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MARINEWIND

Market Uptake Measures of Floating Offshore Wind Technology Systems (FOWTs)

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D2.1: Analysis of social and environmental barriers and enablers

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EXECUTIVE SUMMARY

Deliverable D2.1 Analysis of Social and Environmental Barriers and Enablers will be produced within the objective of Task 2.2 Elaboration of results of social and environmental analysis, with the previous Task 2.1 Analysis of Social and Environmental Barriers and Enablers and its subtasks 2.1.1 Analysis of Social Barriers and Enablers, 2.1.2 Analysis of Environmental Barriers and 2.1.3 Identification of Conflict Management Solutions of Work Package 2 related to the socio-economic and environmental part of the MARINEWIND project.

The aim of this deliverable is to collect existing information, both from the literature and from real-life testimonies (through laboratories, interviews, and surveys) and to identify these socio-economic and environmental barriers and enablers.

This information will be used to identify barriers and enablers to the deployment of floating offshore wind while taking inspiration from lessons learnt in contexts such as fixed offshore wind technology and other renewable energy sources. In doing so, we will be able to identify the enablers which support successful deployment, drawing on the experience of existing FOW (Floating Offshore Wind) farms.

1 INTRODUCTION

1.1 Aims and objectives

Floating offshore wind is considered as an essential technology for achieving renewable energy targets worldwide. This is particularly important in countries where bottom-fixed offshore wind cannot be developed due to f the depths of the nearby coast, such as Spain, Portugal, Italy, or Greece.

At the moment, there are only a few operational pre-commercial floating wind farms worldwide, pilot or demonstration projects. With a limited number of operational projects to learn from, the industry faces challenges in identifying best practices, optimising designs, and standardising components, especially in the UK and Portugal.

Since floating offshore wind technology is relatively less mature than the bottom fixed counterpart, operational experience, and historical data to assess performance, reliability, and long-term viability are significantly limited. The poor track record on floating wind farms, a limited supply chain, lack of standardisation, and platform solutions which are not yet scalable can lead to higher costs and perceived higher risks for developers and investors. As a result, the industry is still reluctant to develop components (e.g., the turbines) specifically designed for floating installation. This trend is already leading to technical issues as well as loss of performance. As the technology matures and more projects are deployed, learning curves will be achieved, and costs will decrease. Therefore, there is a need for further research, development, and demonstration projects to prove the technology and build investor confidence.

Floating offshore wind technology allows for more energy potential in those areas, far away from the coasts, with other possible conflicts or enablers from the social and environmental perspectives. The document will provide a comprehensive analysis of the impact of the offshore technology.

1.2 Methodology

This document details the social and environmental barriers and facilitators identified in different geographical areas. To this end, a wide range of sources were analysed:

- Bibliographic review of more than 130 socio-economic articles (e.g., real state, tourism, fisheries, MGMT strategies, visual impact, cultural heritage, shipping, aquaculture, etc.) and 50 environmental articles (e.g., noise, birds, etc.)
- Interviews conducted in Spain, Greece, and Portugal with representatives of the main stakeholders identified (academia, developers, fishermen, environmentalists and grid connection representatives, tourism representatives). The purpose of carrying out interviews was to gather detailed information from various stakeholders on the current situation of their specific sectors and activity areas, as well as their expected interaction and perspectives on the deployment of offshore wind energy, to learn more about those geographies where offshore wind has already been deployed.

- National co-creation Labs were held in the different countries of the consortium, which generated interesting reflections that led to relevant debates, involving representatives from the 5 helix-stakeholders:
    - Industry: FOWT installation developers, engineering companies, fisheries, local traders, etc.
    - Civil Society: civil society organisations, renewable organisations, etc.
    - Academia: scientific community and public/private research organisations
    - Public Authorities: national, autonomic, and local government
    - Green Innovation: ecologists, environmental organisations, and green cooperatives
- Internal questionnaire for MARINEWIND partners was used as a basis, built on the experiences and specificities of each country and/or area. The purpose of the questionnaire was to investigate the positions of the local socio-economic sectors and actors regarding FOWT deployment and their arguments, against or supporting to FOWT, both at national level and regional level (if there is difference depending on the FOWT implementation area), to understand the specific background and experience in each country, regarding the deployment of FOWT (if there is any experience) and other renewable technologies (e.g., bottom fixed offshore wind, PV, onshore wind, etc.), trying to identify best practices and lessons learned. Since not all the countries have FOWT operational sites, the analysis took into consideration additional parallelism and comparisons with other renewable technologies.

The analysis presented in the document focuses on areas where offshore wind projects are already underway (such us UK or Portugal), as well as those where other applicable forms of energy are being explored (Spain, Greece, Italy).

The fundamental purpose of this study is to shed light on the challenges and opportunities which are specific to these locations.

2 SOCIAL FACTORS AFFECTING FOWTS

Reaching social acceptance has turned out to be one of the main challenges that governments are facing to boost energy transition. The deployment of floating offshore wind has not been an exception. Many commercial floating offshore wind farms which are currently under development are dealing with local concerns, occasionally turning into opposition. A deep understanding and characterisation of the socio-economic environment of the deployment area seems to be the base for an accurate approach to cope with instances coming from local stakeholders. However, the previous knowledge on socio-economical barriers and enablers affecting the floating offshore wind would ease the alignment of the local stakeholder engagement strategy with the best practices and strategies for managing potential conflicts.

The introduction of offshore wind energy sources faces socio-economic barriers primarily because this technology is novel and unfamiliar in the country. The unfamiliarity with this form of renewable energy generates resistance to change and prompts questions about potential impacts on the local environment and socio-economic activities, such as fishing activities, and tourism.

As a summary of the issues discussed in detail below, a list of barriers and enablers identified in relation to social factors is shown below:

BARRIERS	ENABLERS
• Negative impact on tourism industry • Real estate value reduction • Fisheries incomes reduction • Loss of employment for fisheries • Fisheries cost increase • Gear conflict • Recreation boating or sport activities limited or affected • Agriculture incomes reduction • Cultural heritage	• Positive gross added value • New activities related to tourism or recreational boating • New activities related to Research and Development of marine energies or environmental aspects monitoring. • Employment generation • Development of the supply chain • Specialised training and education related to FOWT. • Compatibility of uses. • Development of communication platforms • Lower electricity rate

Table 1 Summary of barriers and enablers of FOWT

2.1 Community acceptance and perceptions

The expansion of floating offshore wind farms has generated debates on their environmental and social impact. The diversity of opinions reflects the need to understand acceptance and perception in various geographical and cultural contexts.

Existing literature [6] highlights several factors which influence the acceptance of floating offshore wind. These include transparent communication from the early stages, consistency in the information provided, and real engagement with local communities and concerned parties. A thorough understanding of social dynamics and early expectation management also emerge as key elements.

Previous experiences have revealed that success in social acceptance is directly linked to the credibility of projects, administration and companies involved. However, acceptance of each project must also be evaluated according to its specific characteristics and its implications in the region.

Active participation of communities, equitable distribution of economic benefits and local contracting are practices that have proven to improve the image of wind projects. Within this context, companies in the sector have implemented innovative initiatives to improve social acceptance. These include citizen participation workshops, early engagement strategies, and efforts to demonstrate the connection between projects and the well-being of surrounding communities. However, some sectors need feedback and project management to understand which the implications of offshore wind farms will be. Transparency, consistency, and community engagement are essential pillars to ensure the success and sustainability of these projects in different geographical and cultural contexts.

There is currently a public prejudice about the perception that the development of floating offshore wind projects is promoted by foreign entities and/or outsiders without considering the impact on the local community but with a focus on economic profit.

2.2 Fisheries

The expected expansion of the offshore wind sector on a global scale could intensify conflicts with fishing activities, as coastal users compete for space, being also the potential displacement of fisheries a particular cause for concern. It is therefore crucial to investigate the potential for co-existence between offshore wind farms and fisheries. In addition to ecological evidence on the effects of offshore wind farms on commercially exploited species, addressing the issue of co-existence includes the need to understand the perceptions of both fishermen and offshore wind farm developers on key constraints and opportunities.

Proposals have been put forward suggesting that the proximity of wind farms and fishing grounds could be beneficial. However, fisheries have expressed reluctancy, arguing a wide variety of drawbacks related to potential risks and particularities of each project, fishing gear, and so on. The lack of experience of fishing within OWFs is not necessarily related to concerns about stocks, but rather to uncertainty on issues such as safety, gear recovery, insurance, increased costs, and liability.

For this proximity to be viable, it is essential to establish clear protocols and encourage communication to address these issues. The fisheries liaison officer is presented as a key player in improving communication between developers and fishermen. It is defined as a person employed by the developer to inform the fishermen, with the responsibility to gather emerging concerns and challenges and organise meetings (preferably face-to-face) between the two parties. Usually, the liaison is a person known to the fishermen, even if he/she is not involved in fishing. Additionally, having a physical officer is strategically important because many fishermen do not have access to email, do not control online information, or are unwilling or unable to attend meetings, and want someone to represent them whom they can trust. This figure was first used successfully in the UK (Scotland, Fishing Liaison with Offshore Wind and Wet Renewables Group FLOWW) and has been transferred to other countries such as the United States and Ireland. In the case of Block Island, the appointment of a liaison officer was a key factor in the developer's decision to tailor the project to fishermen's needs (ten Brink & Dalton, 2018).

The security of employment, income and social status of fishermen is a significant concern. The current panorama facing the sector is determined by European regulations, but also by the conviction of preserving their source of income. For this reason, there are quotas in terms of prices and kilograms, as well as seasons when it is impossible to fish. There is also an increasing competition from other countries with different economic and working conditions compared to Europe. The combined effect of the aforementioned factors that could potentially disrupt fishing activities poses a threat to the income generated by the industry. In fact, increased competition in offshore areas and buffer zones around turbines may result in less flexibility in fishing activity. In addition, adaptation to new installations could require changes in fishing equipment, reducing the fishing market and potentially changing the economic focus in coastal communities.

Fisheries sector also highlights safety concerns, mainly as an increased risks and fears of accidents due to interactions between fishing vessels, equipment, and wind farm infrastructure, such as entanglement with undersea cables, electromagnetic fields, and the danger of capsizing.

Although challenges exist, the proactive involvement of insurers in co-existence planning is considered crucial. One important aspect is addressing insurance coverage concerns and potential liabilities. Co-location strategies, along with trial periods and continued collaboration between developers and fishermen, are seen as potential solutions to achieve harmonious co-existence between FOWT and the fishing industry. In conclusion, balancing fisheries interests in the context of floating offshore wind projects requires careful considerations, collaboration, and the establishment of effective communication channels to ensure a sustainable and mutually beneficial co-existence.

2.2.1 Mitigation strategies and compensation mechanisms

In the context of offshore wind farms, compensation schemes for fishermen affected by the installation of floating wind turbines are crucial. These schemes aim to address the disruptions caused to fishing activities and mitigate any adverse socio-economic impacts. It is imperative to standardise the definition of compensations and establish guidelines for best practices (Reilly et al., 2015). Instead of solely relying on direct payments, which are short-term solutions, there is a growing emphasis on establishing compensation funds (Reilly et al., 2015). For instance, Vineyard Wind implemented various compensation funds, including fiduciary and innovation funds for fishermen (of Ocean Energy Management & of Renewable Energy Programs, 2020). However, the state-by-state or project-by-project approach has proven unsatisfactory, prompting efforts to develop a consistent, fair, and transparent procedure for defining compensations, as seen in the "Fisheries Mitigation Project" by the "Special Initiative on Offshore Wind" (Hooper et al., 2015).

Compensation mechanisms vary across regions. In Denmark, developers are required to pay compensation for losses to affected fishermen based on data on catches, fishing efforts via vessel geolocation, and interviews with fishermen (Danish Energy Agency, 2018). The final estimates of losses and compensations are determined only after the definition of the precise location of the wind farm and the compensation level is fixed by independent consultants hired by developers, following the scope and methodology agreed upon by the Danish Fishermen's Association. Final agreements, including economic compensations and other measures, must be negotiated, and accepted by all involved fishermen before the project can proceed (Danish Energy Agency, 2018). Moreover, the "Green Fund Scheme" in Denmark mandates developers to pay a certain amount per megawatt to affected municipalities, fostering local investments (Østergaard et al., 2021). In South Korea, there's a discussion on standardising processes for the definition of compensations aimed at garnering local support (Alexander et al., 2013).

Beyond economic compensation, additional measures include the provision of alternative employment opportunities for fishermen (Braga, 2020, European MSP Platform. European Commission, 2021b). For instance, in Ireland, priority in maintenance jobs is given to affected fishermen, or they are encouraged to establish cooperative businesses, such as fuel supply ventures for developers (Reilly et al., 2015). Some projects in the US prioritise hiring local fishermen for their activities, like Fishermen's Energy Inc. (Haggett et al., 2020).

Other compensation measures include supporting fishermen in adapting their vessels for different tasks such as the equipment surveillance or helping in the construction and installation phases (Alexander et al., 2013). On the other hand, developers could contribute to sustainable fishing practices by establishing sanctuaries within wind farm zones or supporting fishing activities within designated areas (Reilly et al., 2015). Developers can also assist fishermen by providing discounted traditional or alternative fuels, aligning with the decarbonisation goals of the European fisheries sector. Lastly, revenue generated from wind farms could fund monitoring initiatives to ensure sustainable fishing practices (Hall & Lazarus, 2015). In summary, compensation schemes for fishermen impacted by offshore wind farms should encompass a range of measures beyond direct economic payments, aiming to support local communities and foster sustainable fishing practices.

2.3 Tourism

Maritime and coastal tourism is an important economic sector for many countries, especially in tropical and subtropical zones such as the Mediterranean, generating millions of jobs and contributing significantly to the local economy of coastal areas, as tourists are attracted to certain coasts for their landscape and the experiences offered, whether in terms of scenery, informal activities, or sports. The same is true for coastal residents, who also appreciate certain coastal landscapes, experiences or activities. These landscape activities and experiences may conflict with offshore wind farms that are being developed in many countries and are rapidly increasing in size (European MSP Platform, European Commission, 2021a).

As detailed in the European Maritime Spatial Planning Platform's conflict document (European MSP Platform, European Commission, 2021a), the confrontation breaks down into three key areas: visual impact on the landscape (linked to the pre-existing memory of the existence of the farms), reduction of visitors (affecting property values and incomes) and obstruction of recreational routes and activities (e.g. sailing, diving and windsurfing).

2.3.1 Prevention and mitigation strategies

The following Table 2 outlines nine lines of action to reduce the conflict between wind farms and tourism: four actions are oriented towards the prevention, while five are presented as feasible mitigation measures.

Strategy	Observations / Examples
Prevention	
Zoning	Identification of priority zones for offshore wind farms at a significant distance from the coast or areas which are prioritised for tourism and recreational activities. Depending on the country and the morphological characteristics of the coast, the distance should be set to strike a balance between visual impact and technical feasibility. Examples include initial restrictions in Germany (within 12 km of the coast, later softened) and in the Netherlands (minimum of 18,5 km after various modifications).
Socio-cultural Impact	Identification of areas of special social, historical, or cultural importance.
Tourism Knowledge	Gathering information about touristic activities and destinations. Example: Havfrilutsliv project in Denmark, using an open database to collect routes and tourist destinations.
Tourism Impact Statement	Development of statements about the impact of tourism and its inclusion in the Strategic Environmental Assessments (SEA) and in the Environmental Impact Assessment (EIA), as already recognised in the planning in Scotland.
Mitigation	
Recreational Boat Access	Allowing access to defined areas. Already implemented in park plans in the UK, Denmark, and Poland; while not allowed in Belgium or Germany; permitted under certain conditions in the Netherlands.
Multi-Use Designs	Designing parks for co-location, including tourism (navigation routes, wind tourism, diving). Example: Scroby Sands Wind Farm in Scotland, attracting over 35,000 visitors annually.
Local Community Involvement	Ensuring that the wind farm benefits local communities and addresses their concerns. Examples include developer contributions to the regional or local economy (Estonia) and cooperative participation models (Denmark).
Visual Impact Communication	Clear and transparent communication about the potential visual impact of the wind farm, using interactive virtual visualization tools and a consensus communication strategy.
Innovation Encouragement	Encouraging and facilitating innovation, with floating technology being a way to move parks away from the coast to reduce impacts.

Table 2 Strategies to reduce the conflict between wind farms and the tourism sector.

The visual impact of offshore wind farms, whether actual or anticipated, can lead to emotional disputes, since some residents could be very attached to a particular location and consider a critical impact, the visual intrusion caused by an offshore wind farm. Although conflict over a wind farm may seem small, it can escalate quickly if these concerns are not taken seriously into consideration.

Even if it is generally known that landscape disruption inevitably affects touristic attractiveness, what matters is mainly the scale of the impact (Caledonian, 2007). Studies indicate that the impact is perceived differently by different agents. Groups organised by age have been observed and gave well-defined and opposing results. The impact on tourism and leisure seems intrinsically related to local traditions, culture, and socio-economic and demographic factors such as age, education, and income (Lin et al., 2019; Parsons & Firestone, 2018; Smith et al., 2018; Sokoloski et al., 2018). For example, experienced fishermen and fish farmers tend to have high opposition or neutral positions on the Floating Production Offloading (FPO), while younger people and workers with higher education level show higher approval rates (Machado & de Andrés, 2023). In summary, it is crucial to consider the importance of the visual impact as a subjective concept which varies depending on their social profiles.

Among the concerns, stakeholders related to coastal tourism are worried that the visibility of offshore wind farms from the coast could reduce the attractiveness of the site. This may negatively influence the number of visitors and negatively affect the local economy (Broekel & Alfken, 2015; Sims & Dent, 2007). Moreover, the noise generated during the construction, operation and maintenance periods of offshore wind farms is also presented as a negative factor that could directly affect tourism in the area. On the other hand, there is a potential opportunity in the ability of wind farms to become tourist attractions by own right, offering visitors the unique experience of witnessing wind energy in action (Sutherland et al., 2017).

Studies (Machado & de Andrés, 2023) prove that the visitors interviewed did not show significant promptness to any kind of instantaneous behavioural change in the frequency of their visits due to the installation of OWFs, although they did believe that OWFs detract from the visitor experience.

Results from various studies on offshore wind farms indicate that opposition to these projects increases as the plants are situated closer to the coast, although the definition of "near" varies. Some studies suggest distances of 15-20 km, while others propose more than 30 km. In Languedoc Roussillon, 12 km from the coast, local objections could be overridden by environmental benefits. In addition, the debate on the transboundary impact on tourism and visual pollution is highlighted. However, the opinions vary according to the specific country (e.g., Romania and the Netherlands), showing once again the subjectivity of the issue (Christoforaki & Tsoutsos, 2017; Nichifor, 2016; Voltaire et al., 2017).

