

# **Environment effects of Ocean Renewable Energy Development and Countermeasures in China**

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## **Abstract:**

Ocean Renewable Energy Development(ORED) has the potential to provide clean , reliable power. China government attaches great importance to rational use of ocean renewable energy resources. After summary of ORED status, we make analysis on the characteristics, trends and environment effects of such sea use in China. The environmental impacts are mainly the ocean physical, chemical, biological, ecological and other environmental changes of the renewable energy projects during construction, operation and equipment stages. These environmental potential impacts can be prevented and controlled by the marine environment protection systems developed by the Chinese Government, such as approval of marine projects, marine functional zoning, marine environmental impact assessment and feasibility assessment of the sea use. These four systems as the main countermeasures on negative environmental effects play an important role in the management process of ORED. They not only regulate the development of new energy projects with legal systems, but also guarantee the development space for ocean renewable energy strategic emerging industries. The systems have good effect on the prevention of environmental impacts and can ease considerably the sea use conflict.

## **1.Introduction**

While the international communities increasingly concern about climate change, environmental protection and other issues, reducing carbon emissions and developing clean and renewable energy become the consensus of the world. Ocean renewable energy industry will be developed greatly thereby.

According to the investigation on the ocean renewable energy by the State Oceanic Administration of China, the offshore wind energy, tidal power, wave energy and other ocean

renewable energy resources in China are abundant. When the ocean renewable energy industry is developing rapidly, it is a subject with significant research value how to diagnose and identify the main environmental issues and environment risks which may be caused by large-scale ocean energy development, and how to avoid the significant adverse effects on marine ecosystem of the ocean energy development projects, the Chinese Government is very concerned about this subject.

## **2 Status and trends of ocean energy development project**

China started research and exploration of ocean energy in the 1970s. Thermal gradients energy, salinity gradients energy and ocean biomass energy are at the stage of theoretical research and equipment design. Tidal energy, tidal current energy and wave energy development projects are at the stage of pilot construction, and some projects are put into trial operation. The tidal power plant constructed before the 21st century and operated still now is only Jiangsha experimental tidal power plant. The installed capacity is 3900kW. In recent dozen years, some small projects in the wave energy and tidal energy have been constructed continually in China. Since 2010, Chinese Government has started to set up ocean energy development special fund, funded 11 research projects on wave energy and tidal current energy, and constructed newly one ocean energy development experiment plant. Each project takes sea area of 1 to 100 hectares, is located mainly in Yellow Sea, East China Sea and South China Sea. Some projects have provided energy to local residents.

It is expected the scale of ORED in China tend to be expanded within 10 years, focus on island's poly energy complementary independent electricity system. Ocean energy projects will be developed comprehensively with marine aquaculture, marine tourism and freshwater. The projects tend to be concentrated.

## **3 Potential environmental problems on ORED**

The marine environment will be affected seriously during ocean renewable energy project construction period and equipment removal period, and the impact mode and results of these two periods are similar. When the project construction is ended, the disturbance on the ocean environment is reduced gradually, the impact on the environment is gone gradually also. These effects include noise, suspended substances, light pollution and chemical leaks. The structures will

occupy the habitats on the sea, result in permanent loss of marine life and habitats.

The impact of the equipment in operation period is more complicated. Many of the projects lead to individual behavior change, such as communication, reproduction, orientation, prey and predator sensing and migratory, and main objects affected include fish, birds, mammals and benthic organisms. After that, Due to the long-term working period over 10 years, the Ocean Renewable energy project will have an impact on the seasonal activities of the species, also change the hydrodynamic force, ecological environment and other conditions for a long time, and result in the spatial-temporal change of regional eco-environment.

#### **4. China's operating measures of environmental protection on ocean energy development**

China has set up strict ocean management systems, including The Law of the People's Republic of China on the Management of Sea Areas Use, Marine Environmental Protection Law of the People's Republic of China, Environmental Impact Assessment Law of the People's Republic of China etc. The main management systems include approval of marine projects, ocean functional zoning, ocean environmental impact assessment, as well as the feasibility assessment of sea areas use.

##### **4.1 Approval of marine projects**

The law specifies clearly the materials and procedures required for the application of renewable energy projects. After years of practice, the examination and approval experiences have been accumulated gradually, such as how to determine a project is consistent with the function zoning, how to examine and approve the project with the conclusion of environmental impact assessment and sea area use feasibility assessment. Based on years of examination and approval experience, a number of examination rules have been formed, such as "offshore wind farms should not be less than 10km away from the coastline" and "where the beach width is more than 10km, the water depth where ORED project located shall not be less than 10m".

##### **4.2 Marine functional zoning**

National Marine Functional Zoning Plan is the marine spatial planning presented and compiled by Chinese Government in the 1980s and is the important basis on marine environmental

protection and other marine management of China. Any sea area project must comply with the National Marine Functional Zoning Plan. National Marine Functional Zoning Plan (2011-2020) promulgated specifies the "renewable energy zones". The management rules have been prepared on ecological protection and sea use method in the marine functional zone. These rules reserve the development space for renewable energy resource and guarantee the development of renewable energy industry.

#### **4.3 Environmental impact assessment system of marine engineering**

The ocean project environmental impact assessment is to invest, analyze and forecast the negative environmental impacts of renewable energy projects, propose environmental protection measures at the managerial and technical level. This system plays an important role in mitigation of environmental pollution and ecological damage, risk accident prevention. As the ocean renewable energy projects are at early stages of development, lack of empirical research on environmental issues, the potential environmental problems are difficult to be predicted and evaluated.

#### **4.4 Feasibility assessment system of sea use**

The feasibility assessment of the sea use is the system to define scientific sea use, analyze and appraise scientifically the rationality and feasibility of the sea use of the projects. Feasibility assessment of the sea area use on ocean renewable energy source includes mainly project site selection, project plane layout, sea use mode, project construction scale and other rationality analysis. Feasibility assessment of the sea area use can ease the conflict between stakeholders, and the coastal ecology and marine ecology of the special sea area can be protected, so that the social, economic and ecological benefits of the ocean renewable energy project can be optimized.

### **5 Conclusion**

The sea management systems in China are relatively complete at present, but there are still lack of technical standards, specifications and guidelines to support the environment management on ORED.

Approval of marine projects can control strictly by law the ocean renewable project

development. The marine functional zoning, environmental impact assessment conclusion and feasibility assessment conclusion of the sea use can play role in the examination and approval of the project.

Marine Functional Zoning plays an important role in protecting the eco-environment and sustainable use of marine resources, reserves the space for the development of ocean renewable energy strategic emerging industries.

Environmental impact assessment system of marine engineering can predict environmental impact and risk, and is useful to the constructor and relevant departments to formulate measures to prevent the impact and risk. But it is currently still lack of long-term monitoring data on ocean renewable energy environment impact, the potential environmental issues and technical standards shall be studied still.

Feasibility Assessment of Sea Use analyzes the site selection, plane layout, sea use mode, area rationality and so on of the ocean renewable energy project, plays a prominent role for regulating the sea use of the ocean energy development projects, easing the conflict between the ocean renewable energy projects and periphery sea use projects, and protecting the ecological environment.

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