+" is becoming an important path to improve the economic viability of projects. Many regions have explored diversified integration models such as "wind power + marine ranching," "wind power + hydrogen, ammonia, and methanol," and "wind power + oil and gas development," achieving multiple revenue streams from electricity, marine products, and green hydrogen in the same sea area, effectively offsetting the uncertainty of revenue brought about by market-based electricity price fluctuations. Coastal provinces such as Guangdong and Hainan have formed trillion-yuan-level industrial clusters and continue to expand their installed capacity plans. It is estimated that by 2030, the installed capacity of Guangdong province alone will reach 30 million kilowatts.

3.2. Deep-sea oil and gas has become the core replacement area for increasing reserves and production.

The 15th Five-Year Plan clearly outlines efforts to promote stable oil and gas production across four key areas: deep earth, deep sea, unconventional oil and gas fields, and established oil and gas fields, aiming to make offshore areas the main driver of stable crude oil production. Deep and ultra-deep

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oil and gas, with their enormous resource potential, will become a key replacement area for increasing domestic reserves and production.

In terms of resource endowment, the South China Sea accounts for one-third of my country's total oil and gas resources, with 70% located in deep water. Preliminary estimates suggest that the South China Sea holds 35 billion tons of oil and gas resources, but exploration and development remain at a relatively low level, indicating huge development potential. Globally, in 2018, most conventional oil and gas discoveries were made in deep water, with deep and ultra-deep water accounting for 81%, signifying that global exploration has fully entered the deep water era.

China's deep-water oil and gas exploration and development technology has reached the world's advanced level. After more than 20 years of technological breakthroughs, CNOOC has successively overcome three world-class oil and gas exploration and development challenges in high-temperature, high-pressure, and deep-water areas, making my country one of the few countries in the world to systematically master the complete set of exploration and development technologies in this field. Three major breakthroughs have been achieved in deepwater exploration: a major natural gas discovery through cooperative exploration in the Pearl River Estuary Basin, exemplified by the Liwan 3-1 gas field; a major natural gas discovery through self-operated exploration in the Qiongdongnan Basin, exemplified by the Lingshui 17-2 gas field; and a major crude oil discovery through self-operated exploration in the Pearl River Estuary Basin, exemplified by the Liuhua oilfield cluster.

In terms of production capacity contribution, the Liwan 3-1 gas field has contributed a cumulative 15.6 billion cubic meters of natural gas. Its deepwater natural gas from the South China Sea is transported via pipeline to gas-fired power plants, industrial enterprises, and residential homes in the Pearl River Delta, traversing much of the Guangdong-Hong Kong-Macao Greater Bay Area. The Lingshui 17-2 gas field is also accelerating its development and construction; once completed and operational, it will supply gas to Hong Kong, Guangdong, and Hainan. In terms of planning targets, the proportion of deep-sea exploration in the planned proven geological reserves of natural gas has increased from 42% to 64%. CNOOC has formulated a "Seven-Year Action Plan," aiming to achieve annual oil and gas production targets of 20 million tons and 20 million cubic meters respectively in the eastern and western South China Sea oilfields by 2025, in order to meet the demand for clean energy in economic and social development.

An official from the Oil and Gas Department of the National Energy Administration pointed out that the development and expansion of deep-sea oil and gas must take technological progress as the most important driving force and means. CNOOC is increasing its investment in the research and development of intelligent deep-sea oil and gas resource development equipment and technologies, and vigorously promoting the deep integration of big data, cloud computing, artificial intelligence and deep-sea resource development equipment and technologies to achieve intelligent, safe and environmentally friendly deep-sea resource development. As my country's offshore oil industry continues to achieve theoretical innovation and technological breakthroughs in exploration and development in high-temperature, high-pressure and deep-water fields, the comprehensive capability of deep-sea oil and gas resource development will continue to improve, providing strong support for ensuring national energy security and optimizing the energy structure [9].

3.3. Large-scale utilization of ocean energy opens up a new track

China aims to achieve a marine energy installed capacity of 400,000 kilowatts by 2030. "Multi-energy complementarity and integrated development" has become the core path, and marine energy

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development is evolving from a single type to an integrated model of "energy islands" or "integrated platforms."