Even if the distinction between tourism and recreation was once marked by the fact that recreation focused on local, outdoor, non-commercial activities, studies (Hall & Lazarus, 2015) show that integrated research on these activities is now needed, due to new forms of tourism, such as nature-based tourism and ecotourism, that blur this distinction (Smythe et al., 2020). Other types of tourism can be ethical, cultural, historical, environmental, and recreational and draw attention to the diversity of factors that shape tourism. Similarly, coastal and marine recreational activities comprise a diverse and growing set of uses, characterised by a continuum of passive versus active land and water-based activities in environments ranging from purely natural to natural. Coastal and marine recreational activities are further characterised by a range of specialisations in a particular type of leisure (Buultjens et al., 2016) and are driven by diverse motivations, including health, relax, social interaction, escape from crowds, wildlife interests, or general environmental values. Therefore, visitors' responses to wind turbines located in tourist and recreational areas are likely to be varied and nuanced, depending on their motivations and the specific area considered.

Effective management and regulation are crucial to leverage the potential benefits of OWFs for marine wildlife tourism, particularly in activities such as recreational boating and diving. The creation of artificial reefs and fish farms associated with OWFs can potentially enhance marine life, making it an attractive focal point for tourism activities, such as fish farm snorkelling. Thus, ad-hoc regulation is essential to ensure the sustainable development of these sites and to manage access to wind farm areas. By applying well-defined guidelines and practices, negative impacts on the tourism sector can be minimised. In addition, strategic planning can cater to both less specialised tourists seeking general experiences and visitors interested in unique marine environments. The goal is to maintain a balance that could preserve the value of the activity, avoiding overcrowding and fostering a marine wildlife tourism sector in a sustainable manner.

Overall, co-existence between tourism activity and offshore wind farms poses significant challenges, highlighting the importance of addressing visual impacts, potential decline of visitors and restrictions on recreational activities, and requires an in-depth analysis of implications and equitable solutions.

2.4 Aquaculture

Studies show the existence of a potential crossover between aquaculture and floating offshore wind plants (C. T. Huang et al., 2022) along with the need to assess the stability of wind turbine structures to attract aquaculture populations, as well as technical, economic, and legal feasibility in order to mitigate investment risks [28](Buck & Langan, 2017). As an example, studies on multi-use platforms and European Wind Energy Association development demonstrate the high profitability of the combination of the multi-trophic aquaculture system and the seaweed, mussel and Atlantic salmon aquaculture model in the North Sea and Atlantic Ocean wind farm areas (Dalton et al., 2019). In a North Sea case study, the expected profit from pure mariculture accounts for 73% to 85% of the total revenue from wind power generation (C. T. Huang et al., 2022). However, integration faces challenges in the planning and regulation of maritime zones, involving aspects such as fishing, tourism, shipping, oil and gas exploitation, submarine cables, mining, national security, and marine conservation areas.

Even if numerous studies support the feasibility of these projects, concerns about damage to wind turbines and lack of practical references hinder their widespread adoption. The global experimental phase highlights the continued need for strategic research to optimise production efficiency, minimise ecological impact and attract investors (C.-T. Huang et al., 2011; Klinger & Naylor, 2012; Miao et al., 2009; Weaver, 2012). Ultimately, the evolution of integrated multi-trophic aquaculture systems appears to be a promising synergistic strategy that could drive sustainable energy production and fishery resource recovery at the same time.

Additionally, it is important to note that aquaculture is usually located close to the coast at a substantial distance from any floating offshore wind farms. The collection of their products, their transport to the mainland and their exploitation (e.g., health and food control) need to be carefully planned.

2.5 Navigation

Maritime transport is a mature and growing industry that is highly dependent on safe and efficient operating conditions. Fixed installations, such as offshore wind farms, are a particular problem for shipping, as they increase the obstacles in the water ways. Areas with an influx of maritime traffic are susceptible to developing conflicts with OWFs, as the impact is direct, and territory and route management can be costly. This reduces the area in which ships can operate and increases traffic density elsewhere. For offshore wind farms, factors such as the number of turbines, the distance between them and the design of the towers can influence the risk of accidents (European MSP Platform. European Commission, 2021c).

The risk of accidents is heightened by increased traffic density and reduced sea space, potentially leading to the creation of choke points. Additionally, some layouts of offshore wind farms are riskier in terms of accidents and Operations and Maintenance (O&M) vessels may also pose risks while crossing major shipping routes towards an offshore wind farm. Maritime accidents can result in substantial financial losses and, in the worst-case scenario, lead to human casualties or serious environmental damage (GWEC, 2018). Moreover, offshore wind farms may necessitate deviations, leading to additional costs for the maritime industry and resulting in increased time and fuel consumption, elevated crew wages, financial penalties, higher insurance costs on riskier routes, and challenges in complying with national and international laws, especially in areas with specific restrictions.

Preventive and mitigation solutions to these conflicts are therefore proposed (European MSP Platform, European Commission, 2021c). Preventive solutions include the co-design of shipping routes, conducting thorough risk assessments of proposed options, and using existing design guidelines for offshore wind farm layout, taking into consideration the seasonality of the shipping industry during offshore wind farm construction planning. On the other hand, mitigation proposals cover the implementation of technical measures to improve safety within wind farms, the planning of safe crossings for specialised vessels, the implementation of navigational risk assessments early in the maritime spatial planning process and building on documented experiences and existing guidance documents. As an example, new automatic identification system (AIS) technologies could be implemented to provide real-time information and better control of navigational risks. In the face of persistent conflicts, fostering cooperation and raising awareness are crucial to finding effective solutions, ensuring a balanced co-existence between offshore wind energy development and maritime activities, while minimising adverse impacts.

2.6 Local public administration

At the level of local public administration, barriers to the deployment of FOWFs are notable, especially in frameworks such as the current Spanish regulatory environment. Local administrations often do not receive direct fiscal benefits unless terrestrial transmission lines cross their territory or through voluntary agreements with developers. Furthermore, local authorities are aligned with a population divided between those who oppose FOWFs due to various concerns and those who recognise the necessity of such facilities for the energy transition. Debates also revolve around citizen participation and the advantages of centralised versus decentralised models. Addressing these complexities requires nuanced policy frameworks and the implementation of inclusive decision-making processes.

2.7 Scientific community

In the scientific community, the deployment of offshore wind energy faces significant obstacles stemming from divergent views among researchers and practitioners, as well as persistent uncertainty about the state of knowledge. While not all scientists are universally opposed to the development of offshore wind energy, there are diverse perspectives that underline its complexity and, therefore, the need for further research to mitigate uncertainties and to comprehensively assess potential positive and negative impacts on marine ecosystems.

Competing positions within the scientific community reflect the current debate surrounding the sector. Some researchers stress the urgent need for a transition to renewable energy sources such as offshore wind, leveraging on its potential to mitigate climate change and reduce dependence on fossil fuels. On the other hand, other researchers warn of potential environmental consequences, highlighting problems such as habitat alteration, noise pollution and impacts on marine wildlife. The uncertainties surrounding offshore wind energy require a concerted effort to advance scientific knowledge, which includes strengthening observational and modelling capabilities to better understand and manage the intricate interactions between offshore wind installations and oceanographic processes.

As mentioned before, while offshore wind represents a promising avenue for sustainable energy generation, its widespread adoption has to cope with resistance and scepticism from the scientific community. The divergence of views underlines the need for further research to fill knowledge gaps, ensure informed decision-making on environmental implications and improve observational and modelling techniques to investigate the dynamics between offshore wind installations and marine ecosystems (refer to section 3 for details and description of the environmental impacts arising from FOWTs).

2.8 Real estate

The potential loss of real estate value due to the proximity of offshore wind farms is one of the main concerns widespread among the inhabitants of towns located near wind farms. Investigating the factors that contribute to this phenomenon is crucial to develop ad-hoc sustainable energy policies to successfully address this concern. The impact on property values is complex and influenced by multiple factors such as the distance to the turbines, the visibility of the wind farm and additional local economic aspects. The influence of wind farms on property values has been widely investigated, especially in the field of onshore wind energy, showing how results may vary according to distance, visibility, and region-specific characteristics (Heintzelman & Tuttle, 2012; Hoen et al., 2009, 2015; Jensen et al., 2018).

In the context of onshore wind energy, a Danish study reported a decrease in the value of homes within 3 km from an onshore wind installation (Jensen et al., 2018). Conversely, in the United States, studies revealed diverse results, ranging from significant reductions in New York (8.8% - 14.9% for homes within 800 m from the first turbine) to negligible impacts in a study covering nine states (Heintzelman

& Tuttle, 2012; Hoen et al., 2009, 2015). In the UK, visibility of the wind farm emerged as a crucial factor, where homes close to the wind farm and with visibility decreased in value, while those without visual affect could potentially increase, offsetting losses (Gibbons, 2015). In addition, a study in the USA suggested general economic benefits for localities near onshore wind farms (Brunner & Schwegman, 2022).

Although most studies have focused on onshore wind, preliminary data for offshore wind indicate a negligible impact on property values. Research carried out near offshore wind farms in Denmark and United States did not find significant differences in property values, even at distances of 3.5 km and 4.8 km (Dong & Lang, 2022; GWEC, 2018). However, it should be noted that the Danish government has implemented measures to ensure that any impact on housing prices related to wind developments does not impact citizens (GWEC, 2018).

Numerous studies emphasise the need for more detailed research, especially considering the increasing size of turbines and their possible impact at greater distances (Dröes & Koster, 2021). A study focused on Spain analysed the evolution of housing prices in Galicia (2007-2022) applying various sources, including the Housing Price Index of the National Institute of Statistics. The study observed a variation in prices, influenced by the global economic situation, with a recovery since 2015. At the municipal level, a reactivation of the real estate market was found in number of transactions, especially in municipalities close to future wind farm sites. However, this reactivation did not always translate into an increase in prices T (the link between the evolution of prices and the installation of onshore wind farms will be evaluated in later sections of the report). In addition, the cost of rent was addressed, showing a general trend of rising prices per unit area between 2015 and 2021. Therefore, it is crucial to carry out prior socio-economic studies before assuming that the implications in this sector will be predominantly unfavourable.

2.9 Cultural heritage

Cultural heritage and offshore wind farms present an intricate intersection when modern renewable energy initiatives meet historical and cultural legacies. Potential ramifications encompass visual and aesthetic alterations to coastal landscapes, impacting the historical ambiance and cultural heritage of specific regions. As an example, activities on the seabed associated with offshore wind farms may pose risks to underwater cultural heritage. Thus, consolidated mitigation strategies are envisioned through the execution of archaeological prospection prior to and during the works, allowing the identification, rescue and valorisation of possible findings. Community engagement, regulatory compliance, and collaboration with indigenous groups emerge as pivotal components for successful integration, ensuring the preservation of cultural values. Attention to local tourism, identity, and economic development underscores the delicate balance required. A holistic approach, including comprehensive impact assessments and innovative solutions, is imperative to harmonise offshore wind projects with cultural heritage preservation in coastal regions.

However, in this context, the contribution of renewable energies to cultural heritage should be considered. In fact, the integration of renewable technologies could support the cultural heritage preservation, presenting numerous advantages in the convergence of sustainable energy initiatives and historic preservation. By reducing emissions through the adoption of renewable energy sources, it contributes to the decarbonization of the local energy sector, establishing itself as a prominent source of green energy. Likewise, the deployment of offshore wind farms stands out for its minimal visual impact on the surrounding landscapes of heritage sites, outperforming other forms of energy generation. This harmonious integration would also provide opportunities for community involvement and education, fostering a deeper connection between local populations and their cultural heritage. The visual and educational aspects contribute synergistically to the sustainable co-existence of renewable energy projects and cultural preservation, exemplifying a holistic approach towards a more ecological and cultural enriched future.

2.10 Strategies to manage conflicts.

2.10.1 Public awareness and education

Public awareness and education emerge as critical pillars at the local level. Consequently, there is a need to expand training and education programs specifically designed to develop a competent workforce capable of underpinning the growth of the industry, according to the specific demands of this sector. Enhanced training and education initiatives represent a fundamental solution to address the shortage of skilled professionals in the offshore wind sector. By embarking on comprehensive programmes, including dual training cycles, regions can strategically address the shortfall, reducing the shortage of skilled personnel and strengthening the foundation for a sustainable expansion of the sector. It is important to shift perceptions towards opportunities Rather than viewing the shortage of trained professionals as an obstacle, stakeholders should recognise it as an opportunity to drive regional advancement within the sector. Promoting education and career opportunities in the offshore wind sector can spark interest, attract talents and stimulate economic development in the region.

To illustrate the effectiveness of such approaches, noteworthy case studies and best practices have been identified. For example, in Ireland, proactive measures have been proposed, such as prioritising the employment of affected fishermen in maintenance roles or facilitating the creation of cooperative ventures, such as fuel supply companies, in support of offshore wind farms. Similarly, initiatives in the United States in the oil and gas sector have emphasised the importance of hiring locals (e.g., fishermen) for project activities, such as the Fishermen's Energy Inc, a company founded by fishermen dedicated to offshore wind energy development. Together with the case studies, the regional assessments are key instruments to provide information on existing capabilities and opportunities. Focusing on the Iberian Peninsula, the analyses outline strengths and areas for improvement within the offshore wind value chain. While the region has strong capabilities in certain areas such as tower and blade manufacturing, it faces challenges in areas such as nacelle production. However, leveraging expertise in related fields, such as civil engineering for floating structures, presents avenues for strengthening regional capabilities. In conclusion, it is relevant to conduct specific studies on industrial capacity to identify existing opportunities in a particular region, starting from considering the shortage of professional not only as a barrier but as an opportunity.

2.10.2 Government support

Securing the government support is essential for the deployment of offshore wind technology, encouraging innovation and technological advances in the renewable energy sector. The impact on public finances must consider the whole range of effects of the offshore wind industry, combining three dimensions : reduced public spending due to job creation (social security savings), additional public income tax revenue, and the public spending needed to support offshore wind deployment.in fact, financial support for research and development allows for the exploration of new offshore wind technologies, (e.g., floating turbines) which can increase the efficiency of energy production and further expand the geographic scope of wind energy deployment. Moreover, job creation allows for savings in social security and income taxes, which increase with additional deployments and job creation. This underscores how discussions about subsidies for offshore wind energy are short-sighted in the public debate, overlooking the importance of the offshore wind industry, which is also export-based.

Additionally, government subsidies and incentives attract private investment in floating offshore wind projects. The assurance of stable financial returns through subsidies mitigates the risks associated with large-scale investments, making offshore wind more attractive to investors. This influx of capital not only drives the growth of the offshore wind industry but also stimulates related sectors, such as manufacturing and construction. In this framework, government policies play an important role in addressing regulatory hurdles and streamlining permitting processes for offshore wind projects, underlining how the existence of clear and consistent regulations provides developers with the confidence to invest in long-term projects, ensuring a stable pipeline of offshore wind developments.

As an example, in the United Kingdom, the government increased subsidies for offshore wind energy developers by up to two-thirds in 2023 to revitalise new projects in a sector facing challenges due to rising costs. The government also raised the maximum price offered for other renewable technologies, including a 30% increase for solar parks (*UK to Offer Higher Subsidies for Offshore Windfarms after Crisis Talks | Wind Power | The Guardian*, n.d.). In November 2023, the British government announced significantly higher subsidies for new offshore wind farms, following a discussion with developers about cost inflation across global energy supply chains (*Boost for Offshore Wind as Government Raises Maximum Prices in Renewable Energy Auction - GOV.UK*, n.d.). In Germany, the government has set the goal of achieving a total capacity of 15 GW for offshore wind energy installations by 2030, supported by an aid scheme approved by the European Commission. Growth in European offshore wind sector can be attributed to a wide range of subsidies and various funding programs to finance energy projects. The European Union proposes to subsidise all energy projects through two-way contracts for differences, a financial tool that provides revenue stability for electricity generators, in order to support the deployment of renewable energy projects while maintaining cost-effectiveness. On the other hand, it is worth noting that European governments have introduced a 30% socio-economic consideration in the permitting of floating offshore wind projects, which will encourage developers to be more aware of these issues.

To sum up, government support acts as a driver for the widespread deployment of offshore wind energy, promoting economic growth, technological innovation and environmental sustainability.

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Governments therefore have a key role to play in unlocking the full potential of offshore wind by providing financial incentives and facilitating the regulatory framework.

2.10.3 Good practices in community engagement

Community engagement encompasses a range of socio-economic considerations that can influence project success and increase the social acceptability of offshore wind technologies. The implementation of effective community engagement practices could encourage local stakeholders to participate in decision-making processes, fostering transparency, trust and mutual understanding between developers and communities. As an example, in Spain, it has been observed that there are communities with very diverse views on the deployment of floating offshore wind, demonstrating the importance of identifying and addressing the potential socio-economic impacts involving the community.

There are several socio-economic aspects that can take advantage from the direct involvement of local communities in the process, such as the equitable distribution of benefits and burdens associated with offshore wind projects. Impacts that may be caused to a society, such as changes in property values, employment opportunities and local infrastructure development, should be identified a priori. Transparent communication and consultation with affected communities helps to ensure that benefits, such as job creation and economic development, are maximised while minimising negative impacts. In addition, community engagement practices should facilitate the meaningful participation of diverse stakeholders, including residents, business representatives, environmental organisations, and minority communities, securing an inclusive participation process that empowers marginalised groups and ensure that their perspectives and concerns are considered in the decision-making phase.

Another important element is the establishment of collaborative partnerships between developers, governments, and local communities. By working together, stakeholders can leverage on their own resources, experiences, and expertise to address complex socio-economic challenges and maximise the positive outcomes of offshore wind projects. Community engagement practices should prioritise long-term relationships and ongoing and sustainable dialogue between developers and communities beyond the project development phase, building trust, maintaining open channels of communication and addressing community concerns throughout the project lifecycle.

Several countries have implemented good practices in community engagement to facilitate the successful development of offshore wind projects. For example, Denmark has a long history of community-owned wind farms, where local communities have direct financial stakes in projects, fostering a sense of ownership and support (ENERGY & FARMS, n.d.; Mey & Diesendorf, 2018). Similarly, the Netherlands implemented innovative participatory processes, such as citizens' assemblies and deliberative forums, to ensure that local communities are actively involved in decision-making processes related to offshore wind energy development (Priscilla Dion, 2019). In summary, by addressing community concerns, fostering inclusiveness and building collaborative partnerships, developers can enhance positive aspects and reduce potential impacts on local communities.

