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Research Article

Spatial parameters for the development of floating wind farms in Greece

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Keywords

Maritime spatial planning, floating wind farms, wind energy, spatial planning in Greece, Renewable Energy Sources

Abstract

The interest in offshore wind farm markets has recently turned to the use of the strong wind power that can be found in deep-sea marine areas with the use of innovative technology in floating wind farms. This activity attracts the interest of economic actors globally, with prevention still necessary to avoid potential conflicts with other maritime activities and protect sensitive local marine ecosystems. The main research interest of this study focuses on the role that the particular characteristics of the local legal framework can have on the spatial planning of activities. The steps taken in this gradual approach include current spatial planning practice, case law and the country's experience in related projects. Concluding, an example of the possible spatial planning of FWFs, based on the current tools available in the country's spatial planning system, is provided.

Highlights:

- The framework for the siting of Floating Wind Farms in Greece

- The role that the particular characteristics of the local legal framework can have on the spatial planning of activities.

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1. INTRODUCTION

The production of energy from the sea is a relatively recent activity, which is attracting increasing attention. According to the European strategy for offshore renewable sources of energy (EC, 2020), an increase is foreseen in the sustainable offshore wind energy in Europe from 12 GW today to 60 GW by 2030 and 300 GW by 2050. Offshore wind energy is expected to be the most important source for the production of the energy that will be used in Europe by 2040.

Compared to onshore infrastructure, offshore wind farms have higher total installation costs, although these fell by 18% in the period 2010-2019 as did operation and maintenance costs, due to larger turbine sizes and expanded service capacities. Related investments in the United Kingdom and Germany account for 81% of total European investment (around € 60 billion) with remarkable growth rates in other countries due to effective cooperation between government and industry. Considering the future development of the activity, the existing know-how gives an advantage to specific countries but at the same time more countries, among them Greece, Finland, Norway, Poland, Croatia and Cyprus in Europe, are also beginning to get involved.

These prospects have led to an extensive dialogue around the possibilities and parameters for the development of offshore wind farms. Sun, Huang and Wu (2012) have investigated technical, economic and environmental issues, pointing out that offshore wind will lead to technology advances in the near future as it seeks to exploit resources further offshore. Akbari, Jones and Treloar (2019) assess the efficiency of 71 offshore wind farms, concluding that there is a relatively high average efficiency score across all the north-western European countries studied. Zountouridou et al. (2015) and Ejdemo & Söderholm (2015) confirm the significant impact on jobs and new activities. Furthermore, social benefits are mentioned, arising from the contribution of wind energy in the reduction of energy imports, the increase of energy supply security and the reduction of CO2 emissions (Zountouridou et al., 2015).

An analysis of a series of hypothetical offshore wind farm scenarios in European countries examines how national regulations and geographical conditions affect projects profitability (Prässler & Schaechtele, 2012). Favorable governmental policies are considered of important significance for the development of the offshore renewable energy industry, so that the required innovations and economies of scale can be shaped (Leary & Esteban, 2011). Moreover, further research about location factors and legislative considerations are required (Díaz & Soares, 2020).

Although the Mediterranean Sea has a high wind farm potential, the development of offshore wind farms is limited, mainly due to its deep waters. Offshore wind turbine foundations are considerably affected by sea floor soil properties, water depth and wave heights, and so until recently offshore wind farms were built primarily in shallow waters (less than 30m. deep) and close to the shore (Zountouridou et al., 2015). According to research by Díaz and Soares (2020), 91 of 112 operative wind farms in Europe are located at a maximum depth of 24 m. Floating wind farms, can be installed at a depth of up to 900 m., significantly increasing the maritime areas that are available for energy production, thus providing a solution to the question of the insufficient available and suitable space on land but also where seabed conditions are not favorable for fixed-bottom foundations even in shallow waters (IRENA, 2019).

The installation of floating wind farms far from the shore and inhabited areas can: reduce visual pollution (Laskow, 2011); facilitate co-existence with other uses of the sea, such as fishing and navigation (Svenvold, 2009); facilitate the use of a stronger and more stable wind power, which is located in deep waters (Musial et al., 2004); and avoid the effect of the relief on wind speed. A doubling of wind speed increases the power output of a wind turbine by a factor of eight (IRENA, 2019b). Moreover, floating offshore wind farms significantly reduce seabed disturbances during installation and also have limited installation time as the relevant equipment can be largely assembled on land and towed to its final marine location. Offshore wind turbines may also have lower overall operating and maintenance costs, although that depends on the distance from a suitable deep-water port (IRENA, 2019).

