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# Social Acceptability of Offshore Wind Projects in Greece: Citizen Perspectives on Challenging Issues of Site-Selection Problem

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**Abstract.** Lack of social acceptance remains a major constraint towards offshore wind project (OWP) deployment. The incorporation of local population perspectives and concerns into the site-selection process of OWPs can assist to overcome the respective barriers. In this work, an appropriately designed methodological framework is introduced for the identification of citizen perspectives on many challenging issues of site-selection of OWPs. The methodology includes three consecutive phases: (Phase 1) design of questionnaire survey and acquisition of citizen responses; (Phase 2) quantitative and qualitative analysis of citizen responses and synthesis of survey results; and (Phase 3) creation of an OWP roadmap for Greece in GIS, in accordance with the citizen perspectives and requirements. In total, 1,802 citizens participated in the survey from various geographic locations of all Regions of Greece. The survey results reveal the high social acceptability (80.6% of the participants) for OWP deployment in Greece and present the citizen requirements on the selection of eligible sites for their installation (e.g., a minimum distance of 5,000 m from shoreline has been suggested (median value)). In conclusion, the proposed participatory tool could facilitate the deployment of OWPs in Greece, by avoiding socially unsustainable sites and, thus, strongly enhancing the social acceptability of the future projects.

**Keywords:** citizen participation; offshore wind; social acceptability; site-selection; GIS

## 1. Introduction

Wind energy is currently one of the leading renewable energy sources in terms of installed power capacity, bolstering energy security and delivering economic growth. Specifically, the cumulative installed capacity of global wind power reached nearly 940 GW by the end of 2022 (Hutchinson and Zhao, 2023). Offshore wind projects (OWPs) have the potential to rapidly displace fossil fuels, since they are economic viable and commercially available renewable energy projects, with the capacity to produce tremendous amounts of power. The total global offshore wind capacity reached the amount of 64.3 GW by the end of 2022 (Hutchinson and Zhao, 2023), while in Greece OWPs have not been planned and deployed yet. However, the Greek Ministry of Environment and Energy established a framework for the acceleration of OWP deployment in Greece in the following years (Ministry of Environment and Energy, 2022).

Social acceptance is a key challenge for OWP deployment and as a siting parameter could limit significantly the availability of the suitable sites for OWP installation. Lack of social acceptance remains a major constraint towards fulfillment of global energy targets in the medium (for 2030) and long (for 2050) term future (Ellis and Ferraro, 2016). The participation of local citizens in the site-selection process of OWPs can assist to overcome the respective barriers as well as enhance the citizen attitude towards these projects.

In the present work, an appropriately designed methodological framework is introduced for the identification of citizen perspectives on many challenging issues of OWP site-selection problem. Through the quantitative and qualitative analyses of citizen responses and the synthesis of survey results, the citizen requirements on OWP site-selection in Greece are specified. An OWP roadmap is created in a geographic information system (GIS) in accordance with the citizen perspectives, contributing to the identification of social acceptable sites. It should be noted that this is the first participatory tool developed for the incorporation of citizen requirements into the exclusion stage of site-selection process of OWPs as well as the largest study conducted with the participation of 1,802 citizens in important tasks of site-selection. The remainder of the paper is structured as follows. Section 2 presents the participatory tool developed for the incorporation of local citizen requirements into the site-selection process of OWPs. The main results of the citizen participation process are presented and discussed in Section 3, while the concluding remarks of this investigation are cited in Section 4.

## 2. Materials and Methods

The present participatory tool is developed for the incorporation of citizen opinions into the early stages (e.g., Exclusion Stage) of site-selection process of OWPs and is applied on national spatial planning scale. In particular, the

study area includes the territorial waters of Greece. Accordingly, any marine area further away of twelve (12) nautical miles from the Greek Ionian Sea coastline, which extends to Cape Tainaron in the Peloponnese (including Ionian Islands coastline), is excluded. It is also eliminated any marine area further away of six (6) nautical miles from the Greek Aegean Sea coastline and Cretan Sea coastline. A comprehensive methodology is developed for the creation of the present participatory tool, which is shown in Figure 1 and includes three consecutive phases.

In Phase 1, a systematic questionnaire survey is appropriately designed for the investigation of citizen attitude towards OWP siting in Greece. Specifically, this part of the participatory tool consists of two main cores: (a) the coordinators of sustainable energy planning of OWPs and (b) the local citizens. The coordinators are responsible for the proper and holistic execution of the sustainable energy planning of OWPs and for the conduction of a systematic questionnaire survey through which the citizen perspectives and requirements on site-selection of OWPs would be derived. Therefore, in this phase, a comprehensive questionnaire survey was performed and sent to the local citizens through the internet. Specifically, the questionnaire survey was sent to all employees of 13 Administrative Regions and 203 Municipalities of Greece, to all official members of the Technical Chamber of Greece (17 Independent Regional Departments) and to many other organizations. In addition, the questionnaire survey was posted on some local news websites as well as on social platforms, such as LinkedIn and Facebook. Through this survey, the citizens participated on many challenging issues of site-selection problem of OWPs, such as on the selection of the exclusion criteria and their respective exclusion limits. Also, they had the opportunity to add as many criteria as they wished, in order to determine the social acceptable sites for the potential OWPs. The survey lasted 163 days (started on the 5$^{th}$ of July and ended on 28$^{th}$ of December of the year 2021) and closed after a certain number of citizen responses.