Additionally, studies identified good practice principles for community engagement, which include the design of (Cowell et al., 2012; Klain et al., 2017; Xchange, 2015) :

1. **Community benefit package** to be proposed by the developers and discussed with the community, including the scale of the project, the technology applied, the distance of the park from the coast, and its nature.
2. **Identifying the community**: in advance of a public consultation, the developer should undertake an initial study to previously identify the key elements of benefits for a specific, who the appropriate key contacts might be, and the communities of interest to be involved in the consultation.
3. **Maximising impact**: optimising community benefits and dialogue with the local community.

2.10.4 Research development

Research efforts play a major part in addressing both technological breakthroughs and societal challenges. Technology research and development focuses on improving the maturity and efficiency of offshore wind energy systems, including turbine design, installation methods and maintenance practices. Through these initiatives, innovations are pursued to improve the reliability, performance and cost-effectiveness of offshore wind farms. Advancing technological maturity provides several tools to address impacts and meet local needs effectively. However, alongside technological advances, the development of social research is equally essential to understand and manage the socio-economic dimensions of offshore wind energy. Research aims to improve community engagement strategies, assess the socio-economic impact on local communities and optimise benefit sharing. This requires the design of inclusive policies and frameworks to ensure equitable access to opportunities. Moreover, the more research is done, the better and more prepared society is to face societal challenges and to manage offshore wind energy in a sustainable way.

3 ENVIRONMENTAL FACTORS IMPACTING FOWT

Although the role of offshore wind generation in global decarbonisation process is widely recognised, and the net contribution of this technology to the mitigation of climate change effects is considered to be very positive in contrast with its potential negative impacts on the environment that, as any other new industrial activity, need to be evaluated and mitigated.

More than twenty years after the first bottom-fixed (BF) wind turbines were installed near the northern coasts of Europe, a certain amount of data is now available from satellite images, in situ observation campaigns of chemical, physical and biological variables, the analyses of which, combined with the predictions of numerical models, have provided the scientific community with a fair amount of knowledge of the effects produced. However, these data are not complete as not all relevant species have been analysed, the effects are highly dependent on the specificity of the basins, and the technology used - bottom-fixed - is different.

Therefore, the impacts of FOWFs are far from being comprehensively explained, as current knowledge on coastal bottom fixed OWFs cannot be directly applied to predict the effects of this new technology based on floating turbines anchored on the deep seafloor (Danovaro et al., 2024). FOWFs can cover areas of thousands of km^2 and, although presumed to have a lower impact than fixed FOWFs during their installation, the activities during installation, operation and decommissioning could still have potentially significant impacts.

These concerns call for the development of robust criteria for the Environmental Impact Assessment (EIA) of these installations and for Cumulative Impact Assessment methodologies that can help authorities at correctly managing the marine environment.

On the other side, deep-sea ecosystems remain largely unknown (Danovaro et al., 2017), therefore it is extremely difficult to quantify the effects. The concern for the potential environmental impacts of FOWFs is leading all countries to adopt careful permission procedures (European Court of Auditors, 2023), significantly lengthening the time of the authorisation process, which is one of the main bottlenecks for the fast development of FOWT farms.

It is thus urgent to provide the criteria and approaches that can accelerate the environmental impact assessment and positive authorisation processes of the future FOWFs. The adoption of comprehensive criteria, standardised procedures, and best practices to support appropriate siting and use of mitigation measures can make FOWFs eco-compatible, potentially supporting the scaling up of this renewable energy production.

3.1 Potential impacts on the marine environment

The interaction of floating offshore wind turbines with marine ecosystems can manifest through a complex range of environmental impacts, reflecting both the potential benefits and concerns associated with this new electricity generation technology. The uniqueness of these structures, supported by floating systems and anchored in offshore locations far from the coast, might introduce new environmental dynamics.

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The main environmental concerns raising from the interaction of FOWTs with the marine environment are **acoustic and electromagnetic disturbances, impacts on seabirds, changes in atmospheric and oceanic dynamics, alteration of seabed integrity and water quality due to the presence of moving artificial structures, effects on the marine species behaviour due to the presence of mooring lines and submarine cables or an increased risk of accidents, related to a higher density of marine space use** (Figure1).

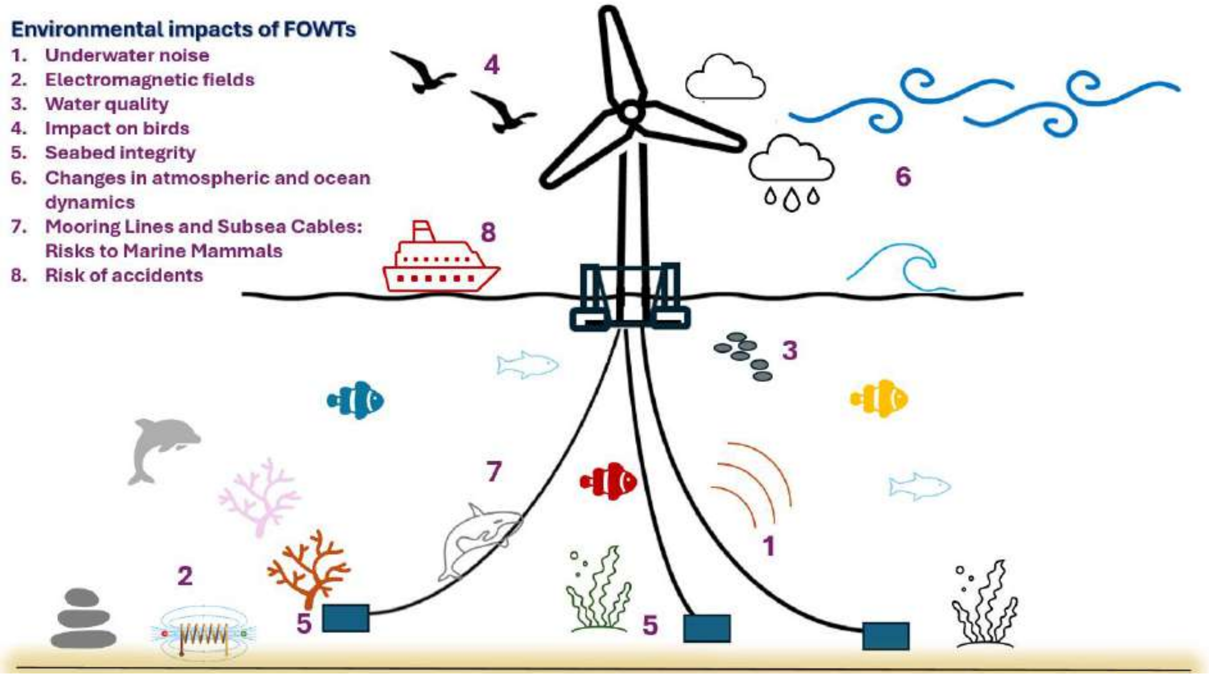

Figure 1 Major environmental impacts of FOWTs.

As any other industrial development based on a new technology, it brings the responsibility to understand its potential environmental impacts and mitigate associated negative effects. The design and operation of FOWTs must therefore be guided by principles of environmental sustainability, incorporating strategies to mitigate negative impacts and enhance, when possible, potential positive local effects, such as increasing marine biodiversity around these structures.

The following sub-sections will explore the cause-and-effect potential dynamics between offshore wind farms and marine ecosystems. In particular, the possible negative effects on the marine environment of FOWTs, their relative weight in comparison with current and expected effects of climate change on it, the knowledge gaps that need to be filled to quantify those potential damages, and the actions to be taken to limit their effects will be detailed.

3.1.1 Noise effects

Underwater noise pollution is a growing concern in marine ecosystems, particularly with the expansion of human activities at sea. Even though the increase in background noise in seas and oceans is mostly due to the continuous noise generated by shipping, and that the most harmful sources of impulsive noise to marine fauna are those from military sonars, airguns and pile driving (Thomsen et al. 2021), the installation of floating offshore wind turbines can also annoy fish, invertebrates, and marine mammals during installation/decommission and operation phases.

In fact, the noise generated by support vessels, the deposition of mooring anchors, depending on the technological solution chosen, and all construction and assembly operations can be significant during installation/decommission (Farr et al., 2021a). Main concern about noise impact of offshore wind farms has been particularly related to the installation stage of bottom-fixed turbines by means of piling or drilling. By this reason, most of noise impact studies have been addressed to this kind of activities. However, in most FOWTs there is no need of such high noise-impact actions, as foundations are based on anchors instead of piles.

Then again, the floating platforms and mooring lines, which are essential for securing FOWTs to the seabed, can produce some noise during the operation phase in different ways:

1. **Vibration Transmission**: Mooring lines can transmit vibrations from the operational activities of FOWTs through the water column. These vibrations result from the mechanical movements and rotations of the turbine components, which are transferred down the mooring lines and can propagate as sound waves underwater.
2. **Contact with seabed and water column interactions**: As mooring lines may drag across the seabed or interact with passing currents; they can generate noise through friction and turbulence. The movement of these lines against the seabed materials or their own induced vibrations from currents can create additional sources of underwater sound.
3. **Snapping of mooring lines**: The sudden tensioning of cables after a state of zero tension produces a broadband peak sound pressure level. For reference purposes, underwater noise measurements performed in the vicinity of the floating wind turbine "Hywind I" installation shown a peak value of 160 dB re 1μPa at 150 m of the chains. The frequency content of the transients extends throughout the recorded frequency range of 0 – 20 kHz, the time for which 90% of acoustic energy is released is of about 25 Ms (Weissenberger, J., 2019).

Finally, noise generated by the turbine itself during operation can be considered negligible underwater, as sound energy is quickly attenuated when passing from one media (air) to another (water).

On the other side, in some recent reviews (Rezaei et al., 2023) noise in the air can be considered a mitigating effect, because it would keep birds away and thus act as a warning mechanism to avoid collisions.

The noise generated by mooring lines, in addition to other sources of noise from FOWTs, can have varying effects on marine organisms. As with any other noise source, species that rely on sound for communication, navigation, and foraging, such as cetaceans and certain fish species, may experience stress, behaviour changes, or displacement from their habitats. The severity of these impacts depends on the frequency and intensity of the noise, as well as the proximity to the source and the duration of the disturbance.

The impacts of noise on invertebrates and planktonic organisms are less studied, but the consensus is that the effects, behavioural or physiological, are minimal unless the organisms are in very close proximity to a powerful noise source (Bocci et al., 2021).

As noted, before, most reported effects on marine fauna during installation and operation of offshore wind farms are related to bottom fixed turbines (Rezaei et al., 2023), being mainly associated with turbine piling (Marmo, 2013; Thomsen et al., 2023). For a detailed analysis about impulsive noise effects on marine fauna see the following study (Thomsen et al., 2021. Long term monitoring campaigns focused on different species are needed to collect data useful for noise disturbance quantification and for cumulative impact analysis (Rezaei et al., 2023)..

To reduce the environmental impact of underwater noise from floating platforms and mooring lines, various mitigation strategies can be employed. These may include the acoustic optimisation of platforms' design or the selection of mooring systems that minimise the contact with the seabed, opting, when possible, for taut or semi-taut mooring lines, the use of synthetic materials over traditional catenary designs to reduce vibration transmission, and the careful planning of turbine locations to avoid sensitive marine habitats. It is also recommended to use appropriate support vessels and equipment that minimise noise generation during construction, maintenance and decommissioning stages. For further information refer to: (Haberlin et al., 2022a; Duffy, O. et al. 2023, Risch, D. et al 2023, Henry, S. et al 2022, Thomsen, F. et al 2021).

3.1.2 Electromagnetic Fields (EMF) Generated by FOWTs

Offshore wind farm power cables can be considered as a primary source of artificial electromagnetic fields (EMF) in the marine context. The concern regarding the potential effects of these fields on various marine organisms has been raised by the existence of some marine species that show sensitivity to electric and/or magnetic fields. This sensitivity is well documented, for example, in rays and sharks, which possess ampullae of Lorenzini, specialised organs capable of detecting electric fields and use this ability to hunt their preys, or marine turtles and other migratory species, that have special sensitivity to magnetic fields and profit them to navigate in the ocean along defined routes.

However, although the physics of EMF are well known and allow to predict the distance range in which natural values of EMF in seawater are altered by submarine cables, the mechanisms by which marine organisms' sense are potentially affected by electromagnetic fields are not fully understood, raising questions about the accuracy of our current knowledge regarding the interactions between artificial electromagnetic fields and marine life.

While most part of electric field associated to power submarine cables can be isolated inside the insulation layers of the cable, magnetic field is projected outside it, exponentially decreasing with the distance to the conductor. This means that the alteration of magnetic field is limited to a close area around the cables (typically about centimetres or metres). Within this range, the implications of electromagnetic fields on the behaviours and physiology of marine organisms may include behavioural changes such as attraction or repulsion, as well as potential temporary impairments in navigation and orientation abilities. However, these effects vary significantly between species and even between individuals within the same species, illustrating the complexity of the phenomenon under investigation

(Haberlin, D. et al. 2022, Hutchison, Z.L. et al. 2020, Gill, A.B. et al 2020, Scott, K. et al. 2018,2021, Galparsoro, I. et al. 2022, Taormina, B. et al, 2020, Hutchison et al., 2020; Mendoza et al., 2019).

In conclusion, despite having a solid knowledge on the effects of artificial electromagnetic fields in terrestrial contexts, significant gaps remain in understanding their effects in the marine environment. Targeted studies on the effects of electromagnetic fields on different species under experimental conditions have provided valuable information, but in situ studies remain too scarce and cover a limited range of species. Furthermore, laboratory experiments often employ high levels of electromagnetic field emissions, not representative of the range of emissions that might be found in the marine environment. Based on the current state of knowledge, it is difficult to predict any cumulative effects, particularly in areas with high cable density, making this issue a major concern in those areas. Therefore, it would be appropriate to carry out field measurements on existing power cables to study the potential effects and to develop long-term monitoring within wind farms to evaluate the cumulative effects on species at different stages of their life (Haberlin et al., 2022a).

3.1.3 Impact on seabirds and bats

The potential negative impact of Floating Offshore Wind Turbines (FOWTs) on seabirds, underscores the complex interplay between renewable energy development and marine avian ecology. Vulnerable population includes seabirds that spend an important part of their life at sea, feeding in marine waters and well adapted to the marine environment. They can also include migratory species, which do not primarily depend on marine resources for their feeding. The main concerns regarding FOWT - bird interactions involve the risk of collision, displacement and potential loss of prey resources. It has to be highlighted that the risk of collision, although significant, is not considered the main threat to seabirds. Other factors as the proliferation of invasive species, climatic change effects, accidental captures or predation of coastal nests may be much more relevant in determining the survival of these populations (Croll et al., 2022; Goodale & Milman, 2016; Haberlin et al., 2022b, 2022a; Lieber et al., 2021).

Mortality and Displacement: Data relative to inland wind farms revealed that average annual bird deaths from turbine accidents range between 0 and 50 yearly casualties (Rezaei et al., 2023). In (Danovaro et al., 2024) it is reported that 250.000–500.000 birds are killed annually by colliding with onshore wind turbines in the USA (Farr et al., 2021a). These data have created concern also with respect to offshore wind turbines. Even if there are currently no studies confirming significant mortality of seabirds by collision, *ad hoc* studies and observations at sea are needed. According to the UN, about 1800 avian species (20% of the total) migrate every year, so these species are potentially vulnerable to collision with FOWT's blades. The risk strongly depends on the species. In (Danovaro et al., 2024) 9 factors influencing the birds' vulnerability to FOWFs have been identified: 1) flight manoeuvrability, 2) flight altitude, 3) percentage of time flying, 4) nocturnal flight disturbance by ship and helicopter traffic, 5) flexibility in habitat use, 6) bio-geographical population size, 7) adult survival rate, 8) local threat and 9) conservation status. These factors shall be used to identify an overall risk index for bird populations due to collisions with marine turbines.

There is ongoing research claiming that applying contract painting to rotor blades can result in significant reduction in annual fatality rate for a range of birds and bats by reducing collision (Garcia Rosa, 2022; R. May et al., 2020; AWWI Publication Synthesis 2012).However, this strategy has not yet

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shown results on seabirds as it has only been tested on land-based farms. Implementing it on an FOWT could be challenging and costly. Colouring one of the three blades could require expensive maintenance operations, especially considering the aggressive marine environment, unless the blades are already produced in black. However, painting a blade black could cause overheating problems, affecting its behaviour compared to the other two blades. These economic and structural aspects therefore require further in-depth studies. The authors themselves suggest further evaluations, which heavily depend on the installation site of the FOWT and the species of seabirds present.

While some species demonstrate avoidance behaviour (Sun et al., 2012), minimising the risk of collision, the energy expenditure for migrating birds to detour around FOWTs is minimal in comparison to their total migratory distance. Most seabirds are characteristically low-flying and spend most of their time resting at the water's surface. However, for breeding seabirds, FOWTs pose a greater risk as they may necessitate extended foraging trips, potentially impacting reproductive success due to the energetic demands of breeding.

Foraging habitat loss: The placement of FOWTs can lead to significant foraging habitat loss, particularly in productive marine areas critical for seabird feeding. This habitat loss is especially concerning for breeding birds with restricted foraging ranges, who may face challenges in provisioning their chicks adequately, thus negatively affecting population growth. Non-breeding birds, while more adaptable in their foraging behaviour, could still be impacted by the cumulative effects of multiple FOWTs in a region, highlighting the need for careful site selection to minimise habitat disruption (Soudijn et al., 2022).

Moreover, the **construction, maintenance, and decommissioning** phases of FOWTs introduce significant vessels and helicopters traffic, which can exclude seabirds from key areas through disturbance. Certain species are known to be particularly sensitive to such disturbances, with potential reductions in fitness due to the energetic costs of repeated disturbance, impacting both breeding success and over-winter survival rates. The installation of submarine cables to export the energy generated by FOWF can also have an impact on coastal biological areas, where most seabirds have their nests. Despite these concerns, there are also potential benefits associated with FOWTs, such as increased biodiversity and abundance of marine species around the turbine structures, acting as artificial reefs and Fish Aggregation Devices (FADs). These structures may enhance foraging opportunities for some seabirds.

3.1.4 Habitat alteration

The need for anchoring and mooring systems for floating offshore wind turbines might significantly impact the integrity of the seabed, risking habitat loss and alterations in local sedimentary processes (Chitteth Ramachandran et al., 2022; Royal Society for the Protection of Birds, 2022). These changes can in turn negatively affect the surrounding marine communities, prompting a necessary review of the environmental impacts of FOWTs, with a particular focus on benthic ecosystems. In particular, an intense, although localised, impact is expected during installation, as anchoring system deployment can cause sediment resuspension as well as mechanical disturbance due to the displaced sediments. In addition, the anchors might require the deposition of a trait of chain on the seafloor before the release of the anchor and its penetration in soft sediments. This could cause direct physical disturbance or, rarely, contaminants' re-suspension into the water column and have the potential to clog the feeding apparatus of suspension-feeding organisms, such as bivalves, sponges, and sea squirts (Danovaro et al., 2024).