There is an international market for the growth of this sector, although it is essential to avoid local risks and restrictions around the area of the installation. This study examines the role that the local institutional framework may have on the location of floating wind farms (FWF) within the framework of Maritime Spatial Planning (MSP). This approach is based on the gradual classification of priorities in relation to the spatial management of the activity in Greece, which includes: (a) an understanding of the European framework and the relevant policy guidelines; (b) the provisions of the current spatial planning; and (c) the case law that has developed in the country in relation to individual issues. The local and international experience in the spatial management of FWF means that potential gaps can be covered and a realistic approach to the immediate promotion of the sector in Greece may be adopted.

2. PARAMETERS FOR THE SPATIAL MANAGEMENT OF FWF

2.1 Spatial management of activities in marine areas.

Until 2008, the policy for marine areas in the European Union came within the framework of the common environment policy. The European Commission announcement in 2008 of a roadmap for Maritime Spatial Planning (MSP) and the achievement of common principles in the EU (EC, 2008), as well as the maritime strategy framework guidelines EP (2008) formed the environmental pillar of European maritime policy and set the bases for Directive 2014/89/EU on MSP.

MSP emerged as a tool for the effective management of maritime activities and the sustainable use of marine and coastal resources. It is called upon to strike a balance between growth prospects and protection of the environment (Cocossis & Beriatos, 2016). MSP has similarities with but also reasonable differences from spatial planning on land (Wassenhoven, 2017). Planning should consider the multiple dimensions of the marine space (surface of the sea, water column, seabed, subsoil) and time, taking into account the migrations of species, oceanographic phenomena, periodic activities, etc.

In Greece, the process of shaping a spatial management framework has resulted in a scientific debate. This has led to a focus on parameters such as the incorporation of Blue Growth policy guidelines (Kyvelou, 2016; Kyvelou & Ierapetritis, 2019), as well as the social and economic dimensions (Niavis et al., 2016), landscape management (Tsilimigkas et al., 2018), and the spatial management of activities such as Renewable Energy Sources (RES) (Vagiona & Karanikolas, 2012; Vasileiou et al. 2017).

Both the relevant policy documents and the scientific literature highlight the need to preserve the biodiversity and adopt an ecosystem approach (Douvere & Ehler, 2010; Langlet & Rayfuse 2018) in an era of increased sensitivity to the environmental consequences of socio-economic development (e.g. Vintar-Mally, 2020). This is recognised as the key framework for action to implement the UN Convention (1992) on Biological Diversity (CBD, 2002; Wassenhoven, 2017: pp. 156-158). The adoption of the 12 interlinked ecosystem principles offers a holistic perspective in an attempt to combine environmental and socio-economic objectives and ensure cross-sectoral planning at various levels (Zervaki, A. 2019), an approach which lags behind in Greece (Asprogerakas & Zachari, 2020).

2.2. The European experience in the development of floating wind parks.

The world’s first floating wind turbine, the Hywind Demo, was installed in the North Sea in 2009, in the Stavanger region of Norway, 10 km. from the coast, at a depth of 220 metres (Cox, 2010). The project was based on extended experience in the field of offshore oil and gas extraction. In 2017, the Hywind Scotland floating wind farm (FWF) was launched, becoming the first of its kind in the world, followed by another one launched in July 2020, 20 km. from the Viana do Castelo coast, in northern Portugal (HWEA, 2021). Since then, several countries have expressed an interest in the development of FWF (Díaz & Soares, 2020b).

The general development of offshore wind farms in European countries can be distinguished according to two main models. In the centralised model (with Belgium as a typical example), the government selects the zones where the farms will be located, the specific areas and how long the creation of the wind farm will take, based on Renewable Energy Sources spatial planning and Maritime Spatial Plans, for both territorial waters and the Exclusive Economic Zone. It then grants the relevant rights to private operators following a competitive tender, where the operator who offers the lowest price is selected. The connection with the Electricity Transmission System is also the responsibility of the Manager of the Transmission Network, for both its marine and land sections (HWEA, 2021).

In the decentralised model (with the United Kingdom being a typical example), the government regulates the creation of wind farms through maritime spatial plans and environmental law and selects the investors who will be given a right of preference to develop wind farms in wider marine areas. The competition procedure consists mainly of criteria related to the economic and technical capacity of the investor and consultations, and there are usually negotiations. The design, technical studies, fixing of the location of the installation and the licenses, the connection and consultation with the local community are the responsibility of the investor. Some countries adopt an intermediate model (France, Denmark, the Netherlands), which combines elements of the above two (HWEA, 2021).

