

## **Advisory Opinion**

# **Toward Sustainable Development of Offshore Wind Power at Active Margins -Importance of Submarine Geohazard Risk Assessment-**



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**Science Council of Japan**

**Subcommittee on Energy Science and Technology  
Committee on Comprehensive Synthetic Engineering**

This Advisory Opinion is issued in accordance with the outcome of the deliberations of the Working Group on Study of Offshore Wind Power for Sustainable Development Goals of the Subcommittee on **Energy Science and Technology**, of the Committee on Comprehensive Synthetic Engineering, Science Council of Japan.

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## EXECUTIVE SUMMARY

### 1 Background

Offshore wind power is being developed in the world, mainly in Europe. The installed capacity worldwide was 1.5 GW in 2008 and reached 57.2 GW by the end of 2021. During this period, it increased by nearly 56 GW, more than 38 times.

As Japan's location is surrounded by the ocean, there are high expectations for its offshore wind power. It has been more actively developed, backed by the enforcement of Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities aiming for expansion of offshore wind power and the government declaration aiming for carbon neutrality.

Deployment goals of the Japanese government are now to establish projects of 10 GW by 2030 and 30 GW - 45 GW by 2040, to increase the domestic procurement ratio to 60% by 2040 as industry's goal, and to reduce the cost of seabed-fixed power generation to 8 - 9 yen/kWh by 2030 - 2035. In order to accelerate project formulation, the government also introduces a government-led push-type project scheme (Japanese version of the central system) and the strategic development of infrastructure.

### 2 Current Situation and Issues

While public-private collaboration of offshore wind power projects has been advocated, there are risks in development unique to Japan. The risks derive from the bathymetry in an island arc active margin, which greatly differs from the one in continental inactive margin such as Europe.

In Europe, offshore wind power is progressing mainly in areas of the North Sea with a water depth of shallower than 200 meters, the area of which is approximately 570,000 km<sup>2</sup>. In the case of the UK, the fixed type is in operation in areas several kilometers to 100 kilometers off the coastline and shallower than 50 meters water depth and is also under development in areas several kilometers to 150 kilometers offshore and shallower than 50 meters. In addition to the seabed-fixed type, there are also plans to develop a floating type in areas 20 km to 200 km off the coastline and shallower than 200 m water depth. Seas in these areas are shallow and relatively calm and there is little movement of seafloor. Although the impact of storm surges and high waves on offshore structures is an issue, there may be little need to consider the induced movement of seafloor.

On the other hand, around Japan, most of the promising offshore areas shallower than 200 m lie within 50 km off the coastline. In case of 50 m or shallower water depth, the areas lie within 10 km off the coastline. Further, Japan is in severe meteorological and

oceanographic conditions and prone to earthquakes. In this geographical context, in addition to storm surges and high waves, there are significant impacts of the external forces of earthquakes, tsunamis, and typhoons on the limited shallow seafloor areas near the coast. Therefore, there is a high possibility that geohazards will occur in the seafloor. These diverse "submarine geohazard risks" include liquefaction caused by earthquakes and high waves, and submarine landslides. It is known that liquefaction caused by stormy waves during typhoons is also closely related to scouring (the outflow of seabed sediments around infrastructures).

In this way, earthquakes, tsunamis, and typhoons are natural phenomena that are rare in Europe. The direct impact of external forces on infrastructures is being considered as a risk, but the whole interaction between external forces, seafloor and infrastructure, especially seafloor and foundations, has not been fully studied. Since seafloor is the foundation that supports infrastructures, once the seafloor becomes unstable, offshore wind power facilities would no longer be able to operate. So submarine geohazard risks are urgent and serious risks that are currently being overlooked.

In Europe, risks in offshore wind power development are summarized in guidelines. However, although such guidelines may be applied to assessing the impact of waves on infrastructures, they cannot be applied to assessing the impacts of geohazards unique to Japan.

Therefore, it is an urgent issue for Japan to appropriately understand, evaluate, and manage submarine geohazard risks related to constructions of infrastructure foundation and power cable installations.

Risk assessment requires surveys, but leveraging existing data can save money and time. Existing offshore geoscience data collected and compiled mainly by public institutions have been released and available for use, but they have not been fully utilized. This is due to the fact that the data were not observed by the advanced equipment and that the collaboration between industry, government and university is insufficient. There is also the problem that new data acquired for current and future offshore wind power development is not being made public timely.

### **3 Recommendations**

This advisory opinion, which is from the perspective of an expert on submarine geohazard risks, describes significance of guidelines that take into account submarine geohazard risks, sharing and utilization of existing and new data, human resource development that promotes sharing of case studies and needs, and industry-government-university collaboration that accelerates these efforts. This is addressed to the government agencies promoting offshore wind power (Ministry of

Economy, Trade and Industry; Ministry of Land, Infrastructure, Transport and Tourism; New Energy and Industrial Technology Development Organization; Japan Organization for Metals and Energy Security; Nippon Kaiji Kyokai), business operators, local governments, research institutes, universities, and related academic societies.

(1) Submarine geohazard risks-aware development

In waters around Japan, most of the areas shallower than 200 m that are suitable for the development of fixed and floating offshore wind power are limited 50 km off the coastline. In addition to storm surges and high waves, these areas are also subject to strong external forces from earthquakes, tsunamis, and typhoons, which have a large impact on the limited shallow seas near the coast. As there is a possibility that submarine geohazards unique to Japan may occur near the coastline, we need to recognize such submarine geohazard risks toward sustainable development.

(2) Developing systematic guidelines for submarine geohazard risks

It is necessary to identify and evaluate submarine geohazard risks, because Japan is an earthquake-prone country located in active margin with severe meteorological and oceanographic conditions. However, guidelines regarding assessment / prediction / design / measures for such submarine geohazard risks have not yet been developed. Therefore, in order to ensure full-scale development and stable operation in the future, it is urgent to develop systematic guidelines regarding submarine geohazard risks through industry-government-university collaboration including experts.

(3) Need for utilization of existing offshore geoscience data, human resource development, and industry-government-university collaboration

Existing exploration data and maps useful for submarine geohazard risk assessment have been compiled mainly by public institutions. Promoting use of the data and improving the data sets by industry-government-university collaboration leads to efficient survey and additional investigation planning and activating technological development and human resource development. To this end, it is desirable to promote open access of submarine data and to establish a platform for open discussion. Accordingly, Japan can improve her status by enhancing international human resource development.