The adoption of innovative and targeted anchoring systems can mitigate the impact on the marine environment. It should be noted that in order to prevent the anchor from being initially placed at any point and then potentially dragged along the seabed during mooring, potentially altering its intended position, specific underwater means or devices are employed. These tools guide the anchor's descent with precision, ensuring that its placement does not harm the seabed or the resident flora and fauna. This approach carefully assesses the anchoring site and its surroundings to prevent damage caused by anchor dragging. For example, direct anchoring techniques involve the use of underwater vehicles or specific devices to precisely guide the anchor's descent, ensuring its placement does not harm the seabed and the resident flora and fauna. This approach carefully considers the anchoring site and surrounding areas to prevent the area from suffering damage due to anchor dragging.

Limiting the length of mooring chains laid on seabed further reduces impact, minimising the risk of dragging and erosion of the marine substrate. However, it is crucial to maintain a certain additional length to compensate the effects of marine currents, waves, and tides, while ensuring that the excess does not lie unnecessarily on the seabed, where it could cause damage. This holistic approach to anchoring and mooring systems emphasises the importance of a deep understanding of their effects on the marine ecosystem and highlights the need for targeted research and technological innovations.

It is well known that artificial hard elements such as floating platform, anchors, chains and cables, if not completely hidden by the seafloor sediments, can act as an artificial reef, attracting different species thus increasing the biodiversity (see section 4.3). On the other side, hard substrate may also invite colonisation by invasive species, whose threat to marine biodiversity can have ecological and economic consequences. It is clear that a decommissioning plan including the safeguard of these new ecosystems must be developed and applied (Chitteth Ramachandran et al., 2022; Topham & McMillan, 2017)..

In conclusion, there are no data to date that have demonstrated significant deleterious effects of OWF on reef fish or benthic communities (A. Copping et al., 2015), anyhow the offshore locations of deepwater, floating OWFs make these pathways less likely than those nearshore (A. E. Copping et al., 2020; Farr et al., 2021a). For further information refer to: Vaissière et al., 2014; Hammar et al., 2016; Slavik et al., 2019; Topham & McMillan, 2017; Wilhelmsson & Langhamer, 2014; Defingou, M. et al., 2019; Degraer et al., 2020; Mavraki et al., 2021)

Besides, potential affectation to local habitats should be weighed against expected damage due to climatic change, that many marine communities and species are already undergoing and that are usually of more relevance for their survival in the medium and long term.

3.1.5 Changes in atmospheric and oceanic dynamics

Floating offshore wind farms, depending on their location and extension, could have the potential to produce some effects on atmospheric and oceanic dynamics. The local wake effects produced by the grouping of wind turbines can reduce wind speeds downwind, which in turn could alter local weather patterns and ocean dynamics. Most references of this kind of effects are based on studies in extensive offshore wind farms in the North Sea. For instance, in-situ measurements performed with an aircraft of the far wakes of wind farm clusters in German Bight (Platis et al., 2018) revealed that, under certain specific conditions (stable atmospheric stratification), wake lengths induced by existing OWFs can be more than tens of kilometres with maximum wind speed deficits of 40% and enhanced turbulence, confirming observations from satellite imagery and predictions of numerical models. On the contrary, with unstable atmospheric stratification, wake effects were limited to local domain. In this study case, the reduction in wind speed seems significant enough to have the potential to produce changes in surface wave energy and mixing layer processes.

Although the regional climate impact of wind farms is generally considered to be minor, especially when compared to other human activities and climate changes, the localized effects on weather and ocean dynamics can be significant. For example, alterations in wind patterns may influence local temperature and precipitation, potentially affecting marine and terrestrial ecosystems in the vicinity of the wind farms. In (Akhtar et al., 2022) a high-resolution regional climate model is used to analyse the impact of existing and planned OWFs on sea surface fluxes and other important atmospheric variables in the North Sea. The results show a significant reduction in the air-sea heat fluxes and a local, annual mean net cooling of the lower atmosphere in the wind farm areas due to a decrease in wind speed and turbulent kinetic energy and an increase in low-level clouds. Furthermore, an increase of approximately 5% in mean precipitation was found over the wind farm areas.

The impact of wind farms on ocean dynamics is less clear. There is a possibility that they could influence ocean current patterns, water temperature distribution, and nutrient mixing in the water column. These changes could have consequences for marine biodiversity, including plankton distribution, which forms the base of the marine food web (Ludewig, 2015; Carpenter et al., 2016; Grashorn and Stanev, 2016; Floeter et al., 2017; van Berkel et al., 2020, Lampert et al., 2020; Dannheim et al., 2020; Gill et al., 2020; Akhtar et al., 2021; Lloret et al., 2022). However, these effects are expected to be extremely localized (Danovaro et al., 2024).

The influence of wind farms on the vertical stratification of the ocean and the potential for altering upwelling processes also remain areas of concern. Upwelling zones are critical for marine productivity, and any changes to these processes could have widespread effects on marine ecosystems and fisheries.

It is important to emphasise that the intensity of the effects produced strongly depends on *i)* the size of the farm, *ii)* the number of farms in the area, *iii)* the local ocean and atmospheric conditions and i*v*) the physical characteristics of the marine area.

Overall, while the global climate impact of wind energy is positive due to its role in reducing greenhouse gas emissions, the localised effects of FOWTs on atmospheric and oceanic dynamics require further investigation. Continued research is required to understand these interactions fully, as this knowledge will be essential for the strategic planning and management of FOWT developments to mitigate any negative environmental impacts.

3.1.6 Mooring lines and subsea cables: risks to marine mammals

Additional concerns regarding FOWF include the potential for marine mammal collisions and entanglement, as well as the accidental entrapment of marine animals by anthropogenic materials such as fishing nets and lines. Since these wind farms require anchoring systems to stabilise their structures, the type of anchoring system used, along with anchorage characteristics and turbine array configuration, could influence the risk of marine mammal entanglement. Certain species, such as baleen whales, are particularly at risk due to their size and feeding habits. However, direct entanglement of marine mammals in the anchorages themselves is unlikely, although the risk of secondary or tertiary entanglement is higher, with animals becoming trapped in abandoned fishing gear or entangled while swimming through the wind farm. In all three cases, entanglement can cause severe injury or death to the animals. Similar risks may exist with the subsea cables of offshore wind farms, which connect the various components of the wind farms and transport energy to onshore electrical grids. However, due to advancements in cable laying techniques, such as cable burial, no entanglements with telecommunication cables have been reported since 1959 (Wood and Carter 2008: *Wood, M.P., Carter, L., 2008. Whale entanglement with submarine telecommunication cables. IEEE J. Ocean. Eng. 33, 445–450. https://doi.org/10.1109/JOE.2008.2001638*.),suggesting that entanglement with submarine cables poses a lower risk to marine mammals compared to secondary or tertiary entanglement with mooring systems. (Farr et al., 2021a).

As mentioned before, the entanglement of marine mammals, such as whales, dolphins and seals, in mooring ropes can cause injury or death (A. Copping et al., 2015). The risk is particularly acute for species that exhibit curious behaviours, such as humpback whales known to interact with their surroundings. Entanglement can cause serious physical harm, including cuts, infections, or even amputation of limbs in severe cases. Moreover, entangled animals might suffer from impaired mobility and reduced ability to feed, affecting their reproduction and survival.

Additionally, the presence of subsea cables can create electromagnetic fields that potential to affect animal behaviour but unlikely to alter survival and reproduction (Farr et al., 2021a).

To mitigate these risks, several measures can be implemented. These include the design and deployment of mooring systems that minimise slack, as well as the development and implementation of detection and deterrent systems helping to keep marine mammals away from high-risk areas. Moreover, continuous monitoring and research are essential to better understand the behaviours of marine mammals in proximity to FOWTs and to improve mitigation strategies.

3.1.7 Risk of accidents with FOWTs

Even if extremely unlikely, floating offshore wind turbines might be subject to natural and operational hazards that pose risks of accidents, potentially leading to environmental and structural damage. These risks can be summarized as follows (Lloret et al., 2022; Biehl and Lehmann, 2006).

1. **Natural hazards**: FOWTs are engineered to withstand harsh marine environments, but they are not immune to extreme weather events. Due to climate changes, powerful storms, hurricanes, and rogue waves could represent potential risks. These natural events can cause the turbines to malfunction or

even detach from their moorings. Moreover, extreme sea states and strong winds can push the turbines beyond their design limitations, potentially causing structural failures.

2. **Wind turbine accidents**: Operational issues such as fire or mechanical failure can occur with the turbine components. If not managed correctly, these can lead to the entire unit falling into the sea, causing not only a loss of function but also potentially releasing pollutants into the marine environment (Asian et al., 2017).

3. **Collision risks**: Although extremely unlikely given the security measures taken, ships may accidentally collide with turbines or their substructures, especially in poor visibility, engine failure or navigational errors. Asian et al., 2017; Biehl and Lehmann, 2006)

Unexpected accidents involving FOWTs can have direct environmental consequences. For instance, if a turbine collapses, it could impact marine habitats and the local ecology.

3.1.8 Water quality

Strategies used to prevent biofouling and corrosion on FOWTs, and their substructures could potentially compromise water quality. Antifouling coatings and corrosion inhibitors often contain heavy metals or biocidal compounds that, if released into the marine environment, can be toxic to various forms of marine life, disrupting biological functions and potentially leading to death (A. Copping et al., 2015; Farr et al., 2021a; Haberlin et al., 2022a; Kirchgeorg et al., 2018; Yuan et al., 2023). The potential metal emissions from galvanic anodes in steel floating foundations, can be considered negligible (https://www.sciencedirect.com/science/article/pii/S0025326X23008305). To reduce the risk to marine species, the adoption of environmentally friendly alternatives is essential. This could involve using non-toxic coatings, applying ultrasonic technologies to prevent biofouling, or even selecting materials that naturally resist corrosion and biofouling (e.g., synthetic fibers for mooring lines). In their study, K. Thiruppati et al. present experimental research on the ultrasound technique, defining it as a promising non-invasive solution for controlling biofilm formation on marine substrates. They developed a prototype system that utilises ultrasound waves to combat biofouling in the marine environment. These waves damage the structure of microorganisms, thereby inhibiting their growth. Experiments conducted over a 21-day period demonstrated a reduction in biofouling and structural damage to the test samples. Additionally, a low-cost digital ultrasound system, controlled by pre-programmed microchips, is currently under development for further investigation within the frequency range of 20-40 kHz (K. Thiruppati et al. 2014, *A study on the effect of pulsed power ultrasound waves in marine biofouling,* Indian Journal of Geo-Marine Sciences, Vol 43 (11), November 2014, pp. 2169-2174). Additionally, studies have shown that ultrasound technology plays a crucial role in affecting various bacteria and barnacle species, inhibiting their growth and causing mortality. For instance, ultrasound technology has been effective in controlling the growth and microbiota of European sea bass. Therefore, ultrasound technology can be utilised to control and mitigate biofouling (Gorkem Gizer, Umur Önal, Manoj Ram, Nurettin Sahiner, *Biofouling and Mitigation Methods: A Review,* Bio interface Research in Applied Chemistry, Volume 13, Issue 2, 2023, 185, https://doi.org/10.33263/BRIAC132.185). Such innovations not only prevent the introduction of toxins but can also improve the longevity and effectiveness of FOWT operations. Furthermore, ongoing research is aimed at understanding the long-term impacts of these antifouling measures on marine ecosystems. There is a growing push to develop methods that balance the operational needs of FOWTs with the imperative to protect marine biodiversity. This includes assessing the life cycle of antifouling substances and the potential for their accumulation and biomagnification within marine food webs.

During the installation of the anchors of the mooring systems and the laying and burying of the cables for the transport of the energy, a plume of resuspended sediments can be produced. These plumes create water turbidity, might affect pelagic fish eggs, and decrease megafaunal abundance along the sealine track, with negligible long-lasting effects.

3.1.9 Severity of the identified impacts

According to available knowledge based on the analyses reported in the specific literature on numerical modelling, available satellite and in situ observations and data analyses, the intensity of the reported impacts of FOWTs on the offshore and deep-sea ecosystem, can be summarised in Table 3 for the three characteristic phases namely construction, operation and decommission, respectively.

	Construction		Operation		Decommission	
Underwater noise	M	H	L	M	M	
Electromagnetic fields			L			
Water quality	M		L		M	
Impact on birds	L		L	M	L	
Seabed integrity	M	H	H		M	H
Changes in atmospheric and ocean dynamics			L	M		
Mooring lines and subsea cables: risks to marine mammals			L	M		
Risk of accidents	L		L		L	

Table 3 Intensity of environmental impacts during lifecycle of FOWTs. H=high, M=medium, L=low

It is important to emphasise that Table 3 provides only a global estimate of the intensity of different threats. The environmental impact assessment must be developed for each specific project, carefully analysing the circumstances that may influence the magnitude of the different impacts.

3.1.10 Environmental impact at global scale

Besides the local/regional impact of FOWT installations, as with any other big scale development, it is important to consider also effects produced at global scale as consequence of the procurement of FOWT components and its management along their entire lifecycle. A major concern is related to the sourcing and recycling of materials used for construction and the indirect impacts of those activities.

Mining of critical materials: There is an increasing demand of materials used to manufacture some components of FOWTs, as many of them are also used in other renewable generation technologies. Some of them have been already identified as critical raw materials, which raises concerns about the security of future supply and its collateral impacts. Examples of critical raw materials are the rare earth elements (e-g-, neodymium, praseodymium and dysprosium), which are needed for the manufacturing of permanent magnets for wind turbine generators. According to different scenarios, the future demand for these materials is expected to be several times greater than current production (the materials are also used for other applications), which would imply intensive mining in countries that possess these resources (Alves Dias et al., n.d.), with its potential collateral geo-political and socio-economic implications. The need for increased production could also lead to explorations in the deep ocean (deep sea mining) with effects that need to be carefully evaluated. To avoid excessive exploitation of some territories and political-economic dependence on some countries, offshore wind industry is asked to focus their efforts to minimise the use of these materials by developing new technological solutions but also to increase the circularity of critical materials in the manufacturing process.

Recycling of materials after decommissioning: According to the circularity approach, the design of wind turbines must consider the whole lifecycle from construction to decommissioning. Although approximately 85% of a turbine is recyclable because it is made up of metal components, blades made of fibreglass or, in more recent time of carbon fibre, represent a problem for future recycling, as it requires complex materials separation methods. It is expected that from 2030 to 2050 the wind industry will become the main generator of composite materials for disposal. Projects are already underway for the reuse of turbine blades in different sectors and for the identification of construction materials that are more easily recyclable. Moreover, many research teams all over the world are working on the development of fully recyclable turbine blades. For instance, at the end of 2023, researchers of the National Renewable Energy Lab (NREL) successfully used a novel-type recyclable resin to build a 9-meter blade prototype (Wang et al., 2024). Moreover, in 2023-2024 the US Department of Energy has funded a Wind Turbine Materials Recycling Prize, and, at the beginning of 2024, 20 US teams have been selected to proceed further with the development of their prototypes.

3.2 Criteria for sustainable deployment of FOWTs

3.2.1 Environmental Impact Assessment (EIA)

EIA is a crucial process in the planning and management of FOWT projects. This procedure allows the ecological and socio-economic consequences of specific proposals to be identified, predicted and assessed before their implementation. This is a fundamental step to minimise negative impacts and optimise the environmental benefits of the project.

The phases of the EIA process applied to FOWTs can be summarised as follows:

1**. Screening and scope**: Potential significant environmental impacts are initially identified and the scope and level of detail of the EIA are defined. This includes consideration of sensitive habitats, species at risk and socio-economic aspects.

2. **Data collection and baseline analysis**: This phase involves collecting data on current environmental conditions and how these may change in response to the development of FOWTs. This often requires field studies, modelling and consultation with experts. Baseline analysis should also consider the projection of climate change impact on environmental vectors, identifying possible trends, in order to establish a realistic reference baseline.

3. **Impact assessment and mitigation**: Once potential impacts are identified, their severity is assessed and mitigation strategies are developed to avoid, reduce or compensate for them. For example, construction techniques that minimise disturbance to the seabed or measures to reduce bird collisions with turbines can be adopted. Impact assessment and mitigation proposals must be tailored to each project, considering baseline characteristics and project planned activities. Project impact assessment should also integrate the synergies derived from climate change effects and/or evaluate the mitigation of those effects due to project development. Finally, it is important to assess impacts in a broader context, considering not only the individual impacts of a single FOWT but also the cumulative effects of multiple installations and other marine activities.

4. **Public participation**: a key aspect of EIA is the consultation and participation of stakeholders, including local communities, environmental experts and other interested parties.

5. **post-construction monitoring and management**: After the installation of FOWTs, continuous monitoring is carried out to ensure that mitigation measures are effective and to identify any unexpected impacts. This may require monitoring biodiversity, noise levels and the effectiveness of fishing exclusion zones.

6. **Evaluation of results**: Monitoring feedback is essential to inform adaptive project management. If negative impacts are greater than expected, additional mitigation measures may be necessary.

EIA is guided by national and European directives and laws and must be integrated into all development phases, from design to disposal. This process transfers the Precautionary Principle to projects approval mechanisms and ensures that impacts on marine species and habitats are minimised, whilst promoting renewable and sustainable energy production.

3.2.2 Mitigation measures: technological innovations and operational solutions to minimise impact.

Technological innovation is pivotal in addressing and mitigating the environmental impacts associated with industrial and development projects. It is important to stress that mitigation measures must be included in the FOWT design and must consider all the phases of the project (construction, operation, maintenance and decommissioning). A summary of main feasible technological interventions to minimise the impact on the marine ecosystem, most of which have already been detailed in previous sections, as well as operational measures, is given below.

Impact	Mitigation strategies
Underwater noise	• Mooring systems that minimise contact with the seabed, as for instance, use of taut or semi-taut mooring lines. • Design of floating platforms with improved noise reduction or acoustic isolation solutions. • Use of synthetic materials over traditional catenary designs of similar functional performance to reduce vibration transmission.