The Marine and Coastal Access Act 2009 (UK, 2009) established the legal basis and the UK Marine Policy Statement (UK, 2011) and it provides the policy framework for marine planning in the UK. Marine plans have to consider the objectives for the marine environment that are identified in the Marine Policy Statement (MPS). The marine plan authority for the Scottish offshore region is the Scottish Minister. In 2011, Scotland adopted the first Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2011). In 2020 Offshore wind policy statement set out the context for Scotland's Sectoral Marine Plan for Offshore Wind, which was published in parallel (Scottish Government, 2020). The plan aims to provide options for the sustainable development of commercial-scale offshore wind energy.

The Hywind Scotland wind farm is located approximately 29 kilometres from the coast of Aberdeenshire, at Peterhead, and covers a total area of four square kilometres in an area with a water depth of 95-120 metres. The farm has five turbines with a total power of 30MW (Hill, 2018). The project was comprised of sections within the 12 nautical miles of the country's territorial waters and sections that lie beyond them, for which a different licensing procedure was required (UK, 2010). The project was granted a marine license that has a duration of 20 years or it will cease to be valid if the project is decommissioned at an earlier time based on an approved related plan (UK, 2009). Planning permission was also required for those parts of the project installed on land (Hywind, 2015b) with Aberdeenshire Council as the responsible authority.

Prior to the Environmental Impact Assessment (EIA) and the submission of the environmental study required for a marine license to be issued, the scope of the EIA was defined, as foreseen in the relevant Community Directive. The EIA analysed a series of environmental aspects of the floating wind farm, as regards the possibility that its operation may have a detrimental impact on particular ecosystems (Hywind, 2015b), as well as on the air force (and the impact of the floating wind park on radar systems), commercial fishing activities, shipping (short sea and deep sea) and underwater antiquities. Furthermore, the possible conflict with other uses of the marine area, in particular offshore oil and gas extraction and the installation of existing undersea cables was considered.

2.3 Spatial planning and the earliest efforts to create wind farms in Greece.

The main spatial planning laws in Greece have been revised several times in the last decade to be more flexible and responsive as, in the face of the preceding economic crisis, spatial planning was considered as having created obstacles to private investment. The current framework provides two levels of planning (figure 1): (a) Strategic Spatial Planning is based on the analysis of data and anticipation of future developments, it has mainly a strategic character and includes medium-term or long-term objectives, guidelines for spatial development and economic activities and protection provisions at national or regional level; (b) Urban Planning is mainly regulatory in character, as regards, for example, the establishment of land uses, the building ratio, etc. The governmental executive power, in the field of spatial planning, is represented mainly by the Ministry of the Environment and Energy.

Although the installation of wind farms in national territorial waters is permitted by the legislation and there are provisions for the location of the infrastructure (L. 3468/2006, GG. 129/A' as modified by L.3851/2010, GG. 85/A'), this activity has progressed little. In 2008, the Special Spatial Framework for Renewable Energy Sources (SSF RES, Ministerial Decree 49828/2008, GG. 2464/B') was established, which foresees the creation of wind parks (article 5, para. 1d) and which sets initial criteria for their location (article 10). The SSF provides guidelines for, inter alia, the spatial structure of certain productive activities of national importance and must take the National Spatial Strategy into consideration.

The SSF for RES was established also for legal reasons accruing from the country's commitments to the European Union's legal order. Indeed, as it is apparent from the preamble to its approval decision, the increase in the percentage of energy used produced by RES, in accordance with a specific and mandatory timetable, is necessary so the country can comply with secondary Community legislation (EP, 2001; EC, 2007) and international environmental law (Kyoto Protocol) (UN, 1997). It is, nonetheless, accepted in the text of the SSF itself that however environmentally friendly the installation and operation of the RES units may be, these units continue to have an impact on both the manmade and built environment (cities, residential areas, etc.), and on other human activities (tourism, agriculture, etc.), as well as on the natural environment (forests and wooded areas, fauna, etc.). Their regulation must therefore be a key concern of the planning administration in the preparation of the SSF.

The objectives set by the SSF RES cover both the sustainability of the facilities and their goal to achieve economies of scale in the required networks as well as their harmonious integration into the natural and manmade environment and the landscape. For the siting of wind farms, the national territory is divided into categories according to the potential use of wind power and its particular spatial and environmental characteristics, one of which is the "offshore marine area and uninhabited islets". The mainland is further divided into (a) Wind Power Priority Areas, which have comparative advantages for the installation of wind farms; (b) Wind Power Suitability Areas, which are not included in the Wind Power Priority Areas but are considered energy efficient areas. Wind power installations must be located within the minimum distances from adjacent land uses, activities, and technical infrastructure networks. In Greece, the installation of wind turbines on land has led to significant opposition while the sensitivity of island ecosystems means that selecting them as the sites of wind farms is problematic.