Marine energy is an important green and renewable energy source, specifically including tidal energy (including tidal range energy and current energy), wave energy, thermal gradient energy, and salinity gradient energy. my country's overall level of marine energy development and utilization has entered the world's top tier. my country has a long coastline, a large marine territory, and abundant marine energy resources with enormous untapped potential. The development and utilization of marine energy is conducive to developing new types of productive forces and is of great significance for alleviating power shortages in eastern coastal areas, remote islands, and deep-sea facilities, building a new energy system, developing the marine economy, and building a maritime power.

In 2024, my country's total marine economy exceeded 10 trillion yuan for the first time, reaching 10.5 trillion yuan, an increase of 5.9% over the previous year, accounting for 7.8% of GDP. Nationwide, 4,123 new marine-use projects were approved, covering an area of 263,000 hectares, with an investment of 1.1 trillion yuan. Marine energy supply continued to grow, with marine natural gas production increasing by 4.7% and 8.7% year-on-year, and offshore wind power generation increasing by 28.2% year-on-year.

Regarding demonstration projects: First, the implementation of key 100-megawatt-level tidal energy projects. In areas rich in tidal energy resources, support is given to using tidal energy power generation as one of the green energy supplementary solutions for coastal areas and islands. For example, based on the "Fenjin" tidal energy generator in Zhoushan, Zhejiang, a key 100-megawatt-level tidal energy large-scale utilization project will be launched in stages. Second, the large-scale utilization of wave energy is being promoted. Based on the existing "Zhoushan No. 1," "Changshan No. 1," "Nanji No. 1," and "Huaqing" wave energy generator units, the construction of megawatt-level large-scale wave energy pilot projects will continue to be steadily promoted, while encouraging the development of wave energy in conjunction with offshore wind farms. Third, the comprehensive utilization of thermoelectric energy resources is being supported. Building on the work of the China Geological Survey's 20-kilowatt thermoelectric energy generator unit, support is given to carrying out engineering construction in areas rich in thermoelectric energy resources. Fourth, promote multi-energy complementary applications on islands, supporting the construction of marine energy multi-energy complementary power stations on islands to achieve continuous and stable power supply to islands and surrounding waters, alleviating power shortages for island residents and enhancing the islands' energy security capabilities.

Regarding equipment technology iteration, the Ministry of Industry and Information Technology (MIIT) has proposed the development principle of "innovation-driven, iterative optimization." In recent years, the MIIT, together with relevant departments, has successfully delivered a number of marine energy equipment, including the world's first megawatt-class wave energy generator "Nankun" and the megawatt-class tidal energy generator "Fenjin." The Chinese Academy of Sciences (CAS) actively supports research institutions in conducting research and promotion of integrated marine energy applications. Its Guangzhou Institute of Energy's "Eagle-type" wave energy power supply platform and various types of marine energy power supply buoys have been successfully applied and marketed. In 2024, the CAS established a special project to tackle key core technologies, focusing on the energy shortage problem in island construction and development, and carrying out key technology research on multi-energy complementary power supply combining waves, wind, solar, and energy storage.

Regarding integrated development, it is necessary to promote the integrated development of marine energy with various marine production activities, expand marine energy application

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scenarios, and improve the economic and social benefits of marine energy development and utilization. The Chinese Academy of Sciences will actively guide the integrated development of ocean energy with seawater desalination, offshore oil and gas platforms, breakwaters, and other fields, and support ocean energy in providing green energy security for marine observation and monitoring equipment and platforms, marine engineering, etc.; it will encourage the combination of deep-sea marine ranching and wave energy, and encourage the development of wave energy in conjunction with offshore wind power. The Chinese Academy of Sciences will further plan the integrated application of ocean energy with seawater desalination, offshore oil and gas platforms, breakwaters, etc., accelerate the demonstration application of the integrated development of offshore wind power and wave energy, promote the "ocean energy+" development model, and transform the development and utilization of ocean energy into a new type of productive force in the marine field.

4. Key challenges

4.1. Technological equipment bottlenecks

The transition from nearshore to deep-sea areas presents a significant leap in technological challenges. The extreme characteristics of deep-sea environments, such as high pressure, low temperature, and strong corrosion, place extremely high demands on key technologies such as deep-sea drilling, underwater robots, floating foundations, and flexible DC transmission. For example, wind turbine capacity needs to be developed to the 20 MW level and above, and it is currently urgent to solve the "bottleneck" problems of key materials and core components. Taking floating offshore wind power as an example, its cost is as high as 20,000 yuan per kilowatt, and there is still considerable room for improvement in technological maturity [10].