Impact	Mitigation strategies
	• Use of bubble curtain and other noise dampening systems during piling execution (when feasible and applicable) to attenuate impulsive noise. • Use of deterrent devices to temporarily keep fish and marine mammals away of main noise sources during works execution. • Suspension of noise generating construction and maintenance activities during biologically sensitive seasons such as breeding or feeding periods of relevant species present in project area. • Select appropriate work vessels and equipment that minimise noise generation during construction, operation and decommissioning stages.
Electromagnetic fields	• Shielding, burial and/or bundling for out-of-phase cables (where the voltage and current peaks are out of phase) • Selection of optimal export tension and amperage according to functional needs, seabed conditions and sensitive receptor groups.
Water quality	• Non-toxic coatings for biofouling prevention • Use of alternative cathodic protection or ICC corrosion prevention solutions
Impact on birds	• Increase of hub height and inter-distance among wind turbines. • Use of flashing lights instead of steady red lights for aeronautical signaling. • Implementation of bird detection technologies and automated braking and/or shutdown systems in the turbines. • Assessing the feasibility and effectiveness of using distinguishing colour for one rotor blade or other detection enhancement measures. • Use of acoustic and visual deterrents.
Impact on marine mammals	• Monitoring of marine mammals' presence by acoustic devices to release warning notices and increase surveillance during construction or maintenance operations to reduce collision risk.
Seabed integrity	• Avoidance or minimisation of seabed occupation on vulnerable and/or high diversity benthic communities (e.g., reefs, seagrass meadows). • Select soft bottoms lacking vulnerable biota for the location/penetration of the anchors. • Use of underwater vehicles or specific devices to precisely guide the anchor's descent and installation, reducing drag impact. • Limiting the length of mooring chains.

Impact	Mitigation strategies
	• Sharing of mooring lines among turbines when possible. • Use of cable laying and burial systems that minimise sediment removal and re-suspension.
Changes in atmospheric and ocean dynamics	• Design specific monitoring campaigns to measure relevant atmospheric and ocean variables and determine their natural variability. • Perform numerical simulations to evaluate the cumulative impact of the planned offshore wind farms at regional/basin scale and ensure that it is compatible with the conservation of biological systems.
Mooring lines and subsea cables: risks to marine mammals	• Design of mooring systems that minimise slack. • Develop and implement detection and deterrent systems to keep marine mammals away from high-risk areas. • Continuous monitoring to better understand the behaviour of marine mammals in proximity to FOWTs to improve mitigation strategies.
Risk of accidents	• Develop rigorous safety protocols during construction, operation and decommissioning activities. • Design mooring systems to prevent turbine detachment during extreme weather events. • Implement adequate marine signalling and strict maritime traffic controls in the vicinity of FOWF. • Continuous remote monitoring of FOWF performance for situational awareness and prompt response. • Implement predictive maintenance models. • Perform regular maintenance. • Develop a risk management plan.

Table 4 Mitigation strategies: technological innovation and operational solutions

Mitigation strategies can be facilitated by:

- **Data collection and monitoring**: Advanced sensor technologies and satellite tracking systems to enable continuous monitoring of environmental and operational conditions.
- **Digital technologies**: Machine Learning and Artificial Intelligence for predictive maintenance and to build the Wind Farm Digital Twin.

3.2.3 Compensation and restoration measures

When mitigation strategies are insufficient at preventing negative effects on marine ecosystems, a compensation plan that includes restoration measures shall be implemented. In Table 5 specific restoration measures focused on seabed and marine fauna, suggested in (Danovaro et al., 2024) are reported.

Impact	Mitigation strategies
Passive and active seabed restoration	• Protect the marine ecosystems within the wind farm areas to enhance natural recovery after construction stage. • Increasing of the rugosity of mined substrata to promote larval settlement by means of the deployment of artificial substrates. • Electrified artificial reefs to enhance survival/growth/recruitment rate of Cold-Water Corals on shallow areas. • Recruitment of larvae in shallow depths and translocation in deeper areas. • Transplanting fragments from coral donor colonies or rearing and transplant of nubbins of deep corals. • Deployment of hard artificial substrata or 3D structures for the recruitment and/or transplant of colonial organisms and improve larval settlement. • Addition of artificial sponges to enhance recruitment of associated fauna. • Replanting or transplanting seagrasses or other ecologies in the area interested by the sea cables reaching the shore. • Re-introduction of algal forests in shallow areas. • Collection of ecologically relevant organisms colonising the anchors or other infrastructures in situ and transplanting these organisms in suitable habitats for re-populating regions damaged by human activities.
Reducing other threads for affected species to increase populations survival	• Installing coastal nesting structures for threatened seabird species that help to reduce predation on eggs and chicks.
Restocking of target species of commercial interest	• Restocking of endangered species. • Creation of nurseries and/or restoration of impacted habitats in nearby areas. • Creation of aquaculture systems able to reproduce or maintain the target species of restoration.
Environmental cleaning	• Removal of abandoned infrastructures, removal of marine litter and ghost nets.

Table 5 Restoration measures

3.2.4 Cumulative Impact Assessment

As already mentioned, environmental effects of FOWTs must be evaluated in terms of cumulative impact of all the planned installations in a specific area. A Cumulative Effects Assessment methodology, using open-source geo-spatial software, is described in [Gusatu et al., 2021]. The aim of the study was to assess the impacts of OWF on selected seabed habitats, birds and marine mammal species. The methodology considers the specific pressures of the three phases of OWF development (construction, decommissioning, operation) for a period from 1999 to 2050, for the entire North Sea basin. In figure 2 weights of each of the 18 pressures identified for the three different phases and pressure propagation distance are depicted showing that, in terms of spatial magnitude, the construction phase tends to have a large area of impact through pressures such as underwater noise and marine litter, while the operation phase is characterised mostly by localised pressures.

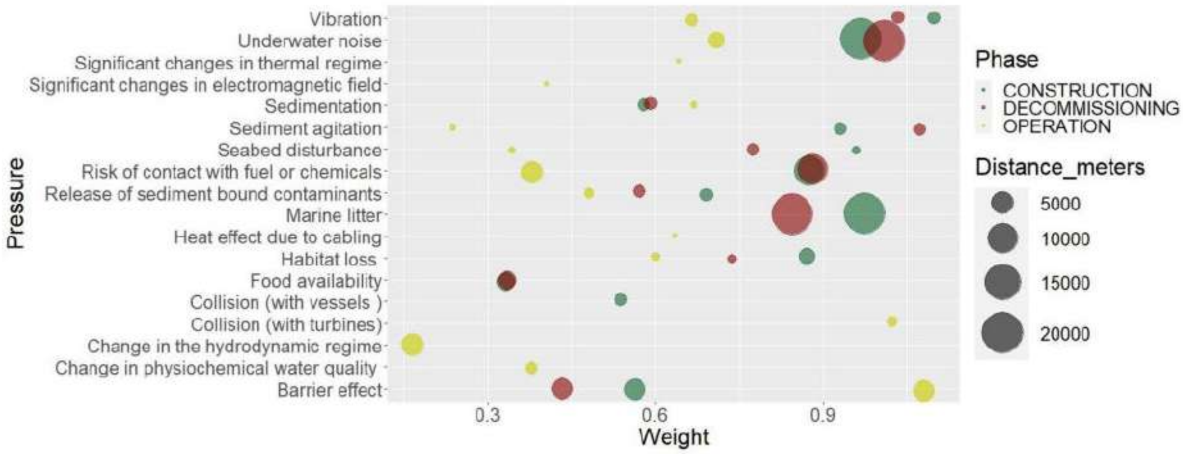

Figure 2 Pressure weights and pressure propagation distance reproduced from (Gușatu et al., 2021)

Equally important is the analysis of the cumulative impacts of different activities taking place at sea, including FOWTs. Results of this kind of analyses can provide robust criteria, reliable methodologies on which build standard procedure to facilitate decision-makers and the OWF industry in a joint effort to mitigate the environmental impacts of future large OWF developments and accelerate the authorisation process.

3.3 Environmental enablers

The major environmental enabler for FOW development, as well as for most of renewable generation technologies, is their significant contribution to the decarbonisation of the global energy system, by replacing current fossil fuel-based generation technologies. This progressive reduction of greenhouse gas emissions is indispensable to slow down the effects of climate change on the environment and particularly on biological systems, enhancing the opportunities to adapt and survive.

Climate change consequences, such as ocean warming, oxygen loss and ocean acidification among others, have significant effects on the majority of the marine biological communities: increasing frequent and prolonged marine heatwaves are causing bleaching and extinction of corals globally; latest estimates from the UN Educational, Scientific and Cultural Organization warn that more than half of the world's marine species may stand on the brink of extinction by 2100 (Heron S. F., et al., 2018). Considering this perspective, the simple fact of contributing to mitigate climate change can be considered as an environmental enabler.

With a more local focus, while the installation of floating offshore wind turbines may have some negative effects on the marine ecosystem, studies have also highlighted beneficial effects which will be outlined below.

3.3.1 Reef effects

The underwater structures of floating offshore wind farms, including moorings, anchors, and anchoring cables, provide solid surfaces that can be colonised by various marine species. Thus, these structural elements become artificial reefs, habitats that support increased biodiversity. The growth of organisms such as algae, corals, and mollusks on artificial substrates offers nourishment and protection for a variety of fish species and beyond, leading to a cascade of positive effects along the food chain (Abhinav et al., 2020; Galparsoro, Menchaca, Seeger, et al., 2022; Haberlin et al., 2022a; Vaissière et al., 2014; Hammar et al., 2016; Degraer et al., 2020; Mavraki et al., 2021; Lloret et al., 2022).

Studies have shown that, thanks to FOWFs, there is an increase in species typically associated with reef environments. Notable examples include populations of mussels and brown crabs that settle on the underwater structures, which offer both a substrate for attachment and refuge from predators. This increased biodiversity provides vital ecological services, such as water purification and support for broader ecosystems. The reef effect is particularly pronounced where previously sandy or muddy seabed dominated. Here, the turbines act as new ecosystems, promoting the presence of species that otherwise would not have suitable habitats to thrive. Furthermore, these new structures can serve as ecological corridors, connecting previously isolated marine populations and thereby facilitating migration and genetic diversity.

Moreover, it is worth mentioning the effect on certain species of seabirds that take advantage of the structures to rest or feed, benefiting from the increased concentration of prey around the turbine floats.

To maximise the benefits of the reef effect, careful management of FOWFs is essential. It includes long-term monitoring of ecological impacts and the implementation of construction and maintenance practices that consider the health of marine ecosystems.

3.3.2 Marine protected areas (the reserve effect on fish)

Although FOWTs are not designed primarily as conservation tools, their presence and the subsequent creation of Marine Protected Areas (MPA) can provide substantial benefits to marine ecosystems, like the positive effects found in designated marine protected areas. The installation of these wind farms often leads to restrictions on fishing activities, which reduces pressure on marine populations, allowing ecosystems to thrive (Abhinav et al., 2020; Farr et al., 2021b; Galparsoro, Menchaca, Seeger, et al., 2022; Haberlin et al., 2022a; Schupp et al., 2021).

This de facto creation of protected areas can lead to:

- **Growing areas**: No-fishing zones around FOWFs can become growing areas for juvenile fish and other marine life, which is critical to sustaining the life cycles of various species.
- **Habitat restoration**: The exclusion of some harmful fishing practices allows the recovery and restoration of damaged the seabed and habitats, which is vital for the conservation of biodiversity.
- **Spillover**: Marine protected areas, including those created inadvertently by FOWTs, can cause a spillover of fish and other marine organisms into adjacent areas, supporting local fisheries and improving long-term catch rates.
- **Research opportunities**: These areas offer unique opportunities for scientific research to study undisturbed marine ecosystems, which can improve our understanding of marine biology and inform conservation strategies.
- **Ecosystem resilience**: Marine protected areas can improve the resilience of marine ecosystems to external shocks, such as climate change and pollution, by maintaining healthy populations with diverse genetic lineages.
- **Socio-economic benefits**: Although FOWTs primarily serve as energy infrastructure, their role in creating protected areas can also lead to socio-economic benefits, such as increased ecotourism and sustainable fishing that relies on a healthy marine environment.

Careful planning and management of these areas are key to ensuring that the environmental benefits are fully realised.

3.3.3 Distributed Observatory System

Sensors used to monitor FOWTs during operation can constitute a Distributed Observatory System that can provide physical, chemical, and biodiversity data thus, valuable information on the status of the marine ecosystem and on the effects of climate changes far away from the coast.

These data can be used for various applications not limited at the management of the farm itself contributing to the Digital Ocean. Moreover, if appropriate digital technologies are utilized, it is possible to build on these data the Digital Twin of the farm and contribute to the Digital Twin of the Ocean-DTO.

4 INTERSECTION OF SOCIAL AND ENVIRONMENTAL FACTORS

The aim of this chapter is to present a summary of key factors that are considered cross-cutting to both social and environmental challenges and synergies, considering that the majority of environmental actions have also a social impact, as expressed throughout the document.

4.1 Identification of overlapping challenges

- Restoration of seabed damaged by trawling (actions to combat the depletion of fish resources by creating a protected marine area around the farm, creating new opportunities for fishermen, for example re-employment in offshore mariculture activities or in other activities linked to the FOWF).
- Monitoring and managing environmental impacts throughout projects lifespan.
- Protected areas (zones to safeguard marine ecosystem from potential disturbances).

4.2 Synergies and conflicts between social and environmental aspects

- Conservation of ecosystems.
- Monitoring environmental data.
- Creation of new professional figures with a multidisciplinary profile (e.g., focus on technological and environmental skills).
- Creation of new jobs related to technologies for sustainability and for the restoration of damaged habitats.
- Promotion of innovative start-ups linked to the development and application of green technologies.
- Development of new products and services for sustainable tourism (e.g. observation of new habitats grown around the farms due to reef effects).
- Creation of a local supply chain to support installation, energy storage and transmission.
- Creation of a land-based value chain for the energy produced.
- Distributed observatory system, contribution to the digital ocean and to the digital twin of the ocean (e.g., physical, chemical, biological, etc.).

5 CONCLUSIONS

5.1 Summary of key findings

Achieving successful co-existence between floating offshore wind farms and various sectors requires careful consideration of social, economic, environmental, and cultural factors, along with collaborative efforts and adaptive management strategies.

A comprehensive approach which integrates public awareness and education, government support, community engagement, and research development is essential for managing conflicts and facilitating the sustainable expansion of the offshore wind energy sector. By addressing these key pillars, stakeholders can navigate challenges, capitalise on opportunities, and realise the full potential of offshore wind energy for economic, social, and environmental benefit.

Floating offshore wind technologies (FOWTs) represent a promising renewable energy source, but their interaction with marine ecosystems entails a range of potential impacts. These include acoustic and electromagnetic disturbances, risks to seabirds including collision and habitat loss, alterations in seabed integrity, changes in atmospheric and oceanic dynamics, risks to marine mammals from mooring lines and subsea cables, accidents, and concerns regarding water quality. Mitigation strategies, such as the optimisation of the platform design, careful site selection, innovative anchoring techniques, and the adoption of environmental friendly antifouling measures, are essential to minimise potential impacts and ensure the sustainable development of offshore wind energy. Additionally, addressing global-scale concerns, such as material sourcing and recycling, is crucial for minimising environmental and socio-economic implications. Continued research and monitoring are necessary to fully understand and manage the complex interactions between FOWTs and the marine environment.

5.2 Recommendations for overcoming barriers.

5.2.1 Sustainable practices in offshore wind farm operations

It is evident that the integration of environmental strategies is crucial for mitigating the ecological footprint of FOWT installations. This section aims to summarise key sustainable practices that have been identified as pivotal in minimising impacts on marine ecosystems while ensuring the efficient operation of offshore wind farms.

1. **Site Selection and EIA**: A foundational aspect of sustainable offshore wind farm operations involves the careful selection of sites. Prioritising areas with lower ecological sensitivity and conducting thorough EIAs are critical steps in identifying potential impacts on wildlife and habitats. EIAs provide a framework for understanding the environmental baseline conditions and predicting potential changes, enabling the development of mitigation strategies tailored to local ecosystems.

2. **Technological Innovations for Impact reduction**: Advancements in turbine technology play a significant role in minimising environmental impacts. The development of quieter turbine models and the incorporation of blade designs able to reduce impact on seabirds are examples of how technological innovation can address specific wildlife concerns. Furthermore, innovations in

foundation designs, such as the use of suction buckets instead of traditional pile-driving techniques on soft seabed, can significantly reduce underwater noise pollution, identified as a key stressor for marine fauna.

3. **Adaptive management and monitoring programmes**: Sustainable offshore wind farm operations require ongoing adaptive management, supported by robust monitoring programmes to successfully track the actual environmental impacts against predicted models, allowing for the timely adjustment of operational practices. Monitoring the movements and behaviours of marine mammals, birds, and fish around wind farms contributes to a deeper understanding of turbine interactions, guiding the optimisation of turbine locations and operational protocols to minimise disturbances.

4**. Biofouling and corrosion management**: Biofouling on turbine structures and subsea cables can lead to ecological imbalances by providing unnatural habitats for certain species while potentially introducing non-native organisms. Employing non-toxic anti-fouling materials, cathodic protection and ICCP systems, exploring innovative solutions, represent sustainable approaches to managing biofouling and corrosion, thus protecting local biodiversity.

5. **Collaboration with stakeholders**: Engaging with a broad range of stakeholders, including local communities, environmental organisations, and regulatory bodies, is essential for the sustainable operation of offshore wind farms. Collaborative efforts can facilitate the exchange of knowledge, enhance regulatory frameworks, and ensure that the concerns of all parties are addressed in the management and expansion of wind farms.

6. **Decommissioning strategies**: Planning for the eventual decommissioning of wind farms is a critical component of sustainable operations. The development of strategies to ensure the removal of structures while minimising environmental impacts and restoring marine habitats is vital. Research into decommissioning techniques to minimise the disruption of marine ecosystems is an ongoing area of focus as well as the integration of circularity concept in the FOWTs design.

7. **Creation of multidisciplinary teams:** The design and installation of offshore wind farms based on principles of sustainability of the offshore and the deep-sea ecosystems require the involvement of experts in the fields of engineering, marine biology, ecology, and marine geology while also taking socio-economic factors into account. It is therefore necessary to create multidisciplinary working groups capable of finding the most appropriate technological solutions while minimising negative impacts and, when possible, favouring positive ones.

8. **Training new skills**: In parallel, it is desirable to train new generations of researchers and technicians capable of managing the complex interaction between FOWT farms and the environment.

In conclusion, the sustainable operation of offshore wind farms needs a multi-faceted approach that incorporates careful planning, technological innovation, continuous monitoring, and stakeholder engagement. By adhering to these principles, the offshore wind industry can significantly contribute to reach global renewable energy targets while preserving marine biodiversity and ecosystem health.