In 2011, the Ministry of Environment and Energy presented a report on the preliminary location of offshore wind farms, thus laying the foundations for the launch of this project (CRES, 2010), within a timeframe for horizontal development of 2012-2017, yet without the planned strategic environmental assessment process having been completed (it was foreseen that turbines would be installed at 12 sites, 10 in the Aegean and 2 in the Ionian, for a total capacity of 1.2 GW) This should have been followed by the granting of licenses for the installation of the approved marine wind farms and the announcement of an open public tender for the construction of the farms and their connection to the network by private investors.

This effort is an initiative of the Ministry of Environment and Energy. It is centralised and thus prohibits direct action by private actors at a first stage. The choices made during the design of the programme (location at a shallow depth, exclusively fixed-bottom technology) reflect the data that was available at the time when the Special Spatial Framework was being prepared and is now considered out of date. The technology of floating wind turbines is expected to significantly expand the possibilities for the use of wind power in the Greek seas and more widely in the Mediterranean, where the installation of fixed-bottom offshore wind farms has limited potential due to the complex topography of the seabed, the acute relief, and the difficulty in finding areas of suitable depth (<50m) (Zountouridou et al., 2015). There are relevant proposals considering the allocation of floating wind farms based on a decentralised model in Greece (Melissas, 2021; Melissas and Vasilakos, 2021).

The role of Maritime Spatial Planning is expected to be crucial following the incorporation of EU Directive 2014/89 into Greek law (L. 4546/18, GG. 101/A'). The current planning system for the maritime area includes: (a) the National Spatial Strategy for Maritime Areas, a policy document that is part of the National Spatial Strategy; and (b) the maritime spatial frameworks, which are applicable on a regional level and are integrated into the country's planning system, without, however, them necessarily corresponding to the Administrative Regions. Recently, Maritime Spatial Planning has been detached from spatial planning that covers the terrestrial part of coastal zone, with a view to avoiding overlaps (L. 4759/2020, GG. 245/A'), although it must consider the land – sea interaction and coordinate the various policies that have impact on the sea. The law does not provide specific implementation tools or an underlying planning level (Asprogerakas et al., 2020). As regards the tools and the implementation of Maritime Spatial Planning, proposals have been made (Asprogerakas & Lazoglou, 2018) for, indicatively, protection zones, the process for approving environmental terms (L.4014/11, GG. 209/A'), and the plans for the Organized Development in Productive Activities Areas (ODPAA, namely POAPD, L.2742/99, GG. 207/A' Art.10).

Although maritime spatial plans have not yet been issued in the country, specific spatial plans directly related to maritime activities have been established, such as those for Renewable Energy Sources and for Aquaculture, which are considered of great importance as a "qualifier" for future maritime spatial planning (Wassenhoven, 2017). The case of aquaculture is of particular interest as it is a maritime activity that is regulated by a Special Spatial Framework on a national level (Hellenic Council of the State (HCS), Decision 3632/2015), which is methodologically related at many points to examples of maritime spatial planning, such as the provision of zones or areas within which specific arrangements and restrictions apply (Wassenhoven, 2017: p. 280). For the location of aquaculture activity, the law provides for the creation of reception zones on two levels: (a) Aquaculture Development Areas (ADA) are broad marine areas which fulfill specific characteristics for the development of aquaculture; and (b) organised reception areas (Organised Aquaculture Development Areas), which are a kind of ODPAA, determine the area with topographic accuracy and provide the specific regulations for the development of the related marine and on-shore infrastructure by a management legal entity.

2.4 Greek case law (Council of the State decisions) on the planning of marine and coastal areas.

According to the Greek constitution (the provisions of articles 24 para. 1 and 2, article 79 para. 8 and article 106 para. 1) spatial planning, which is the spatial expression of programmes aimed at economic and social development, is the responsibility of the State, which is obliged, in accordance with the principles and findings of the science of spatial planning, to take the necessary measures so as to ensure the protection of the environment, the best possible living conditions for the population and economic development in accordance with the principle of sustainability, also setting objectives and regulating, inter alia, the areas of productive activity (HCS 3632/2015).

The case law had initially accepted that it was not necessary for spatial planning to have preceded for a major project to be undertaken (HCS 3478/2000). At a subsequent stage, it was considered possible to undertake projects and activities if they were at least based on a substitute for planning (HCS, 2844/1993). In a third phase, given the lengthy passage of time since the adoption of the Constitution, the Hellenic Council of the State (the Supreme Administrative Court) cancelled projects and activities if these were not provided for in the necessary spatial plan (HCS 705/2006).

The case law addressed issues concerning the protection of coastal and marine areas, the most notable cases being those related to the Special Spatial Frameworks for aquaculture and RES. All the special frameworks were challenged and applications made for them to be annulled as, in the initial judgments, the Court held that they were of a regulatory nature and cannot thus be annulled given that they have direct legal consequences.