4.2. Dual pressure of costs and benefits

With increasing offshore distances and continuously declining electricity prices, deep-sea development faces significant pressure on profitability.

Soaring Costs: The later-stage operation and maintenance costs of deep-sea projects are 5 to 10 times that of onshore wind power; the cost of stationary deep-sea projects can reach 12,000-13,000 yuan per kilowatt.

Limited Profits: Offshore wind power has completely lost its fixed electricity price advantage, and coastal competitive bidding prices continue to decline. At the same time, offshore oil and gas are facing downward price pressure, limiting the growth potential of the traditional engineering market.

4.3. Institutional and systemic obstacles urgently need to be removed

Deep-sea affairs involve multiple departments, including natural resources, science and technology, industry and information technology, transportation, and the environment, which can easily lead to inconsistent planning and fragmented efforts. Currently, the supporting regulations for the law on the exploration and development of deep-sea seabed resources are not yet complete, and there are still obstacles in the approval process for sea use and the transfer of projects. It is urgent to strengthen overall coordination at the national level and establish an inter-ministerial joint meeting system.

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4.4. Risks of ecological protection and spatial conflict are emerging

Offshore wind power projects occupy vast amounts of physical space, inevitably intersecting with aquaculture areas, shipping lanes, migratory bird routes, and marine spawning grounds. Of particular concern is that the first batch of large-scale offshore wind power projects are gradually entering their decommissioning phase, and the dismantling of old equipment and the retention of seabed foundations may lead to hidden pollution. The balance between marine energy development and ecological protection and restoration still needs further strengthening at the institutional level.

5. Conclusions and outlook

5.1. Key conclusions

During the 15th Five-Year Plan period, my country's marine energy resource development is at a historic turning point, shifting from nearshore to deep-sea, from single-source to diversified, and from demonstration to large-scale. The 15th Five-Year Plan provides a clear top-level design and systematic policy support for marine energy development, with the "100 million kilowatt" target for deep-sea wind power, increased reserves and production of deep-sea oil and gas, and large-scale development of marine energy constituting three major strategic opportunities. However, key challenges such as technological and equipment bottlenecks restricting deep-sea development, dual pressures of cost and benefit, institutional and systemic obstacles, and ecological protection and spatial conflicts cannot be ignored. To unleash the potential of deep-sea marine energy, my country must seize the opportunities of the times while confronting the aforementioned constraints, and coordinate multiple objectives including technological breakthroughs, industrial economics, institutional construction, and marine ecology.

5.2. Policy recommendations

First, strengthen technological innovation, establish a consortium for tackling key core technologies in deep-sea areas, achieve breakthroughs in areas such as deep-sea sensors, floating foundations, and flexible DC transmission, solve "bottleneck" technological problems, and improve the reliability and market competitiveness of domestically produced marine equipment. Second, improve the system and mechanisms, strengthen the legal and regulatory framework for deep-sea development, refine supporting rules, explore the establishment of a national-level dedicated agency for promoting deep-sea development, and establish a cross-departmental coordination mechanism to resolve institutional obstacles in areas such as sea use approval and engineering construction. Third, promote integrated development, encourage collaboration between offshore wind power and industries such as marine oil and gas, marine ranching, and seabed data centers, break down barriers to cross-regional factor flows, optimize the allocation of technology, talent, and capital, and avoid homogeneous regional competition. Fourth, coordinate protection and development, adhering to the principle of "developing in specific areas and protecting across the board," accelerate the formulation of deep-sea development management policies, improve environmental impact assessment standards for deep-sea development, address shortcomings in deep-sea ecological restoration technologies, and properly handle practical issues such as marine spatial conflicts and pollution from the decommissioning of offshore facilities.

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5.3. Future outlook

Marine energy resource development will no longer be limited to a single type, but will evolve towards an integrated and systematic model, using "energy islands" or "integration platforms" as carriers. From nearshore to deep-sea, from fossil fuels to multi-energy complementarity, from scale expansion to quality and efficiency, my country's marine energy industry is entering a new stage of high-quality development. Only by adhering to the dual-engine approach of technological and institutional innovation, and balancing industrial development with marine ecological protection, can we effectively transform the advantages of marine resources into a real force for ensuring national energy security during the 15th Five-Year Plan period.

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