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7 ANNEX 1 INTERNAL SURVEY

7.1 Greece

Socio-economic sector position & characterization

	Socio - Economic sector (fisheries, real estate, tourism, agriculture, aquaculture, maritime traffic, local public administration, regional public administration, social movements, etc.)	*Description of the expected effect (even negative or positive) (incomes or investment reduction/increase, gain or loss of employment, etc.*	*Which is potentially the cause (visual impact, seabed occupation, noise, increase in employment, etc.)*	*Description of its current position according to representatives' expressions (if it depends on the country area, please explain)*
1	**Tourism**	Reduction of tourists at coastal resorts and hotels	Noise and visual impact during construction, maintenance and operation periods.	
2	**Aquaculture**	- Creation and increase of vibrations in the water layers that affect the fauna of the area. - Creation of man-made reefs, favoring the development of marine organisms.	- Noise and vibration. - Man-made reefs	
3	**Social movements**	Increase in local protests and demonstrations	Visual impact, restrictions on fishermen's operability, reduced fishing grounds and sports activities.	
4	**Maritime traffic**	Increase of travelling time in marine transportation routes	- Boats/ships cannot travel through offshore	

			wind farms and have to go around the farm	
5	**National economy**	- Reduced energy bills - Increase of investments in wind technologies in general - Reduction of fees for purchasing CO2 emission rights	- Cheaper energy production. - Economic potential of wind energy. - Replacement of fossil fuel for energy production	
6	**Local communities**	- Generation of new jobs. - Increased participation and profit of citizens via the exploitation of wind energy	- Need for further manufacturers, constructors, workers, and materials. - Awareness of wind energy capacity and potential profit	
7	**Regional public administrator**	Increase of taxes to regional authorities	Increase of installed offshore wind technologies	

Socio-economic barriers

RES	Socio-economic barriers	Description
Onshore wind	**Visual impact and noise affect citizens' social acceptance, paving the way for protests and demonstrations (Alma Economics, 2021).**	Local communities usually oppose onshore wind farms because of their impact on the landscape and the noise they generate. Although there is evidence that an onshore wind farm located several kilometers from the cities/villages may not be visible and its noise may be masked by the sounds of the environment, there may still be impacts on the local population.
	Visual impact and noise affect several regions (e.g.,	Local communities and entrepreneurs usually oppose onshore wind farms because of their impact on the landscape and the noise they generate during their construction and maintenance.

	islands, mountains), reducing tourist attraction.	
	Variable wind energy supply and increasing peak energy demand.	According to experts, the variability of wind energy supply and the increasing peak energy demand require the utilization of other energy sources from the Greek energy production system, especially fossil fuels. The uncertainty associated with wind energy poses obstacles to the adequacy of the system.
	Significant uncertainty in the market	There is an overall uncertainty in the market of renewables around the globe which affects also the Greek market thus creating barriers in investing in onshore wind energy.
Photovoltaic (Apotesis (n.d), https://apothesis.eap.gr/archive/search)	**Cost for installation, licensing and grid connection.**	Although the overall cost for a photovoltaic park is constantly decreasing, the rate of decrease is not as expected. The high prices across the entire supply chain are affecting the viability of photovoltaics and are currently barriers on the investments on solar energy.
	Lack of knowledge about the solar technology and consumers' concerns about its complexity and effectiveness.	Several engineers don't possess sufficient knowledge about photovoltaics and their efficiency, resulting in preventing citizens to install solar panels on their buildings.
	Occupation of arable fields	Local and regional communities oppose photovoltaic parks because of their landscape impact and occupation of arable fields, resulting in protests and demonstrations.

Socio-economic enablers and strategies to manage conflict.

Does the government or any local/regional administration lead a consultancy process or similar to manage stakeholders' engagement (as e.g. Concertation process on offshore wind projects in France)? *If it does, please provide a description of the process and how results from this process are included in the FOWT area selection, and auction process* (HEREMA, (n.d.), https://herema.gr/).

> Within a period of two (2) years from the end date of the first round of applications for Exploration Licenses, Hellenic Hydrocarbons and Energy Resources Management Company (HEREMA) launches a public consultation for the OWF installation areas within each Organised Area for OWF Development. These areas will be determined by a relevant Ministerial Decision.

4) Does the administration set up an offshore wind auction which includes socioeconomic criteria? If so, which criteria have been included?

> A competitive bidding process is launched by the Regulatory Authority for Energy (RAE) for the installation of OWF projects and the granting of operational aid on the basis of a sliding feed-

in-premium. Investors will be called upon to submit distinct bids for each OWF installation area (within the OWFODA), for which such investor holds a previous Exploration License. At this stage, the selection criterion will be the lowest bid price (in €/MWh) for the compensation of the energy produced through the OWF project, developed within the OWFODA. The successful investor will be granted the exclusive rights for the licensing, development, and exploitation of the OWF project (OWF Development: Licensing Procedure in Greece. (n.d.) https://herema.gr/offshore-wind/licensing/).

5) Has the government made a renewable auction (any technology) which included socioeconomic criteria? If so, which criteria have been included? Which percentage represents these socioeconomic criteria regarding the overall score?

In Greece, for several years the auctions for energy supply that were carried out included only the "lowest bidding winds the grant" socio-economic criteria. However, following the new regulations of the European strategy to boost the domestic production of green technologies, Greece will introduce non-tariff criteria in the RES auctions. In particular, it will introduce criteria that will require de-dependence from third countries through the domestic production of green technologies. These criteria will be made more specific by the EU in the near future.

6) Did the government or any local/regional administration lead a pedagogy campaign around renewable energy, offshore wind and climate change to increase citizen awareness to reduce opposition and the NIMBY effect? *If it did, please provide a description of the process/campaign and which are the results, such as if there is any increase on the awareness of climate change and/or renewable energy necessity or if there is a reduction on NIMBY movements.*

The Hellenic Wind Energy Association runs an awareness campaign (ΕΛΕΤΑΕΝ (n.d.), https://energypress.gr/news/enimerotiki-kampania-apo-tin-eletaen-gia-tin-aioliki-energeia-nea-istoselida-kai-entypo) through a dedicated website, where the general public can view the material and gain valuable information on how:

- The wind energy contributes to the reduction of climate crisis.
- The wind energy reduces the cost of the overall energy production.
- The Wind parks benefit the communities where they are developed.
- The wind energy offers energy independence.
- The wind turbines are recycled, and
- The wind energy and biodiversity go together.

So far, there is an increase in citizens' awareness about wind energy, but there are no specific results captured (quantitative and qualitative).

7) Describe enablers to the introduction of FOWT and other renewable energy sources that are specific to your country. Please provide details about strategies to manage conflict executed.

Enablers	Description

Low maintenance costs	Although the renewable energy sources require large investments, they have lower operating and maintenance costs once the infrastructure is in place, as sunlight and wind, for instance, are free and inexhaustible resources.
Creation of new jobs	Local communities can benefit from RES projects on the one hand by creating new jobs, such as workers and constructors needed for the installation and maintenance of the RES, and on the other hand by attracting more citizens due to local economic growth, resulting in market development.
Reduced energy bills	Through community-owned renewable energy projects, citizens can benefit from energy generation, providing electricity at competitive rates. Also, transitioning to renewable energy sources such as solar and wind reduces reliance on fossil fuels, which tend to be subject to price fluctuations.
Skilled workforce	Skilled workers possess the technical knowledge and expertise required to design, install, operate, and maintain renewable energy infrastructure. This includes understanding the complex engineering principles behind wind energy and electrical systems.
Experience in managing RES	Prior experience in RES projects provides managers with skills to assess market conditions, regulatory landscapes, technological advancements, and associated risks to develop effective implementation and operation strategies.

7.2 Italy

Socio-economic sector position & characterization

	Socio - Economic sector (fisheries, real estate, tourism, agriculture, aquaculture, maritime traffic, local public administration, regional public administration, social movements, etc.)	*Description of the expected effect (even negative or positive) (incomes or investment reduction/increase, gain or loss of employment, etc.*	*Which is potentially the cause (visual impact, seabed occupation, noise, increase in employment, etc.)*	*Description of its current position according to representatives' expressions (if it depends on the country area, please explain)*
1	Ports (Tourism)	**<u>Negative</u>**: Lower number of ships calling at the ports causing reduction in port's incomes with negative economic effects for the connected value	Occupation of large marine areas avoiding an easy transit of ships to ports.	*This topic has been raised by port and local authorities of the Puglia region where the potential impact of FOWT could be relevant due to the*

		chain and for the touristic sector **Positive**: economic advantages for ports during farm deployment due to the increase of traffic and operations. If ports are selected as hubs for FOWT deployment procedures, they will benefit from infrastructure upgrades. Furthermore, FOWT projects could attract tourists interested in visiting renewable energy installations.	The cause of positive effects is described in the left column.	*huge number of authorizations for FOWT installations requested. FOWT will be concentrated in specific marine areas in proximity of important ports for cargo and passenger traffic (Bari, Brindisi….* *Italy is currently moving towards the selection of two ports which will represent the official hubs for FOWT deployment to support the planned installations.*
2	Fishery	**Negative:** A, B, C affecting: i) costs (fuel and time) for fishermen with possible loss of jobs especially in the small fishery sector, ii) costs for consumers, iii) the sustainability of the sector because of the increase of GHG emissions. FOWT may also affect marine habitat in terms of generated noise and sea occupation.	A, B, C	In general fishermen are against FOWT installations

3	Defense	**Negative**: Conflicts between FOWT installations and military activities with effects on safety and security at sea **Positive**: co-existence between offshore renewable energy projects and defense operations for the co-use of infrastructures and of energy produced with possible co-sharing of construction/installation and maintenance costs also ensuring resilience of critical infrastructures.	Seabed, marine space and aerial occupation Co-use; Sensitive target	Studies at EU defense level are ongoing to evaluate the possible conflicts and synergies (Symbiosis project Italian defense is the proponent of an EU project (EDA project CAT B) focused on the protection of underwater space and critical infrastructures (European Defense Agency, 2022).
4	R&D, shipping and all blue economy sectors	**Positive** Data acquisition and monitoring of ocean physical and biological variables increasing knowledge on marine biodiversity, contributing to the Digital Ocean and to the Digital Twin of the Ocean and to the creation of new business models for large industries and	Distributed observatory system	These are key objectives of the Sustainable Blue Economy Partnership coordinated by Italy

		SMEs based on digital technologies		
5	Aquaculture Fishery	**Positive** Co-use limiting investments for the single sector and creating new jobs opportunities in the aquaculture sector with the possibility of relocating part of the workers of the fishing sector (fishermen and food chain operators)	Synergies	A number of national and EU projects have been funded
6	Coastal communities and residents on island	**Negative:** see point 1 **Positive:** Desalinization of seawater using renewable energy Lower costs of energy produced by renewable sources and economic benefits (subsidies etc.) Increase of jobs opportunities in the short-midterm to support the deployment of FOWT and in the long term if local value chains will be created	Increase of citizen's wellbeing and creation of economic benefits Employment generation, grants and subsides.	local and regional authorities emphasis the need to create economic benefits for coastal communities affected by the installation of offshore wind farms

7	Grid infrastructure upgrades	**Positive** Integration of FOWTs into the grid may require upgrades and expansion of grid infrastructure to accommodate the increased capacity and variability of renewable energy sources.	Significant amount of energy coming from FOWTs	A plan is already in place by the national TSO.
8	Supply chain	Local and national (also for O&M) Industry Development Economic Diversification	Establishment of local supply chains for FOWT components and services can stimulate manufacturing activity, create jobs, and foster innovation. FOWF projects offer opportunities for economic diversification in regions traditionally reliant on industries like oil and gas or traditional fishing.	Financial support for the development of the supply chain of FOWT in 2 Italian ports is planned.

Socio-economic barriers

Describe socio-economic barriers to the introduction of other renewable energy sources (bottom fixed offshore wind, onshore wind, photovoltaics, etc.) that are specific to your country.

Bottom fixed: the Mediterranean and the Italian Seas are in general characterized by a high depth, so bottom fixed installations would only be possible close to the coast. This would create a major visual impact in areas of great naturalistic value and an occupation of marine areas intended for other economic activities such as tourism, recreational boating etc. In the case of the only existing offshore bottom fixed nearshore wind farm **Beleolico**, the chosen site is an industrial area with low naturalistic value and the presence of large industrial plants. Problems in the consenting process were related to the different level and number of the several involved authorities (National, Regional, municipal bodies).

In the case of the Adriatic Sea, it is possible to install bottom-fixed offshore wind plants far from the coast. AGNES would be the first offshore bottom fixed plant combining wind and photovoltaics with hydrogen production and bunkering of the energy produced. Barriers are mainly related to the safe bunkering of energy which could be unfeasible along a very busy cost.

Onshore wind: There are no specific socio-economic barriers for onshore installations. Nevertheless, land occupation can affect local agricultural activities. The land designated for wind turbine installations will anyhow remain under the agricultural entrepreneur's use, with the exception of the area around the turbines and the needed infrastructures. Opposition from local communities, often driven by Not-In-My-Backyard (NIMBY) sentiments, have been observed in some regional areas and can hinder the deployment of renewable energy projects. Concerns about noise, visual impact, and perceived property value reductions may lead to resistance and legal challenges.

Photovoltaics (offshore): high economic risk (low TRL) for investors due to the delicate nature of the systems when subjected to the action of severe weather and sea conditions.

Photovoltaics (onshore): power plant area is leased from the landowners. Nevertheless, land availability is reducing. This is being faced by the so called agrivoltaic strategy joining PV with agricultural activities. In any case, some local oppositions have been observed also for PV installations.

Socio-economic enablers and strategies to manage conflict.

Does the government or any local/regional administration lead a consultancy process or similar to manage stakeholders' engagement (as e.g. Concertation process on offshore wind projects in France)?

If it does, please provide a description of the process and how results from this process are included in the FOWT area selection, auction process, etc.

A public consultation of all stakeholders is performed during the procedure for the maritime state-owned property (see response to Q13 of the country survey on consenting process and deliverable 1.1).

4) Does the administration set up an offshore wind auction which includes socioeconomic criteria? If so, which criteria have been included?

Socio-economic criteria are only included in terms of number of employees needed for the construction and deployment of the plants (minimum 15)

5) Has the government made a renewable auction (any technology) which included socioeconomic criteria? If so, which criteria have been included? Which percentage represents these socioeconomic criteria regarding the overall score?

According to information currently available regarding the draft of Decree FER 2, for any auction a quota will be set for each considered technology. Quotas are expected to be related to specific geographical area.

The anticipated feed-in tariff, which serves as the base auction price for offshore wind, seems to have been set at approximately €185 per megawatt-hour (MWh). No further measures related to socio-economic aspects are announced.

6) Did the government or any local/regional administration lead a pedagogy campaign around renewable energy, offshore wind and climate change to increase citizen awareness to reduce opposition and the NIMBY effect? *If it did, please provide a description of the process/campaign and which are the results, such as if there is any increase on the awareness of climate change and/or renewable energy necessity or if there is a reduction on NIMBY movements.*

There are no structured and adequately advertised-initiatives.

7) Describe enablers to the introduction of FOWT and other renewable energy sources that are specific to your country. Please provide details about strategies to manage conflict executed.

Socio-economic enablers: 1) Increase cultural awareness among citizens, 2) Exploitation of the work done and the results achieved within the numerous past and ongoing relevant R&D projects at EU, National, sea-basin and subsea-basin level, with particular attention to those focused on stakeholders' engagement and by the creation of 5 helix communities 3) creation of a local value chain to exploit the economic benefits of energy production.

A complete and implemented MSP can help managing conflicts.

7.3 Portugal

Socio-economic sector position & characterization

	Socio - Economic sector (fisheries, real estate, tourism, agriculture, aquaculture, maritime traffic, local public administration, regional public administration, social movements, etc.)	*Description of the expected effect (even negative or positive) (incomes or investment reduction/increase, gain or loss of employment, etc.*	*Which is potentially the cause (visual impact, seabed occupation, noise, increase in employment, etc.)*	*Description of its current position according to representatives' expressions (if it depends on the country area, please explain)*

1	Fisheries	Mostly A, B, C; Equally D, G, H, to a certain degree	Allocated areas for FOW will partially overlap with fishing grounds and constraint fishing fleet navigability. Concerns with the impact of export cables landing points have also been expressed.	After initial rounds of comments, the limits of the allocated areas have been redefined. There are concerns that FOW implementation will lead to the relocation of fishing effort and overexploitation of certain areas. Also, that working areas of fishing professionals become inoperable, causing professionals to carry out their activity in areas closer to the coast, typically already overcrowded with fishing gear and vessels. Impacts on fisheries are a concern for all the areas in the country, given that it is a traditional sector and, as such, relevant fishing communities are generally evenly spread along the coastline. Although the likely positive national economic impacts of investments in FOW have been recognized, it has been highlighted that the affected territories are not always adequately compensated for the

				negative effects they generate. Inasmuch as restriction on access to traditional fishing areas directly affects the livelihoods of fishermen and dependent jobs on land, it has been suggested that, whenever necessary, adequate compensation should be provided as a last resort.
2	Tourism / Recreation & Leisure	L, P, and, less directly, I, N, V	Visual impact (landscape degradation). Occupation of areas for maritime sports and recreation.	Concerns with landscape degradation, harm beach areas with high tourism potential, and interfere with maritime sports and recreation. Potential interference with the Ericeira area, where a World Surfing Reserve is delimited. It has been suggested to reconcile wind farms with scientific and recreational diving activities in the case of identified relevant cultural heritage. Impact on wave resource to be

				assessed, whenever sites with waves of particular value for surfing or other sliding sports are potentially affected.
3	Maritime traffic	C	Allocated areas overlapping with ship routes and ports entrance.	Though in general navigation lanes do not cross areas allocated for FOW, they come close to western delimitations in a few cases (Ericeira, Figueira da Foz). Although 5-6 km wide approximation cones to ports have been taken off preferential areas for FOW implementation, areas should be adapted to account for navigation towards large commercial ports.

Where:

A. Impact of FOWT on loss of fishing grounds.
B. Impact of FOWT on the fishermen's flexibility and restriction on their operability
C. Impact on travelling time for fisheries, local communities, and goods and services marine transportation routes (due to having to go around the farm)
D. Impact on fishermen in terms of security of employment, income, and decision making.
E. Impact of FOWT safety rules, co-location, and displacement on unhealthy fisheries competitiveness

Co-funded by the European Union

F. Impact of FOWT on the fishing market in coastal communities.
G. Impact of reduced fishing grounds due to FOWT on the unhealthy competition among local fishermen.
H. Impact of FOWT on fishermen's fishing gear.
I. Impact of FOWT noise on coastal resorts and hotels in the area during construction, maintenance, and operation periods.
J. Impact of FOWT on Aquaculture.
K. Real estate value reduction
L. Recreational boating and/or sport activities limited or affected by the FOWT farm.
M. Agriculture incomes reduction
N. Cultural heritage.
O. Positive gross added value
P. New activities related to tourism/recreational boating.
Q. New activities related to R+D on marine energies development or environmental aspects monitoring.
R. Employment generation
S. Development of the supply chain of the FOWT.
T. Specialised training and education related to FOWT.
U. Compatibility of uses (including aquaculture, tourism, fisheries activities).
V. Artificial reef and marine protected areas.
W. Development of communication platforms.
X. Lower electricity rate

Socio-economic barriers

Describe socio-economic barriers to the introduction of other renewable energy sources (bottom fixed offshore wind, onshore wind, photovoltaics, etc.) that are specific to your country.