The general guidelines and specific arrangements of the Special Spatial Framework (delineation of exclusion areas and incompatibility zones, maximum permitted densities of wind farms, rules for integration into the landscape, etc.), which must be taken into account when adopting environmental terms and granting the necessary licenses for the installation and operation of wind farms, have full regulatory power and projects that do not meet the criteria foreseen in the plan will not be authorised. It is also clear from the same provisions that, while compliance with the aforementioned criteria and terms means that it is permissible in principle to install the planned power plant, it is necessary, however, to comply with the necessary legal procedure for environmental authorisation. In this context, it will be assessed whether the terms specified in the environmental legislation for the installation of the project in question in the pre-selected area are met and the conditions that are necessary, in the view of the management, to prevent and limit the adverse effects of the activity on the environment will be imposed in the assessment of the specific characteristics of the project and its area of establishment (HCS 2489/2006). Indeed, following the entry into force of the sectoral spatial plan in question, the case law accepted that the relevant regulation in the Special Spatial Framework, which applies directly and exclusively, is sufficient for the location of a wind farm if regional and other forms of local spatial planning have not yet been adapted to the sectoral planning forecasts and may thus contain divergent forecasts (HCS 1421-2/2014).

The marine parks of the northern Sporades islands and Laganas Bay in Zakynthos, which are defined as areas for the protection of nature, presented a special form of maritime spatial planning. The case law highlighted the need for the gentle management of these sensitive ecosystems, with respect for their ecological carrying capacity and physiognomy (HCS 2601/2005). According to the case law established by the Council of State, the installation of wind power plants for electricity production within or near areas of the Natura 2000 network and Special Protection Areas (SPAs) is not prohibited a priori by the Greek legislative framework and the European Directives. It is possible after an “appropriate assessment” of the environmental impact of the project. It is worth mentioned that a significant proportion of the Natura 2000 Sites in the Mediterranean are still without any form of planning and management, making them potentially vulnerable to numerous threats (Fuentes et al, 2011).

As regards the Important Bird Areas (IBAs), the Council has interpreted the international case law [CJ, 2000; 2007) as meaning that these are protected more stringently than areas that are classified as Special Protection Areas, as there is no possibility of derogating from the negative results of the Appropriate Assessment of the impact of the project for the sake of overriding reasons of significant public interest, as foreseen in article 6 para. 4 of Directive 92/43. Particular care is needed if the wind farm under approval is to be located in the area of an important migratory bird flyway or in a marine area that is important for birds, or in an IBA that has not yet been classified as an SPA.

3. DISCUSSION: FORMULATION OF A MODEL FOR THE SITING OF THE ACTIVITY IN GREECE

3.1 Criteria for the location of offshore wind farms

The concept of location criteria contains specifications and rules, on the basis of which: (a) certain areas may be exempted as sites for the location of a particular activity; (b) the minimum distances from other activities and areas of particular interest may be defined; and (c) maximum permissible wind plant densities may be set (assessment of the carrying capacity of the areas of installation). Depending on the priorities adopted, the criteria may also consider the conditions that will ensure the economic viability of the investment (wind speed, installation costs, etc.).

Based on the above, the criteria for the locations of wind farms are divided into:

(a) Exclusion criteria. Areas that are not suitable for locating this activity, due to:

- Conflict/incompatibility with manmade activities, e.g., areas with a national security interest
- Environmental impacts, e.g. against important protected habitats.

(b) Suitability criteria: areas with characteristics that are conducive to the installation and operation of wind farms and in which the relevant investments can be prioritised, e.g., areas with significant wind power or where it is possible to develop suitable onshore support infrastructures.

This study considers the greatest possible mitigation of any potential pressures on the natural and manmade environment as the overriding priority for the public interest. It thus focuses on possible exclusion criteria as a key element in the profiling of areas to be explored for the location of floating wind farms installations. For this reason, an attempt will be made to identify exclusion areas and zones of incompatibility, as well as possible restrictions or procedures resulting from: (a) spatial planning, (b) national case law, and (c) uses and activities in the sea that may result in conflicts/restrictions as these arise from relevant studies and data as well as current experience.

The Special Spatial Framework for RES considers an exceptional regime for the marine area, including rocky islets. According to Article 10, “wind farms may be placed in all the marine areas of the country that fulfill the preconditions for the use of wind power, provided that they are not part of areas where such facilities are expressly excluded or are not part of an exclusion zone, such as marine or underwater parks or certified shipping navigation lines,” in this way defining the special zoning criteria (Table 1).

In assessing the impact of a licensed wind farm on the landscape, account shall be taken of its visual interference from points of “special interest”, which are located within a circle that is defined with the wind farm at its centre and a radius that is differentiated according to the importance and quality of the point of “special interest” and the classification of the space to which it belongs.

