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해양에너지를 활용한 에너지 자립 섬 구축방안

A Study on the Direction of Promoting Self-Reliant Islands Using Ocean Energy

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국문초록 : 본 연구는 해양에너지를 활용한 에너지 자립 섬 구축에 대한 정책 방향을 문헌 고찰하였다. 즉, 에너지 자립 섬 사업 계획 수립시 전략적인 해양환경영향평가를 실시하여 해양의 환경적 특성을 고려해야 함을 제시하였다. 선제적으로 부지선정을 진행하자는 제안도 제시하였다. 특히 해양에너지 개발사업의 건설 및 운영과정에서 해양환경에 대한 지속적인 모니터링이 이루어져야 함을 강조하였다. 또한, 해양에너지를 활용한 자립 섬 추진에 중요한 해양환경 영향 데이터 확대 방안 모색과 섬 주민들의 적극적인 참여와 지원이 필요함을 강조하였다. 이는 정부 주도 스마트그리드 사업단과 한전이 협력할 때 성공 가능성이 크다고 분석하였다. 이처럼 문헌 고찰을 통하여 집중적으로 분석한 결과, 첫째, 주민주도의 적극적인 참여와 지원이 필요하다. 둘째, 한전은 스마트그리드사업단 등 전문 공공기관과 협력해야 한다. 셋째, 전략적 해양환경영향평가를 도입해야 한다. 넷째, 지속적인 해양환경 영향조사를 시행해야 한다 등을 제시하였다.

주제어 : 해양에너지, 자립 섬, 해양환경, 에너지 자립 섬, 정부 주도, 스마트그리드 사업단

Abstract : This study examines the policy direction for energy self-reliant islands using marine energy. In other words, it was suggested that the environmental characteristics of the ocean should be considered by conducting a strategic marine environmental impact assessment when establishing an energy-independent island project plan. It was also suggested to proceed with preemptive site selection. In particular, it was emphasized that continuous monitoring of the marine environment should be carried out during the construction and operation of the marine energy development project. In addition, I emphasized the need to seek ways to expand marine environmental impact data and to actively participate and support the residents of the island, which is important in promoting self-reliant islands using ocean energy. This can be said to have a high probability of success when the government-led smart grid project group and KEPCO collaborate with each other. The results of the study analyzed through literature review are as follows. First, active participation and support for initiatives led by residents are needed. second,. KEPCO must collaborate with specialized public institutions such as the Smart Grid Project Group. Third, a strategic marine environment impact assessment should be introduced. Fourth, continuous marine environmental impact investigations should be conducted.

Key Words : Ocean Energy, Self-reliant Islands, Marine Environment, Energy-independent Island, Government-led Smart Grid Group

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Ⅰ. Introduction

Ocean energy is energy generated in the sea, and includes wave energy that can be used when waves strike, temperature difference energy created by using the temperature difference between the sea and the sea surface, and tidal energy, which is a phenomenon that changes the depth of water at high tide and low tide[1,17-19].

Electricity can be produced using these various energies[1]. Accordingly, the world is actively promoting various marine energy development projects. Countries around the world are expanding investment and policy support for marine energy development.

In particular, a microgrid that combines renewable energy such as solar power, wind power, geothermal heat, and fuel cells with an energy storage system(ESS) for diesel power generation sources in island areas that are difficult to receive electricity through land Cases of application to regions or villages are increasing[2].

The microgrid system refers to a local power supply system centered on a distributed power source independent from the existing wide area power system.

When the microgrid system is equipped, the electricity demand can be met 100% from the small power community's own power grid because the surplus energy of each home and facility can be transmitted and distributed through multiple power grids, rather than just generating electricity from the power plant.

Against this background, the current government announced the “Strategy for Activation of New Energy Industry and Development of Core Technology” in April 2015 to respond to climate change, and is promoting the energy self-reliant island as a new energy industry model[3].

In such an environment, Korea, surrounded on three sides by the sea, has abundant marine energy resources. Among them, interest and investment are more focused on offshore wind power, tidal power generation, wave power generation, and seawater temperature differential power generation.

However, marine energy development projects that are considered eco-friendly are pointed out as targets that damage the environment and cause conflicts with local residents[4,20-23].