Complex bureaucratic processes and regulatory hurdles impacting swift project development. Opposition from local communities due to concerns over landscape impacts, noise, and potential declines in property values. Conflicts with environmental protections, agricultural uses, or cultural heritage sites. The Portuguese compact geography and high value placed on coastal and scenic areas complicate site selection for wind and solar projects. In the case of the Wind Floating Atlantic, compensation schemes were implemented to account for any loss of income or disruption to fishing activities due to the construction and operation of the FOW farm.

Socio-economic enablers and strategies to manage conflict.

3) Does the government or any local/regional administration lead a consultancy process or similar to manage stakeholders' engagement (as e.g. Concertation process on offshore wind projects in France)? *If it does, please provide a description of the process and how results from this process are included in the FOWT area selection, auction process, etc.*

Yes. The government led a public hearing about the preliminary areas proposed for offshore wind with the purpose of obtaining stakeholders' views. All stakeholders' contributions were heard, and their suggestions/requests taken into consideration, including those from the entities represented in the Advisory Committee for the elaboration of the Allocation Plan for Offshore Renewable Energies (PAER). A report was prepared about the public hearing. In a second phase, the government opened public consultation on the draft Plan. The public consultation report is currently being prepared.

4) Does the administration set up an offshore wind auction which includes socioeconomic criteria? If so, which criteria have been included?

The rules of the offshore wind auction are not yet established, but there are signals suggesting that socioeconomic criteria may be incorporated.

5) Has the government made a renewable auction (any technology) which included socioeconomic criteria? If so, which criteria have been included? Which percentage represents these socioeconomic criteria regarding the overall score?

To date, the renewable energy auctions in Portugal have focused primarily on technical and economic criteria, such as the capacity of projects, their connection to the network, and the financial viability of the bids. Socioeconomic criteria have not been included in a direct explicit way.

6) Did the government or any local/regional administration lead a pedagogy campaign around renewable energy, offshore wind and climate change to increase citizen awareness to reduce opposition and the NIMBY effect? *If it did, please provide a description of the process/campaign and which are the results, such as if there is any increase in the awareness of climate change and/or renewable energy necessity or if there is a reduction on NIMBY movements.*

Not to my knowledge.

7) Describe enablers to the introduction of FOWT and other renewable energy sources that are specific to your country. Please provide details about strategies to manage conflict executed.

Portugal's specific enablers for the introduction of floating offshore wind and other renewable sources include its favorable geographic and climatic conditions, supportive government policies, and strategic investments in innovative technologies. The government is preparing the country's first offshore wind auction offering an increased overall target of 10 GW of capacity. This move underscores the national strategy to accelerate renewable energy deployment, particularly emphasizing the potential of floating offshore wind. The use of floating photovoltaic solar power plants on dam reservoirs, demonstrates the country's commitment to exploring and implementing cutting-edge technologies to enhance its renewable energy mix.

7.4 Spain

Socio-economic sector position & characterization

	Socio - Economic sector	*Description of the expected effect (even negative or positive)*	*Which is potentially the cause*	*Description of its current position according to representatives' expressions*

1	*Fisheries*	Income reduction. Light disruption in fishing activities due to seabed occupation, which may lead to loss of employment.	Seabed occupation, fear to biomass stock reduction and unhealthy competitiveness for fishermen.	The whole collective express concerns over potential disruption. In regions as Galicia and Asturias the position against the technology is harder than in other regions as Catalonia, due to the importance of the fisheries as sector within the region. In Canary Island, the opposition varies depending on the island, being harder in Tenerife where the areas for offshore wind are closer to the coast.
2	*Tourism*	Potential impact on coastal aesthetics and view due to offshore structures. Reduction on tourism incomes.	Visual impact, potentiel noise pollution. Reduction of tourists and tourist average expense.	Economic reliance, landscape attraction, and identity concerns. Tourism sector has higher weight in the economy of regions as Catalonia or Canarias than Galicia.
3	*Aquaculture*	Potential opportunity for the industry.	Potential seabed occupation, increase in employment, and industry development	There is very little aquaculture in Spain, present in the Canary Islands. The concern is focused on the distance of these facilities from the coast.
4	*Maritime traffic*	Potential alterations in maritime routes	Employment opportunities, potential strain on resources	Unclear position, emphasis on the need for clear actions and defined routes.
5	*Local public administration*	Economic and infrastructural development or challenges.	Visual impact, environmental impact, Positive gross added value, Employment generation, Development of the supply chain of the FOWT, Specialised training and	Mixed opinions within local administrations; strong opposition emphasizing the importance of listening to scientists and the negative impact on cultural heritage and tourism in areas as Catalonia; other representatives express concerns about lack of clear positions from higher authorities and the need for a

			education related to FOWT.	debate on renewable energy alternatives. There are other group of local administration see offshore wind as an opportunity to grow local employment and industry.
6	*Scientific community*	Possible environmental impacts, opportunities for research on FOWT	Increased research opportunities, potential collaboration	The scientific community may welcome the chance for research and collaboration on renewable energy, but concerns might be expressed about potential environmental impacts. Groups as CSIC in Catalonia show opposition to the technology based on the accumulative impact on the area.
7	*Real state*	Value reduction and tourism appeal	Visual impact on the landscape, potential loss of uniqueness of the site, and concerns about the devaluation of the tourism-dependent economy	Concern devaluation of the real estate and banalization of the site's identity
8	*Agriculture*	Threat to agricultural land and concerns about productivity	Land occupation during the execution phase, evacuation line (both aerial and buried) impact on agricultural activities	Concerns about the threat to agricultural land, potential harm to the apple and oil production in Catalonia, and serious concerns about jeopardizing food sovereignty
9	*Recreational sailing*	Concerns about navigation	Seabed occupation in the navigation zone	Strong concerns emphasizing the loss of environmental value and potential negative impact on the Costa Brava's (Catalonia) appeal to sailors; uncertainty and the need for precautionary principles are highlighted

10	*Cultural heritage*	Potential impact on the cultural and historical essence of the region	Visual impact on the landscape, potential disruption of cultural activities	The area in Catalonia is well-known to be the inspiration of renowned writers and artists, as Dali. Some people there have express strong opposition; stakeholders express concerns about the irreversible impact on that cultural heritage. This is also related to Galician area and fisheries. Their cultural heritage is related to that tradition of working in fisheries.

Socio-economic barriers

> Describe socio-economic barriers to the introduction of other renewable energy sources (bottom fixed offshore wind, onshore wind, photovoltaics, etc.) that are specific to your country.

The introduction of offshore wind energy sources in Spain faces socio-economic barriers primarily because this technology is novel and unfamiliar in the country. With no prior history of offshore wind projects, communities are finding it challenging to accept these installations. The unfamiliarity with this form of renewable energy generates resistance to change and prompts questions about potential impacts on the local environment, fishing activities, and tourism.

Consequently, the socio-economic barriers arise from the novelty of offshore wind in Spain, where communities are grappling with the concept of introducing wind energy sources into the sea, a domain traditionally devoid of such structures. Effectively addressing these barriers necessitates comprehensive communication, community engagement, and establishing a clear understanding of the potential impacts and benefits associated with offshore wind projects.

Particularly, in the experience in other renewables energy technologies, the concerns and barriers in Spain have related to topics as:

- How the management of their development and execution has been done with low transparency to the inhabitants in the area, just doing contacts to those landowners that the developer buys or rents the land for the plant and some local authorities, which has created an environment against those kinds of projects.
- In the case of onshore wind farms, the lack of distance from village or isolated houses of some units or the evacuation line has been a cause of concern and opposition.
- Although those municipalities where the renewable plant is installed increases its taxes collection, and some of them receive additional compensation, other surrounding municipalities that consider they are impacted by the plant (mainly visual impact) do not receive nothing.

- The loss of land of agricultural high value, particularly when has been related to expropriation processes and low payments due to the declaration of public utility for the execution of evacuation lines, has been another barrier.

Socio-economic enablers and strategies to manage conflict.

3) Does the government or any local/regional administration lead a consultancy process or similar to manage stakeholders' engagement (as e.g. Concertation process on offshore wind projects in France)? *If it does, please provide a description of the process and how results from this process are included in the FOWT area selection, auction process, etc.*

In Spain has not been executed an extended process as in France, where a specific large public consultation in a zone-by-zone approach has not been carried on. The minister responsible of the Spatial Maritime Plan elaboration has been conduct some sectorial meetings and this regulation has been submitted to public consultation. The new regulatory framework, which is currently under public consultancy, will regulate the auction and permitting of offshore wind projects, includes a public dialog after the call for an auction. However, its duration and how it would impact on the basis of the auction is not ready clear.4) Does the administration set up an offshore wind auction which includes socioeconomic criteria? If so, which criteria have been included?

In Spain, the auction has not yet been set up. Last year a change in the electric sector regulation included the possibility to consider socioeconomic criteria up to 30% of the awarding criteria. The new regulatory framework under public consultancy includes this possibility.

5) Has the government made a renewable auction (any technology) which included socioeconomic criteria? If so, which criteria have been included? Which percentage represents these socioeconomic criteria regarding the overall score?

Yes, the auction of grid connections points and renewable energy projects, as thermosolar, include socioeconomic criteria. There is short experience applying them and there were more related to future commitments than previous work executed by developers.

6) Did the government or any local/regional administration lead a pedagogy campaign around renewable energy, offshore wind and climate change to increase citizen awareness to reduce opposition and the NIMBY effect? *If it did, please provide a description of the process/campaign and which are the results, such as if there is any increase on the awareness of climate change and/or renewable energy necessity or if there is a reduction on NIMBY movements.*

The general feeling in Spain is that in general government and local/regional authorities has not been effective explaining the climate change and its impacts on our daily lives, how renewable energy and energy transition can contribute to mitigate that effect and a properly assessment on the pros and cons of each technology. The approach has varied at regional and local level and there is heterogeneity in the results of their heterogeneity of campaigns.

In the case of offshore wind, the introduction of this technology to the citizen has been led by developer and supply chain and the administration had engaged later.

7) Describe enablers to the introduction of FOWT and other renewable energy sources that are specific to your country. Please provide details about strategies to manage conflict executed.

Based on previous experience in renewable energy projects:

- **Transparent Communication:** Establish transparent communication channels to disseminate information about the renewable energy projects. Providing accurate and accessible information to the public helps in building trust and managing expectations. Clear communication can address concerns and misconceptions, reducing the likelihood of conflicts arising from misinformation.
- **Environmental Impact Assessments:** Conduct thorough Environmental Impact Assessments (EIAs) before initiating any renewable energy project. By assessing potential environmental impacts and involving relevant stakeholders, the projects can be planned and executed in a way that minimizes negative effects on ecosystems and local communities. This approach contributes to conflict prevention and ensures sustainable development.
- **Community Benefit Agreements:** Establish Community Benefit Agreements (CBAs) to ensure that local communities directly benefit from renewable energy projects. This may include economic incentives, job creation, or investments in local infrastructure.
- **Continuous Monitoring and Adaptation:** Implement a continuous monitoring system to track the socio-economic and environmental impacts of renewable energy projects. This allows for ongoing assessment and adaptation of strategies to address emerging conflicts. By staying vigilant and responsive, potential issues can be identified early, and corrective measures can be implemented promptly.

Besides the points above, for the future offshore wind farms, additional approaches could be:

- **Engage with the Fishing Community:** Organize specific meetings with the fishing fleet to actively listen to their concerns regarding routes and fishing grounds. This proactive engagement helps identify potential conflicts early on and allows for collaborative solutions to be developed. By involving the fishing community in the decision-making process, a sense of shared responsibility and understanding can be fostered.
- **Conduct Comprehensive R&D&I Projects and/or pre-commercial offshore wind farms**: Execute prior Research, Development, and Innovation (R&D&i) projects of **pre-commercial offshore wind farms** in the areas earmarked for industrial parks. This includes extensive data collection, creating awareness among the local population about the benefits and potential challenges of renewable energy projects, and ensuring the safety and security of the scientific community involved. These projects serve not only to gather valuable insights and mitigate potential conflicts but also to foster a culture of informed decision-making within the affected communities.

7.5 United Kingdom

Socio-economic sector position & characterization

	Socio-economic sector (fisheries, real estate, tourism, agriculture, aquaculture, maritime traffic, local public administration, regional public administration, social movements, etc.)	*Description of the expected effect (even negative or positive) (incomes or investment reduction/increase, gain or loss of employment, etc.*	*Which is potentially the cause (visual impact, seabed occupation, noise, increase in employment, etc.)*	*Description of its current position according to representatives' expressions (if it depends on the country area, please explain)*
1	General Public	Sustainable power generation	Low carbon energy	79% of positive respondents cited sustainable energy creation as the reason for positive responses.
2	General Public	Reduced electricity prices	Increased local/domestic generation capacity	Only 33% of positive respondents believe it would reduce the price of energy.
3	General Public	Positive gross added value	Increased local/domestic generation capacity	33% of people thought it would add to the economy. Scotland offshore wind: Whereas in Scotland 89% of respondent think that renewable energy sector is important for Scottish economic value and 66% of respondents who live next to the coastline think the development provides a boost to the local economy.
4	General Public	Increased energy security	Increased local/domestic generation capacity	83% of people are worried about energy security. 85% of people said that they supported offshore wind. 56% cited a reduced reliance imported energy

5	General Public	Employment generation	New employment opportunities in FOWT	Only 34% cited the importance of job creation. Scottish offshore: 20% responded better job creation than expected.
6	General Public	Change the character of the area	Visual impact	68% of those against offshore wind cited the views as being the greatest concern. Scotland offshore wind: 34% of respondents who live next to the coastline think that offshore wind farms detract from the traditional image of the coast, 34% also believe they don't.
7	General Public	Economic impact	Decline in house price	36% of respondents think it will negatively affect the house prices in their area. Scottish offshore wind: 41% of respondents this that offshore wind farms are a positive feature of the landscape. 70% of respondents indicated no impact on the value of their home, whereas 10% reported a positive impact and only 3% reporting negative.
8	General Public	Harm to wildlife	Marine and seabed occupation environment	52% fear the impact on the local flora and fauna.
9	National Public Administration	Specialised training in future technologies	New educational and employment opportunities related to FOWT	
10	National Public Administration	Domestic and local supply chain specialism	Development of supply chain for FOWT	Scottish offshore wind: 33% indicated that offshore wind had improved local infrastructure

11	Environmental	Reduced biodiversity	Offshore operations and installations reduce habitats and deter marine species	Natural England support government plans for offshore wind but recommend actions to mitigate damage to marine species.
12	Environmental	Harm to marine species from Electromagnetic fields (EMF)	EMF from cabling at the wind farm. Dynamic cables cannot be buried to shield from EMF.	Natural England has commissioned several bodies of work at looking at the ecological impacts EMF being one.
13	Environmental	Cumulative impact of marine activities on marine wildlife	Marine environment	Natural England is researching the cumulative effects.
14	Environmental	Increased knowledge and R&D into marine ecosystems	Monitoring infrastructure on turbines and platforms	Natural England is researching installing cameras and other environmental sensors on turbines to better understand the local environmental conditions and species.
15	Fisheries	Concerns over the security of employment, income, and social "voice"	Shift in economic activity in the coastal areas from traditional fishing to wind farms	Greater than 50% of respondents considered changing industries as a result of new developments.
16	Fisheries	Loss of revenue	Compound effect of multiple factors disrupting fishing activities	57% of respondents reported negative outcomes on catches and profitability. 1 respondent responded positively.
17	Fisheries	Loss of fishing grounds	Increased competition in the maritime area and buffer zones around the turbines	80% of the wind farms in the UK are viewed as impacting fishing grounds with fishing activities being undertaken elsewhere.
18	Fisheries	Reduction of the fishing market and change to the economic focus in coastal communities	Increased activities related to the wind farm detract from traditional fishing	Fishing Liaison with Offshore Wind and Wet Renewables (Scottish Fishing Sector) FLOWW foster good relations between the two industries. Chaired by The Crown Estate.

19	Fisheries	Reduced flexibility and restrictions on fishermen's activities	Increased competition in the maritime area	Disproportionate impact on scallop and whelk fishing grounds
20	Fisheries	Security and safety fears	Increased risks and fears of accidents due to interactions between the fishermen vessels-gear and the wind farm equipment	Fear over subsea cabling, EMF, and entanglement, causing capsizing.
21	Fisheries	Loss of fishing gear and incompatibilities	Interference with vessel RADAR for navigation and entanglement of fishing gear with farm equipment	Fishermen reported changing of fishing gear due to new installations. Towed gears are unable to operate safely in the turbine arrays.
22	Tourism	Negatively impact tourism in the area	Noise from construction, operation, and maintenance periods	Scottish offshore wind farms: 81% of respondents said that their choice of destination would not be impacted by the visual presence of an offshore wind farm
23	Tourism	Potential new opportunities	Wind farms can be a tourist attraction	Scottish offshore wind: 34% agreed that they create new recreational opportunities 20% disagreed.
24	Tourism	Limitation of recreational boating and water sport activities	Increased competition in the maritime area	Scottish offshore wind: 49% of respondents neither disagreed nor agreed that offshore wind farms will improve the quality of recreational experiences. Over 76% of recreational coast users support offshore wind farm for the following activities (Beach games, wildlife watching, walking, swimming, recreational fishing, sailing, beach clean ups, kayaking, rowing and canoeing).

25	English Heritage	Loss of cultural heritage	Shift in the character of coastal from traditional fishing to generation hubs	Heritage can be applied to maritime sea space. Archaeological exclusion zones. Historical Seascape Characterizations Unexplored Ordinance (UO) for previously undeveloped areas of the sea. Protection of Wrecks Act 1973 Ancient Monuments and Archaeological Areas Act 1979 Protection of Military Remains Act 1986
26	Social Movements	Rebranding as a “green community” progressing net zero	Wind farms can signal that the community is engaged in mitigating global climate change.	Scottish offshore wind: 92% of respondents think that renewable energy is important for social values.
27	Aquaculture	Reduced space for aquaculture	Increased competition in the maritime area	Scottish salmon is globally recognized as a producer of premium products. Livestock welfare, disease management, and carrying capacity are key issues.
28	Aquaculture	Effect of wind farm on product quality	Increase activity in the area, i.e., greater pollution.	
29	Aquaculture	Opportunity for multi-use zones	Siting of FOWT is an opportunity for colocation with aquaculture due to shared infrastructure.	Efficient use of the marine space. Species selection is key as fin fish require regular tending, health monitoring, and surface access making them more suitable to nearshore locations. Lower trophic level species such as seaweed and shellfish.