Distance criteria for settlements (traditional settlements, other settlements, organised construction, holiday homes, monasteries), productive activities (high-productivity agricultural land, reclamation zones, livestock farms, quarrying areas and activities, Organised Development in Productive Activities Areas) and special tourism activities (tourism ports, tourist accommodation and special tourism infrastructure) are effectively covered by the criterion of distance from the coast (1500 m.). In the case of aquaculture, the safety distance is determined in relation to the size of the wind turbine (1.5d), while there are also restrictions for quarrying areas and activities to the extent that they concern marine planning. Finally, in relation to the desired distance from aviation facilities or activities, the opinion of the relevant agency shall be sought on a case-by-case basis.

In accordance with the SSF RES, the depth of the foundations or anchorage of the base of the turbine is determined by the capabilities of the current technology. It is also noted that the adequate interconnection and transmission of the electricity generated must be ensured either with the mainland system or with the network of non-interconnected islands, while the maximum distance of the land route from an interconnection substation is 20 km. (this is a suitability criterion).

Table 1. Restrictions resulting from Spatial Planning (SSF RES)**

Incompatible use	Minimum distance of installation from incompatible use
Areas of strict nature protection and protection of nature in article 19 para. 1, 2 Law 1650/86 (A′160)	According to the approved Special Environmental Study or the relevant presidential decree (of article 21, Law 1650/86) or the relevant joint ministerial decision (Law 3044/02)
- RAMSAR wetlands - Priority habitats of areas of the country that have been included in the list of sites of Community importance of the Natura 2000 network, in accordance with Commission Decision 2006/613/EC (EU L 259 of 21.9.2006, p. 1).	Assessed case-by-case during the approval of environmental terms
Bathing coasts	1500 m
Special Protection Areas for bird fauna	Assessed case-by-case during the approval of environmental terms, after a special ornithological study
World Heritage List monuments, archaeological sites and heritage sites of major importance (para. 5. Section ββ of Article 50, Law 3028/02).	3,000 m
Areas of strict protection of other archaeological sites	A=7d*, at least 500 m
Designated cultural monuments and historical sites	A=7d*, at least 500 m.
Telecommunications infrastructure (antennae), RADAR	Case-by-case after an opinion from the relevant agency.
Aviation facilities or activities	Case-by-case after an opinion from the relevant agency.
Aquaculture	Safety distance 1.5d*
Quarrying area and activities	As defined in the applicable legislation.
* where [d] is the diameter of the blade of the wind turbine. ** selection of the criteria related to the installation of offshore wind farms	

Source: SSF RES, 2008; author's own processing

The initial selection of the distance of 1.5 km. from the coastline under the Ministry of the Environment's National Offshore Wind Farm Development Programme (CRES, 2015) was not considered satisfactory for the protection of the landscape when assessing the environmental impact at a strategic level and was hence extended to 3 km. In some cases, if deemed necessary due to the size of the park and when technically feasible, it was proposed that the facilities be moved further away from the coast.

A number of other activities should be added to the provisions of the SSF RES, which appear in the relevant literature (Christoforaki & Tsoutsos, 2017; Castro-Santos, Lamas-Galdo & Filgueira-Vizoso, 2020; Vagiona & Karanikolas, 2012; Vasileiou, Loukogeorgaki & Vagiona, 2017; Deveci et al., 2020) and are also examined in connection with the Ministry of the Environment programme (CRES, 2015):

- Activities of public interest (national defense, navigation): it is proper to consider and in good time the opinion of the relevant authority/service. As a general practice, installation in areas reserved for national defense purposes and certified passenger navigation lines is prohibited. During the consultation process of the Ministry of the Environment programme (CRES, 2010) prohibitions were proposed on the areas of application in response to the opinions of the National Defense General Staff, due to the potential serious obstruction to the army's systems and activities. Appropriate measures may be taken during the Approval of Environmental Terms.
- Fishing areas. In addition to aquaculture areas, the existence of fishing fields shall be considered.
- Underwater antiquities. The opinion of the Ephorate of Underwater Antiquities may be sought, as its core responsibilities include the regulation of marine and underwater activities that may cause direct or indirect damage to antiquities (L. 3028/2002, GG. 153/A' Art. 15). For their protection, it is prohibited to locate a Diving Park within a distance of less than three (3) nautical miles from designated underwater archaeological sites (L. 4296/2014, GG. 142/A' Art. 10).
- Underwater cable and pipeline transit routes. Wind farms should be located away from the paths of the routed cables. The intrusion into the seabed of the floating parks is limited, but possible impacts and risks should be considered, and any necessary measures provided for.
- Protected areas. The SSF RES includes provisions for protected areas of nature and biodiversity as these arise from international agreements (e.g., the Ramsar Convention on Wetlands, NATURA 2000 Network, etc.) and national law (marine or underwater parks). As it has already been mentioned, according to the case law, Important Bird Areas (IBAs) must be considered. Particular emphasis should also be placed on the impact of the project on *Posidonia Oceanica*. It should be noted that the mapping done in Greece shows that it is present in coastal areas and at depths that are usually less than 45 m. deep (EP, 2007). As happened in practice during the design of the Ministry of Environment's programme, the installation of wind turbines at least 6 km. from the coast is a very important preventive measure for the protection of sensitive habitats (CRES, 2015).