In Phase 2, qualitative and quantitative analyses of citizen responses were conducted, in order to determine their perspectives on numerous site-selection issues. For example, in this phase, the estimation of the exclusion limits that should be applied for important social criteria (e.g., distance from shoreline for landscape protection and avoidance of visual/acoustic disturbance, distance from existing verified shipping routes) was carried out, the identification of the reasons that a portion of citizens disagree with the installation of these projects in Greece was accomplished and many other related analyses were conducted. Completing all necessary analyses and syntheses of survey results, the citizen requirements on the site-selection of OWPs are specified, such as the number and the type of the exclusion criteria that should be applied in an OWP site-selection study, in order to pinpoint precisely the social acceptable sites.

In the last phase of the present participatory tool (Phase 3), the citizen requirements that are related to the exclusion stage of the site-selection process of OWPs are fulfilled. Specifically, the exclusion criteria and their respective exclusion limits, that are proposed by the citizens, are performed in GIS, in order to determine spatially the social acceptable sites. Several of the exclusion criteria that discussed with the citizens or proposed by the citizens have also a strong environmental importance (e.g, distance from protected areas). Therefore, at the end of Phase 3, an energy roadmap was created in GIS with the precise location and the available surface area of the social acceptable as well as environmental sustainable sites for OWP deployment in Greece. It should be noted that the respective provisions and policies of the Greek Specific Framework for the Spatial Planning and Sustainable Development for the Renewable Energy Sources (SFSPSD-RES) are also taken into consideration at this phase (SFSPSD-RES, 2008).

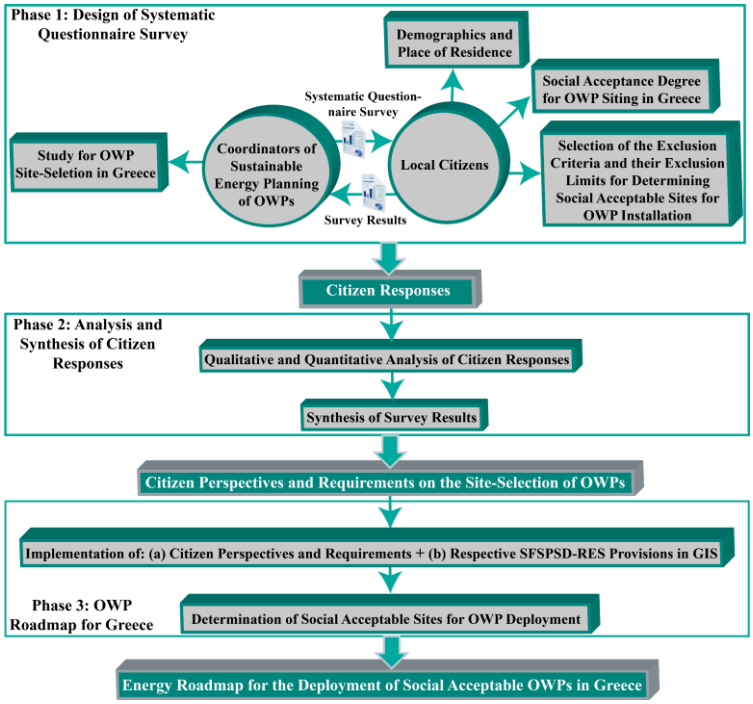


**Figure 1.** Participatory tool developed for the incorporation of citizen perspectives and requirements into the early stages of site-selection process of OWPs.

The final outcomes of the present participatory tool are: (a) the citizen perspectives and requirements on numerous challenging issues of OWP site-selection problem and (b) the precise location and available surface area of social acceptable sites for OWP deployment in the study area (i.e., territorial waters of Greece).

## 3. Results and Discussion

In total, 1,802 citizens participated in the site-selection process of OWPs and fully completed the questionnaire survey. It is appeared that there is a gender-balanced participation in the OWP site-selection process, since the 47.7% of participants are males and 52.3% of participants are females. The participants are from various locations of all 13 Regions of Greece, while the majority of them are residents of the Region of Central Macedonia (62.7%).

The social acceptance degree for the site-selection of OWPs in Greece is 80.6%, while the remaining 19.4% of participants disagree or strongly disagree with the deployment of these projects in the country. The five main

reasons that the citizens disagree with the installation of these projects in Greece are: (a) disturbance of the landscape aesthetic (14%), (b) disturbance of marine mammal habitats (13.3%), (c) bird and bat collision with wind turbines and disturbance of their habitats (12.2%), (d) disturbance of fish habitats (11.7%) and (e) harmful impacts on marine environment (e.g., water contamination by chemical pollutants) (10.7%).

