ANALYSIS OF OCEANOGRAPHIC INFORMATION AS A CO-BENEFIT OF OCEAN RENEWABLE ENERGY PROJECTS-A CASE STUDY OF JAPAN'S OCEAN CURRENT POWER PROJECT

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ABSTRACT

Ocean renewable energy sources have been identified with a high potential globally. Ocean current energy is such renewable energy, where Japan has a potential to generate at least 5% of its total electricity demand, if 10% of the estimated power can be extracted from the Kuroshio Ocean Current. With the post Fukushima social pressure, Japan is trying to improve its electricity generation from renewable sources. Ocean Current Power (OCP) project is one such initiative which tries to capture the power of Kuroshio Current to generate electricity.

Ocean renewable energy technologies are still in the development phase. Hence, there are many uncertainties such as potential impacts to the environment and marine industries. These uncertainties cause social acceptance issues which can be a threat to the deployment of the power project. Potential social acceptability issues become more significant in Japan due to the lack of Marine Spatial Planning (MSP) and high socio-economic prominence given to the marine industries such as fisheries. This has been evident in the past coastal projects such as JAXA's space center development in Tanagashima, Offshore wind farm development in Yasuoka etc. Compensation schemes, the conventional way of handling the stakeholder opposition, results a huge cost to the project developers. Additional costs impact the sustainability of the ocean renewable energy projects which already very expensive.

It is equally important to investigate the potential positive impacts which can be realized from the power project while finding ways to minimize the potential adverse impacts. Sharing project co-benefits to create synergies among the stakeholders has been identified as such positive impact, which can lead to a sustainable way of improving the social acceptability. Previous researchers have proposed several options which can be used to build stakeholder consensus for offshore wind power projects. One of the proposal applicable to the OCP project is, "sharing oceanographic information captured by the power plant's Condition Monitoring Systems (CMS) to the other stakeholders who is in need of such information", based on the hypothesis that 'the plant's CMS can satisfy the stakeholders' oceanographic information requirements'. However this idea has not being tested previously in the offshore renewable energy sector. Hence the purpose of this research is to test the potential of the proposed oceanographic information sharing scheme to create synergies among stakeholders in a context of ocean renewable energy projects. To test the hypothesis, three specific research questions (R.Q.) were considered.

R.Q.1 – What oceanographic parameters are required by the stakeholders?

R.Q.2 – What oceanographic parameters can be generated by the plant's CMS?

R.Q.3 – What is the expected incremental costs and benefits to the stakeholders?

Japan's OCP project was selected as the case study and Shionomisaki area in the Wakayama prefecture, which is one of the project deployment sites, has been selected as the case study area. Fishermen, Fishery Union, Researchers and Project Developers have been selected as the main stakeholders considering the potential impacts to the industries and the socio-economic importance of the stakeholder groups in the area. Stakeholder interviews and focus group

discussions have been used for primary data collection. Data from the similar information sharing systems, financial estimates of the OCP project and related market data etc. has been used as secondary data. Even though the secondary data has been used to validate and complement the primary data, a significant level of data unavailability and uncertainty was evident. Hence DS/AHP model, an evidence based decision making model, which combines the standard 'Analytical Hierarchy Process' and the 'Dempster Shafer Theory', was used as the final Multi Criteria Decision Making (MCDM) methodology. Since there were no calculation tool available to run DS/AHP model, a new DS/AHP software tool was also created using the C# programming language.

In addition to the monetary costs and benefits, qualitative criteria such as improvements to the existing oceanographic data sets and stakeholder engagement were used as decision criteria. From the results of the research question one and two, it was identified that most of the essential industrial oceanographic information requirements, such as water temperature and ocean current data, can be fulfilled by the standard CMS. Considerable amount of other industrial and scientific information requirements can be satisfied by doing incremental changes to the standard CMS. Hence, following scenarios were considered in the MCDM model.

Scenario 1 – No information sharing (Null hypothesis)

Scenario 2 – Sharing all the information required by the stakeholders

Scenario 3 – Sharing the information which is obtained by the standard CMS for the power plant operation

According to the worst case cost estimates, incremental startup cost and the annual maintenance cost was estimated to be in the range of 130 – 190 million yen. Improvements in

fishing area selection, travel cost reductions, improved fish migration pattern etc. have been identified as the potential benefits. Willingness to Pay (WTP) of the fishery union is ranging from 100,000 – 500,000 yen/fisherman/year. Since the fishery union has more than 800 full time members and more than 2700 associate members, union's WTP is comparable to the annual additional costs. Sensitivity analysis done on the identified benefits, shows the mentioned WTP range is reliable if the fisheries achieve at least 1%-5% improvement in income and 'fuel and other cost' reductions. Researchers as well as the developers also identified qualitative benefits even though there were not enough data to estimate in monetary terms. The results of the DS/AHP model shows that all the stakeholder groups selected the third scenario as the preferred scenario, despite there is a significant difference in relative importance levels of the selected criteria. The local government officials were also in favor of the proposal as they believed this can lead to more synergies among traditional and modern industries to revitalize the local economy. Hence this research outcomes proves that the proposed information sharing scheme can reduce the existing oceanographic information gap in the region. Technical and economic feasibility study also proves the viability of the proposed information sharing scheme. However, related legal and policy implications with the available financing options have to be further studied with respect to the real implementation.

Key words: Ocean renewable energy, Co-benefit sharing, Oceanographic information, Condition monitoring system, DS-AHP