The presence of wind turbines of all types appears to pose particular risks and barriers for the bird fauna (AVRA, 2015). A report by the HWEA (2009) discusses studies at European level, which show that wind turbines and birds can coexist. The assessment of possible impacts is also possible during the Environmental Impact Assessment (EIA), which will include a Special Ornithological Study.

The facilities (floating bases, anchorages, connecting cables) and the operation of wind farms may disturb and affect the behavior or migration routes of marine mammals and other species (AVRA, 2015). The assessment of potential impacts can be carried out with relevant EIAs both during the construction phase and during the operation phase of the wind farms.

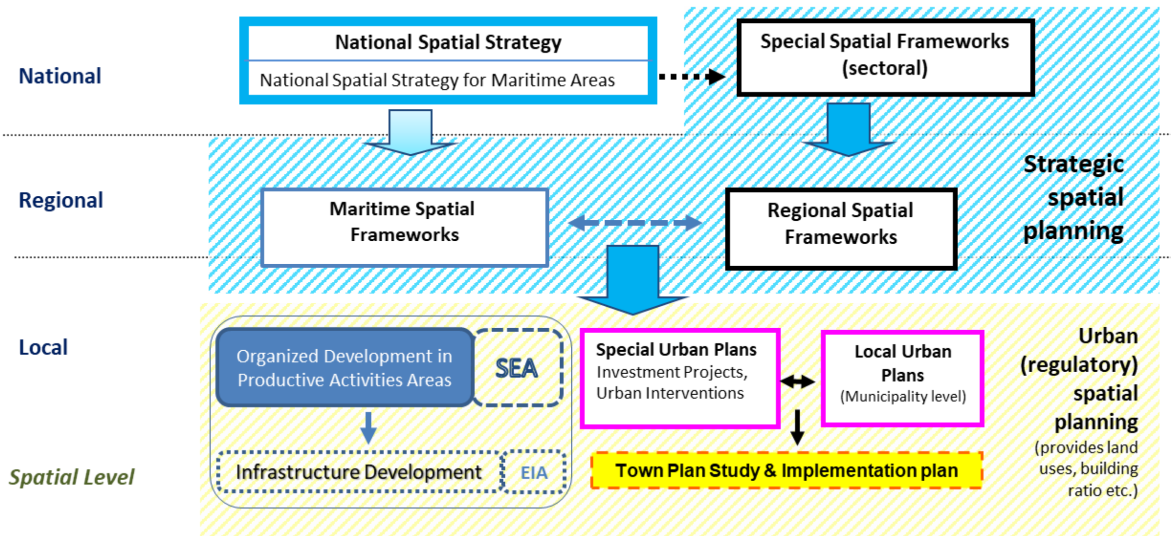
As for the maximum distance from the coast, because of the geopolitical sensitivity of the issue and as Greece has not declared Exclusive Economic Zone yet, it is proposed that the installations be initially limited to the national territorial waters. The country's territorial waters are used as a location criterion for the installation of offshore wind turbines in several relevant studies (Schallenberg-Rodríguez & Montesdeoca, 2018; Chaouachi et al., 2017; Spyridonidou et al., 2020).

3.2 In search for an effective location process

The siting of offshore wind farms (fixed-bottom or floating) requires support from spatial planning and the broader institutional framework. Current spatial planning in Greece, which primarily regulates the location of fixed-bottom wind farms on land and sea, is outdated, especially as regards the use of new floating wind farm technology. There is an urgent need to update spatial planning for Renewable Energy Sources in Greece. A study was commissioned to this purpose in 2020, which is expected to be completed in two to three years time. The maritime spatial frameworks, which will be adopted at regional level, may therefore make the relevant guidelines more specific. In Greece there is no provision for a Maritime Spatial Planning tool that covers this activity (e.g., a Special Maritime Spatial Plan for RES in line with the Scottish model). The updating of the spatial framework is expected to secure both the public interest and legal certainty for prospective investors and to ensure the necessary environmental parameters on a strategic level.