This problem starts from the fact that the site selection emphasizes only economic efficiency, or the survey on the impact of the construction and operation of power generation facilities on the marine ecosystem and the marine environment is neglected or it is difficult to collect information about it in reality.

Therefore, this study, through literature study and domestic and foreign case analysis, has only recently developed a new and renewable energy business model that converges and combines them, although the development level of the domestic industry related to the renewable energy industry such as solar power, wind power and ESS is at a global level. We would like to urge a change of perception considering that the cost is still insufficient to drive the expansion of market demand[9].

In this regard, I would like to examine the demonstration cases of the self-reliance island promotion using marine energy and review the direction of the eco-friendly energy self-reliance island promotion.

This is expected to contribute to the Korean government's search for policy and institutional

measures to promote marine energy development projects in an eco-friendly manner.

II. Theory

In general, an energy self-reliant island or self-sufficient island refers to an island that can produce and use necessary energy by itself using renewable energy such as solar and wind power and batteries[14-16,24].

The ocean, which occupies 71% of the Earth's surface area, is constantly supplied with energy in the form of heat, motion, and potential energy from the sun and moon, and emits the same amount.

However, most of them are not directly utilized as energy sources. Ocean energy can be divided into thermal energy stored in the atmosphere or surface water and energy in the form of fluid flow such as ocean currents, waves, and wind.

However, in general since the energy density of the fluid flow form is relatively high compared to thermal energy, the development of a technology utilizing it is actively being made.

In recent years, marine energy is attracting attention according to the need for the development of new and renewable energy. Ocean energy, which accounts for 23% of solar radiation, has high energy conversion efficiency and high energy density[10].

Therefore, it is a non-depleting clean energy that is advantageous in securing economic feasibility during development. In addition, marine energy is an infinite renewable energy resource that can be developed on a large-scale[5].

Ocean energy〈표 1〉 is a technology that produces electricity or heat by converting ocean tides waves, ocean currents and temperature differences.

The methods of generating electricity include tidal power, wave power, and temperature difference power generation[24].

〈표 1〉 World marine energy reserves

Ocean energy	Energy reserves(TWh/year)
Tidal barrage	300
Wave	80,000
Tidal current	800
OTEC	10,000

Wave power and temperature difference power generation are many for evaluation of energy reserves.

However, considering the location conditions for each energy source, economic feasibility, technological prowess, and environmental factors, the field that is actually being developed the most is tidal power generation.

Since there is no risk of depletion of ocean energy, it can be used as long as the solar system continues after development.

In addition, it has the advantage of being able to predict the amount of power generation almost accurately and providing clean energy without environmental pollution problems.

The proportion of ocean energy such as tidal power, tidal current, and wave power among new and renewable energy is still insignificant at 1%[12].

However, the recent overall technological development has greatly increased the commercial applicability. Globally, the potential of ocean energy is abundant, reaching about four times the annual electricity production.

In particular, there is no risk of exhaustion, there are relatively few environmental pollution problems, and once developed, it has high value

as a pollution-free clean energy with almost no operating cost. In addition, the ocean has advantages as a space for the construction of solar and wind farms, which require a vast area of land, because it is advantageous for the realization of large-scale power generation facilities and large-scale power generation complexes compared to land based on spatial characteristics.

It is estimated that Korea has a total of more than 18,000 MW of marine energy, including 6,500 MW of tidal and wave power, 4,000 MW of seawater temperature differential power generation, and 1,000 MW of tidal power, respectively.

However, if marine energy in a broad sense such as 33,200 MW of offshore wind power and 5,400 MW of offshore solar power is included, the potential is very large[6].

Ⅲ. Case Analysis

Recently, as interest in alternative energy increases, domestic interest in marine energy is also increasing. In order for Korea to emerge as a marine energy powerhouse through strategic support and investment, the present state and problems for the industrialization of marine energy will be identified, and development support plans will be investigated.

Current legal and institutional limitations such as insufficient follow-up support for R&D, sluggish corporate participation, absence of other support laws, and complex administrative regulations in relation to domestic ocean energy development are considered to be factors hindering development[7].

Strategies to overcome these problems and develop marine energy are as follows:

(1) securing source technology and securing empirical R&D support.

(2) support for the promotion of participation of private companies and the expansion of infrastructure is needed.