Furthermore, eleven (11) exclusion criteria identified and their exclusion limits determined (e.g., distance from protected areas (exclusion limit: ≤1,500 m), distance from existing verified shipping routes (exclusion limit: ≤2,000 m)), by the quantitative and qualitative analyses of citizen responses and the respective provisions of SFSPSD-RES. Two necessary exclusion criteria were additionally applied, namely national territorial waters and project minimum required area, for determining the official geographic boundaries of the study area (Spyridonidou and Vagiona, 2021) and for eliminating the areas that are too small (i.e., <2 km$^2$) for the installation of economic viable projects (Spyridonidou and Vagiona, 2020), respectively. Therefore, in total thirteen (13) exclusion criteria implemented in GIS, for the identification of social acceptable sites for OWP installation (Figure 2).

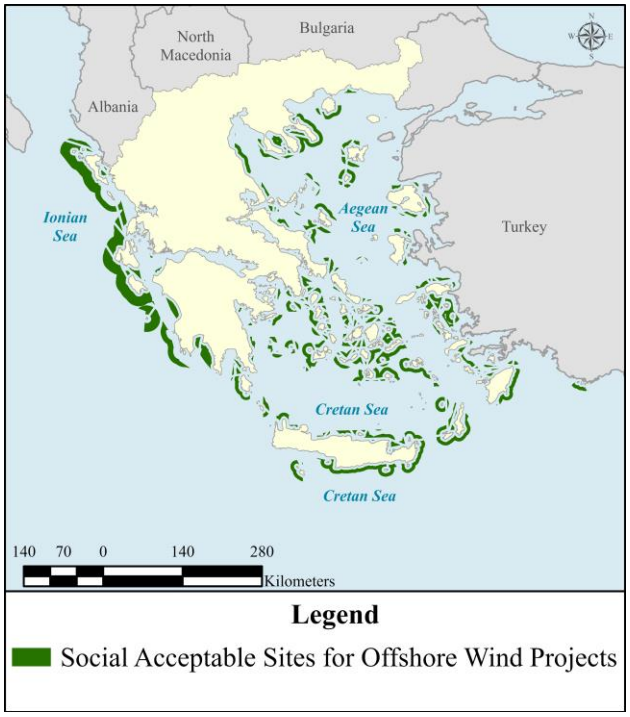


**Figure 2.** Energy roadmap for the deployment of social acceptable OWPs in Greece.

Two hundred twenty (220) social acceptable site solutions with a total surface area of 26,561.028 km$^2$ are determined for OWP installation, in accordance with local citizen perspectives and requirements. The majority of them are pinpointed in the Aegean Sea (179 sites, 54.88% of the available surface area), 23 sites are pinpointed in the Ionian Sea (33.91% of the surface area), while the remaining 18 sites are located in the Cretan Sea (11.22% of the surface area). The energy roadmap for the deployment of social acceptable OWPs in Greece is shown in Figure 2.

The citizens rated positively their participation through the present systematic questionnaire survey. Specifically, they rated their participation in the site-selection process, from a scale of 1 to 10, with 6 (median and mean value), while the mode values given by the citizens are 5, 8 and 10.

## 4. Conclusions

At the present study, social acceptable sites for OWPs are identified in Greece (on national scale), by considering the local citizen perspectives and requirements into the early stages of the site-selection process. This is the first participatory tool developed for the incorporation of citizen perspectives into the exclusion stage of site-selection process of OWPs as well as the largest study conducted with the participation of 1,802 citizens in important tasks of site-selection. It is revealed that there is a high social acceptability for OWP installation in Greece, since 80.6% of the citizens agree or even strongly agree with their deployment in the country. Eleven criteria are determined as important social criteria and they should be applied into each site-selection process for the identification of social acceptable sites along with their respective exclusion limits. Several of these criteria have also a strong environmental importance. Thus, it is revealed a valuable insight, which is that the social acceptability of OWPs is directly linked with their environmental sustainability. Numerous social acceptable sites identified for OWP installation (in total 220 sites). Economic and technical criteria would be included in the site-selection analysis of a future study, in order to pinpoint in which of these social acceptable sites, it is economic and technical viable to install OWPs in Greece. Additional environmental criteria would probably be considered in a future site-selection analysis. Also, many other important features of the proposed participatory tool as well as additional significant results and insights that derived from its implementation would be presented in a future study.

The proposed participatory tool could facilitate the deployment of OWPs in Greece, by avoiding socially unsustainable sites and, thus, strongly enhancing the social acceptability of the future projects. The participatory tool could be easily applied in other study areas and spatial planning scales. Lastly, the present participatory tool could be easily adopted and applied for other renewable energy projects, such as onshore wind projects.

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