The plans for Organized Development in Productive Activities Areas (ODPAA, article 24, l.1650/1986) (Asprogerakas & Lazoglou, 2018) accompanied by a Strategic Environmental Assessment (SEA, Directive 2001/42/EC) emerge as a suitable tool for the regulation of the activity on local level. The ODPAAs are tools of the spatial planning system and they cover statutory activities in the marine area. The Aquaculture Development Areas as well as the Areas for Organized Development of Diving Parks (L.3409/2005, GG. 273/A') are also established in this sense while ODPAAs have also been used for activities in the tertiary sector. Using this tool, offshore wind farms are located in areas that have been designated by an administrative action as suitable for the development of the related infrastructure, as regards both the need to develop this particular activity and the need to protect the environment (Hellenic Council of the State 517/2017). The integration of maritime projects in the current system of spatial planning facilities the cohesion of the whole system (figure 1) (Oikonomou, 2018). The usability of the tool depends on the content of the spatial planning at national and regional level as it will gradually emerge.

Figure 1: The tools for siting floating wind farms as part of the spatial planning system in Greece.



Source: elaboration by the author.

A private or public managing body takes the initiative for the establishment of ODPAAs with an application to the Ministry of the Environment and Energy. This must satisfy the necessary economic and technical conditions, as well as the necessary organisational structure and expertise for the establishment and operation of such a development. The designation of the status of ODPPAA and the selection of its area must follow the options and guidelines of the spatial planning or other related plan that permits the primary, secondary and tertiary sector activities foreseen by the ODPPAA as well as business initiatives of an experimental nature (L.1650/1986 GG. 160/A' Art.24).

According to Article 8 of Law 4269/14, Organized Development in Productive Activities Areas are a form of Special Urban Planning (SUP), making them a type of spatial planning with a regulatory character that is hierarchically integrated into the local planning level. SUP concern, inter alia, the spatial organisation and development of areas which may act as receptors for plans, projects and programmes on a trans-local scale or of strategic importance. They determine land use and every other measure, term or restriction that is needed to make the areas in question suitable either for the organised development of productive or entrepreneurial activity or to implement programmes and interventions on a large scale or of strategic importance. The development of the facilities requires that the environmental conditions prevent and limit the activity’s adverse effects on the environment be satisfied in the framework of Environmental Impact Assessment (EIA).

4. CONCLUSIONS

The development of floating wind farms is seen as a promising maritime activity that can help meet policy objectives for the promotion of RES by significantly expanding the spatial possibilities for the installation of wind turbines. Their development in the Mediterranean Sea will allow the utilisation of wind potential in greater depth as well as installation of the relevant infrastructure far from the shore and inhabited areas and therefore reduction of nuisances.

The recent, albeit limited, experience with the location of such facilities highlights the need for a clear institutional framework that covers the procedures and the plethora of approvals required for the construction and operation of such projects and which will make the best use of European and national environmental law. Maritime spatial planning determines the distribution of current and future activities and uses in maritime areas and will also form the future framework for the development of the activity.

The experience of northern European countries has shown the scope that these procedures can have, according to their particular features as regards the institutional framework and national objectives. Given that the overarching priority is the greatest possible mitigation of potential pressures on the natural and manmade environment within an ecosystems approach, it is apparent that exclusion criteria are the main aspect in the profiling of the areas to be explored for the location of RES facilities. Localising the context on national level, the possible criteria for the implementation of the location process were identified in accordance with the existing spatial planning and the established case law of the country.

The initial attempt of the Ministry for the Environment of Energy to create a top-down (centralised) model for the location and development of offshore wind farms was not completed. In Greece there are often delays in the planning process, something that has been noted from time to time and which has resulted in the introduction of controversial flexible investment location tools in the country’s planning system. The Spatial Strategy foreseen in the law, and the Spatial Plans at National (SSF RES) and Regional (Maritime Spatial Frameworks) level will shape the framework for the development of the floating wind farms including the adoption of specific location criteria.

The plan for ODPAA can be an option for the implementation of Maritime Spatial Planning on local level, partially filling the current institutional gap. It emerges as a suitable tool for locating FWF facilities within the current institutional framework, achieving:

- The application of the exclusion criteria for the location of offshore wind farms, considering the public interest.
- Fulfillment of EU two levels of environmental assessment (SEA and EIA).
- A framework that provides legal certainty and according to the law may facilitate both public and private sector initiatives for the promotion of offshore wind farms.

Moreover, it ensures that offshore energy industry is organised in such a way as to reduce and absorb the environmental pressures as far as possible, making it compliant with the principles of sustainability and carrying capacity, given its dual status as a sector of productive activity and as an infrastructure of national importance and public benefit that is of major importance for the protection of the environment (Hellenic Council of the State 1306/2019).

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