(3) efforts for legal and institutional improvement such as expansion of systems for dissemination and diffusion of marine energy such as tax benefits and subsidies support and improvement of complex administrative procedures are required.

Despite this situation, the number of “energy self-reliant islands” that generate electricity directly in Korea is increasing. An energy self-sufficient island means “an island that can become self-sufficient in electricity with renewable energy such as solar power, wind power, and geothermal energy”.

In other words, an energy self-sufficient island can be defined as 'an island that minimizes external energy demand and strives to increase energy independence'[8].

Ⅳ. Results

1. Active participation and support of residents-led initiatives is required

The energy self-reliance island is very meaningful in the sense of experimenting with the energy self-reliance model, which is the core of the regional distributed system. As in the case of Samsoe Island in Denmark[11], Samsoe Island started the energy self-reliance project in 1997 and recorded 100% energy independence in 2006, 10 years later.

It cost a total of 80 billion won and is equipped with a 45MW wind power facility and a biomass production facility. Of the total of 80 billion won, government subsidies accounted for only 7.5% of the 6 billion won, and the rest was invested by local residents through loans. Thanks to this, 75%

of the current wind power facilities on Samsoe Island are owned by residents or resident cooperatives.

An important reason for Samsoe Island's success in energy independence is that it was led by the residents, not the government or the private sector. As such, having an economic foundation so that residents can directly participate in energy production is the key to success.

2. KEPCO collaborates with specialized public institutions such as the Smart Grid Project Group

Considering the situation in Korea where the initial installation cost of renewable energy is expensive, we propose a step-by-step approach. It is necessary to secure profitability by partially subsidizing construction costs through public initiatives and to spread the model by creating a foundation for local residents to raise funds. For this, KEPCO seems to need a role such as raising a fund for the creation of an energy-independent village.

In order to discover a general-purpose model with high spreadability, KEPCO and professional public institutions such as the Smart Grid Project should work together to increase the likelihood of success.

3. Introduction of Strategic Marine Environmental Impact Assessment

The Yoon Seok-yeol administration should also consider that it is burdensome for private operators to investigate the impact of marine energy development projects on the marine environment and marine ecology in the age of the ocean, and the uncertainty of forecasting is large. Therefore, it would be reasonable to conduct a strategic marine environmental impact assessment when establishing a plan for an energy-independent island at the central or local government level to preemptively select a location considering the environmental characteristics of the ocean.

4. Conduct continuous marine environmental impact survey

The Yun Seok-yeol government should also make sure that the marine energy development project for energy independence in the island area moves from the pilot stage to the construction of a large-scale commercial complex. To this end, abundant and specific marine environmental impact survey data must be secured first. In particular, a plan should be devised to expand marine environmental impact data through continuous monitoring in the construction and operation of marine power generation complexes in the island region in the future.

Ⅴ. Conclusion

In light of advanced overseas cases, the Yun Seok-yeol government should first induce active participation and support of the residents.

Second, it is necessary for KEPCO to collaborate with specialized public institutions such as the Smart Grid Project Group, led by the government.

Third, by conducting a strategic marine environmental impact assessment on the marine energy development project in the island area for the government-led energy independence, in principle, environmentally sensitive areas are excluded and the marine spatial technique is applied to areas that are expected to have little environmental impact. It seems that a preemptive location strategy that utilizes and selects is necessary.

Fourth, if a certain area is set as a marine

energy test zone or development zone in advance through a strategic marine environmental impact assessment like in foreign cases, it would be a good idea to form a mecca for the marine energy power generation complex around the self-reliant island centering on that area.

In addition, in a situation in which the prediction of the marine environmental impact due to the construction of the power generation complex is uncertain, ways to continuously monitor the marine environmental impact of the island area while gradually expanding the size of the power generation complex should be sought. Through this, data on the impact on the marine environment and marine ecosystem should be expanded.

This study pointed out that a strategic marine environmental impact assessment should be conducted when establishing a development project plan for an energy-independent island using marine energy.

In particular, he pointed out that it is necessary to proceed with preemptive site selection considering the environmental characteristics of the sea and to continuously monitor the marine environment during the construction and operation of the marine energy development project.

Through this, it was suggested that a method for expanding marine environmental impact data should be sought. In particular, he pointed out the active participation and support of the residents, and suggested cooperation between the government-led Smart Grid Project Group and KEPCO.

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