30	Renewable Energy Developers (wave, floating solar, electrolysers)	Opportunity for hybrid generation systems with nascent technologies	Shared infrastructure (cabling and substations) is an opportunity for shared generation space between energy developers.	Wave Energy Scotland have shown significant interest in collocating with floating offshore wind. The Dolphyn project is also an ongoing colocation project with floating offshore wind and hydrogen. DESNZ recently announced consultations for AR7 on hybrid metering for shared developments with the aim of removing financial barriers. CfD payments will be made at the point of generation not Balancing Mechanism Unit (BMU) level.
31	Maritime traffic	Delays to port activities, social travel, shipping, and fishing	Routing of maritime transportation around wind farms can increase travel time	

Socio-economic barriers

Describe socio-economic barriers to the introduction of other renewable energy sources (bottom fixed offshore wind, onshore wind, photovoltaics, etc.) that are specific to your country.

In case there is no floating offshore wind deployment yet in your country, but there is bottom fixed offshore wind deployment, please answer questions as well (let us know).

While still in its early stages, the industry is witnessing an increasing number of developers conducting evaluations of the social and economic implications associated with investing in offshore wind farms. The following companies are making strides in overcoming barriers related to socioeconomic factors:

- Beatrice Offshore Windfarm Limited (BOWL) project: SSE and BOWL partners undertook their "first social return on investment analysis to assess the contribution of the project expenditure to the UK and Scottish economies and understand wider implications to society and economy". Factors considered were.

The UK encounters various socioeconomic obstacles, including:

- **Impact on local communities:** Offshore wind farms often encounter resistance from local communities due to concerns regarding visual impact, noise pollution, and disruption to traditional industries like fishing and tourism.

Initial Investment Costs: The substantial upfront expenses linked with offshore wind projects can act as deterrents, dissuading investors and developers from embarking on projects.

· **Employment Challenges**: While offshore wind projects offer employment opportunities, there are hurdles in ensuring that these positions benefit local communities. Addressing skills gaps is crucial to ensuring local workers can access employment opportunities in the sector.

· **Infrastructure and Grid Integration**: Establishing offshore wind farms necessitates significant infrastructure investments, such as constructing transmission lines to link them to the national grid. Delays or complications in grid integration can impede the progress of offshore wind projects.

· **Regulatory Framework**: The regulatory framework overseeing offshore wind projects may impede development, characterised by intricate permitting processes and regulatory ambiguity, leading to increased project costs and timelines.

· **Access to Financing**: Securing financing for offshore wind projects can be challenging, especially for smaller developers or community-led initiatives, which may encounter difficulties in obtaining investment capital or favorable financing terms.

Overcoming these socioeconomic barriers demands a comprehensive approach involving stakeholder engagement, policy reinforcement, investment in infrastructure and skills enhancement, and endeavors to ensure the equitable distribution of offshore wind project benefits among communities.

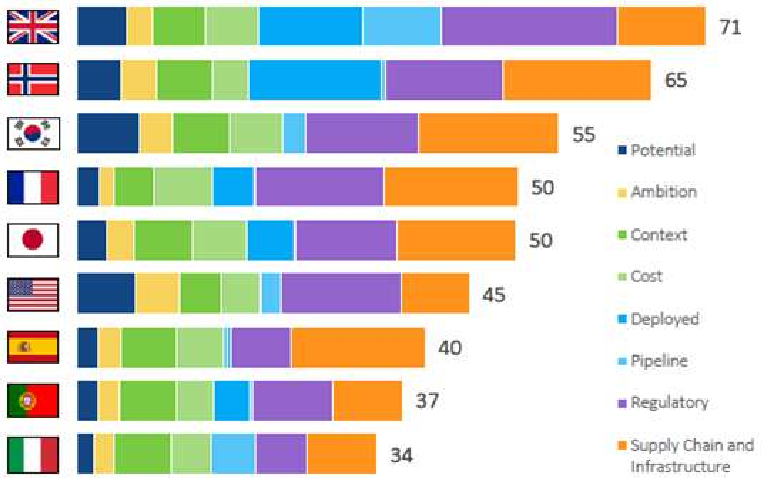
Socio-economic enablers and strategies to manage conflict.

3) Does the government or any local/regional administration lead a consultancy process or similar to manage stakeholders' engagement (as e.g. Concertation process on offshore wind projects in France)? *If it does, please provide a description of the process and how results from this process are included in the FOWT area selection, auction process, etc.*

Globally, 104.2 GW of offshore wind capacity is operational, under construction, or has reached Final Investment Decision (FID) status, with China leading with 32.5 GW, followed by the UK (14.8 GW) and Germany (8.2 GW) in 2023. The UK has positioned itself as a leader in offshore wind energy, evident through projects like Hornsea 1, 2, and 3. Despite setbacks, such as the disappointing Contract for Difference (CfD) auction in 2023, the government maintains its commitment to offshore wind expansion. Policies including sustainable administrative strike prices, support for clean energy manufacturing, and streamlined planning processes underscore this commitment.

Recent advancements include increased administrative strike prices for CfD Allocation Round 6 (AR6) and the introduction of Sustainability Industry Rewards (SIRs) to promote decarbonization and local economies. Leasing Round 5 has been condensed to three sites, and projects reaching FID after November 22nd, 2023, are exempt from the Energy Generator Levy. The budget for AR6 will be disclosed on March 13th, 2024, with bidding taking place in August 2024. Pre-qualification for Leasing Round 5 began this February, with the auction expected in Q1 2025.

In terms of floating wind, as of the end of 2023, the UK was still considered the most attractive market for floating wind based on robust consenting processes, leasing structures, tendering mechanisms, and incentives. Although the UK's long-term commitment to floating wind still holds some uncertainty, the allocation reserved in AR6 is seen as a positive indicator, demonstrating the government's responsiveness to industry feedback post-AR5. While demand for floating wind remains undisputed, the various deployment scenarios in the UK range from 6 to 61 GW, illustrating diverse potential growth paths.



RANK (H2 2023)	RANK (H1 2023)	Δ	COUNTRY
1	1		UK
2	2		Norway
3	3		Korea
4	6	+2	France
5	5		Japan
6	4	-2	US
7	7		Spain
8	9	+1	Portugal
9	8	-1	Italy

Figure 1: Global Market attractiveness index for floating wind [C4offshore, 2023]

Like all major offshore wind farm projects, significant spatial expansion and development expenditures are necessary. Typically, such activities involve specific planning and assessment protocols, including Environmental Impact Assessments (EIAs). However, there has been notably less focus on the impacts on the human environment, particularly regarding local and regional coastal communities near these offshore projects. Assessing the socio-economic implications and opportunities arising from the expansion of this dynamic renewable offshore wind energy sector is crucial (Vattenfall, 2020).

Socio-economic impacts are of growing importance in the planning and assessment of OWFs, especially in the UK. These are influenced by international drivers, including IFC/World Bank Performance Standards (IFC 2012, World Bank 2017), IAIA Social Impact Assessment Guidelines (2015) and the amended EIA Directive (EC 2019). The UK, the assessment procedures:

- 2008 Planning Act limited to economic benefits with minimal social impacts: For offshore wind farms generating greater than 50MW, which identifies a subset of Nationally Significant Infrastructure Projects (NSIPs), with impacts examined by the Planning Inspectorate, National Infrastructure Division (PINs/NID).

While still in its early stages, the industry is witnessing an increasing number of developers conducting evaluations of the social and economic implications associated with investing in offshore wind farms.

An instance of an offshore wind initiative successfully addressing socio-economic challenges is the Beatrice Offshore Wind Limited project. Situated 13km off the Caithness Coast in Scotland, Beatrice stands as one of Scotland's major operational offshore wind farms, with the capacity to generate power for approximately 450,000 homes. Commencing operations in 2019, the wind farm boasts an operational capacity of 588MW.

Beatrice Offshore Windfarm Limited (BOWL) project (2017): SSE and BOWL partners undertook their "first social return on investment analysis to assess the contribution of the project expenditure to the UK and Scottish economies and understand wider implications to society and economy". Factors considered were:

- **GDP value-added** estimated to £113bm from the construction of the project, of which £530m would be contributed to the Scottish economy.
- **Supporting UK and Scottish employment opportunities**: 18,100 years of FTEs in the UK, of which 5,800 in Scotland.
- **Investment in infrastructure:**
    - (1)- Wick Harbor with approximately £10m to transform the building and see a return on maritime use (90 employees).
    - (2)- Burntisland Fabrications (BiFab), with a £100m contract to manufacture 26 wind turbine jackets by Beatrice Tier 1 contractor Seaway Heavy Lifting. Fabrication is being undertaken at all three BiFab sites: Burntisland, Methil and Arnish on the Isle of Lewis (200 jobs and 22,500 tonnes of steel fabrication)
- **Community funding for local initiatives:** The Beatrice Project has a designated community benefit fund of £34 million, of which £28 million will support the Coastal Communities Fund—a program initiated by the UK Government to foster sustainable economic growth and job creation in coastal communities. The remaining £6 million will be managed by SSE's Community Investment Team over a span of five years.

4) Does the administration set up an offshore wind auction which includes socioeconomic criteria? If so, which criteria have been included?

Yes, There has been a growing trend of leveraging auctions to achieve additional policy objectives, incorporating environmental, social or resilience aspects, with the introduction of **non-price criteria** (also called non-price factors (NPF or qualitative criteria) (Euractiv. (n.d.))

- SSE Position Paper (2023) on Non-price criteria in Renewables Auctions
- DESNZ Position on CfD (Sept 2023) and introduction of non-price factors
- Challenges related to NPFs by Linklaters (Sept 2023)
- Regen's view on introducing NPFs into CfD (May 2023)

- Mainstream Renewable Power (Sept 2023): Pathway to unlocking gridlock using Non-price criteria.

5) Has the government made a renewable auction (any technology) which included socioeconomic criteria? If so, which criteria have been included? Which percentage represents these socioeconomic criteria regarding the overall score?

The UK government has been considering the integration of non-price criteria (NPC) into renewable auctions as a strategic move to ensure that renewable projects contribute to societal and environmental well-being, in addition to being executed within schedule and budget constraints. While this proposition is under discussion and review, it has not yet been put into practice.

Examples provided in question 4 illustrate the expansion of criteria beyond the existing parameters of project track record and feasibility. Considerations encompass sustainability aspects such as circularity, workforce development, skills enhancement, ecological preservation, supply chain advancement, and others. SSE Renewables (SSE Renewables, 2023) and similar organisations advocate for the adoption of diverse NPC frameworks tailored to various auction types and reflective of market maturity levels.

6) Did the government or any local/regional administration lead a pedagogy (educational) campaign around renewable energy, offshore wind and climate change to increase citizen awareness to reduce opposition and the NIMBY effect? *If it did, please provide a description of the process/campaign and which are the results, such as if there is any increase on the awareness of climate change and/or renewable energy necessity or if there is a reduction on NIMBY movements.*

The UK government has indeed led educational campaigns around renewable energy, offshore wind, and climate change to increase citizen awareness, demonstrating the government's commitment to promoting renewable energy, particularly offshore wind, as part of its strategy to mitigate climate change and achieve net-zero emissions targets by engaging in partnerships, research, and legislative measures. Here are examples of initiatives and partnerships:

- Renewable Energy Strategy: The UK's Renewable Energy Strategy highlights the significant economic benefits of transitioning to a low-carbon economy. The strategy estimates that up to half a million additional jobs could be generated in the renewables sector and its supply chains. The UK recognises the importance of wind power, especially offshore wind, due to its vast potential for energy generation.

- Offshore Wind Energy (Harnessing offshore wind – UKRI. (n.d.).: The UK government aims for offshore wind to power every home in the UK by 2030. The country is a global leader in offshore wind energy, with more capacity installed than any other nation. Researchers are working on improving turbine efficiency, reducing costs, and addressing intermittency issues to meet ambitious targets.

- UK-German Partnership: The UK and Germany have committed to enhancing cooperation in renewables, particularly offshore wind and electricity interconnection, to accelerate the deployment of offshore hybrid projects. This partnership aims to share industry knowledge, expertise, and best practices on industrial decarbonization, energy efficiency, and net-zero policies.

· Offshore Wind Environmental Improvement Package: The government is legislating to support the Offshore Wind Environmental Improvement Package (OWEIP) to accelerate the deployment of offshore wind while protecting the marine environment. This package aims to reduce offshore wind consenting time from up to four years to one year while maintaining high environmental standards (Department for Business Energy and industrial Strategy, 2023)

· ERSC's two-and-a-half-year funded study delved into the manner in which community concerns are addressed within the expedited, centralized approval process for Nationally Significant Infrastructure Projects (NSIPs) in the UK. NSIPs encompass various developments such as transport routes, power stations, offshore wind farms, and, more recently, housing. There have also been suggestions to broaden the definition to include significant commercial developments. The research team specifically honed in on renewable energy, an area where national policy heavily favors development and where local residents often find themselves positioned as dissenters despite the perceived broader societal benefits (Bartlett (n.d.)).

8 ANNEX 3 LITERATURE REVIEW

ID	TITLE	AUTHOR	CONCLUSIONS	RELEVANT INFORMATION/ INSIGHTS	WEB
1	How Are Tourists Affected by Offshore Wind Turbines? A Case Study of The First U.S. Offshore Wind Farm	Simona Trandafir Vasundhara Gaur Priya Behanan Emi Uchida Corey Lang, Haoran Miao	Tourism in Block Island has not been damaged by the construction of the offshore wind farms, but it has slightly increase thanks to "curiosity trips" and repeaters that search a change of scenario. People would pay for beach locations, recreative fishing, bird and whale watching, etc. with a view of the wind turbines.	People willing to pay for beach locations, recreational fishing locations, sightseeing, and boating routes with a view of the turbines. During construction, an increase in revenues from Airbnb properties was noticed.	https://cbe.miis.edu/joce/vol7/iss1/1/
2	Impact of wind turbines on house prices in Scotland	Stephan Heblich Dan Olner Gwilym Pryce Chris Timmins	There is no evidence of a consistent negative effect on house prices. Most results show no significant effect on the change in price of properties within 2-3 km, or find the effect to be positive. The sales analysis finds a positive effect of 2% for houses in the 2-3km distance band that can see a turbine. Attitudes towards wind farms may be different in Scotland than in other parts of the UK, and may also vary significantly within Scotland, and between individuals.	Properties close to the wind farm (<14km) have a similar house price growth trajectory as the properties that are not in close proximity to the WF. Positive impact on house price growth tending to diminish with distance for properties that cannot see turbines, but rising then falling with distance for properties that can see them.	https://scotlandagainstspin.org/wp-content/uploads/2019/08/Impact-on-house-prices-in-Scotland-2016.pdf
3	The Impact of Wind Farms on Property Values: A Geographically Weighted Hedonic Pricing Model	Toke Emil Panduro Bo Jellesmark Thorsen Thomas Lundhede	There is statistical evidence for a negative impact of wind farm proximity. Various distance dummies also indicate that negative impacts are mainly limited to properties in the immediate vicinity within 1.5km. Properties that were sold after the construction of the wind farm showed lower values compared to those which were sold before, indicating a negative post-construction effect.	A 1% decrease of distance to the nearest turbine decreases the property sales price by -0.047% to -0.098%. Hence, within the first km around the wind farm, prices decreased by 21.5-29.7% according to the estimations.	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2114216

4	The Impact of Wind Farm Visibility on Property Values: A Spatial Difference-in-Differences Analysis	Yasin Sunak Reinhard Madlener	About 42% of the properties that were affected by the construction of the wind farm experienced property devaluation (located within the first 3km to the nearest turbine and have an average unobstructed view on 7-10 turbines). A view that is on average affected by 3 turbines (or less) visible from a distance of 3.5km (or more) does not diminish property values.	The visual impact mostly appears to fade towards the city centers, as higher building-density increasingly tends to obstruct the view from a given property anyway.	https://www.sciencedirect.com/science/article/pii/S014098831600044X
5	The Vindication of Don Quixote: The Impact of Noise and Visual Pollution from Wind Turbines	Jensen, C.U Panduro, T.E Lundhede, T.H	Having a view of a wind turbine from your house results in a considerable reduction in the price schedule of the house. The effect of the view of a wind turbine decreases as distance to the turbine increases. The noise and visual pollution of wind turbines have a considerable impact on local residents. The effect of view and distance changes to a positive externality at around 1,300 m.	The hedonic price models predict that in severe cases roughly 10% of the sales price can be explained by exposure to noise and visual pollution from wind turbines. The impact of turbine noise on the immediate surroundings can be explained by 6.69% of the house price in highly exposed areas.	http://okonomi.foi.dk/workingpapers/WPpdf/WP2013/IFRO_WP_2013_13.pdf
6	Wind Energy Facilities and Residential Properties: The Effect of Proximity and View on Sales Prices	Ben Hoen Ryan Wiser Peter Cappers Mark Thayer Gautam Sethi	Negative effects exist at a very close range to the wind turbines (800 ft). Studies of attitudes towards wind turbines have found that such attitudes are the most negative after facility announcement, but often improve after facility construction. Wind facilities can impact on the amount of time it takes to sell a home.	Nuisance effects are largely concentrated within 1 mile of the nearest wind turbine. Homes that sold prior to a wind facility announcement, but situated within 1 mile of the eventual location, were sold 10-13% less than homes that sold in the same time period but located more than 5 miles away.	https://www.tandfonline.com/doi/abs/10.1080/10835547.2011.12091307

7	Renewable Energy and Negative Externalities: The Effect of Wind Turbines on House Prices	Martijn I. Dröes Hans R.A. Koster	After the first wind turbine is constructed within a 2km radius of property, the value of the property decreases by about 1.4% on average (+1.9% if turbines are higher than 90m, +3.7% if blades are longer than 85m). 2 years before the placement of a turbine, house prices are already 1.7% lower than prices in comparable neighborhoods. the negative effect increases until about 5 years after the placement of a turbine, to 3.5%, and steadily decreases to an effect of about 2% at year 8, after which the effect stabilizes.	As a rule of thumb, wind turbine noise is typically deemed to be a problem within 4-5 times the axis height.	https://www.sciencedirect.com/science/article/abs/pii/S0094119016300432
8	Wind farm proximity and property values: a pooled hedonic regression analysis of property values in central Illinois	Jennifer L. Hinman	The value of properties located near the wind farm site had a higher appreciation rate on average in real terms than the value of properties located farther from the wind farm site. During the time the wind farm project was being approved, the nearby properties value diminish due to the uncertainty as to how disruptive the wind farm facility would actually be. During the construction and afterwards, the price of nearby and further properties were not statistically different.	Even before the wind farm was operational, homes near the site sold for less than homes farther away from it. This means wind farms are placed in lower value properties. Property values rebounded and soared higher in real terms than they were prior to wind farm approval, as surrounding property owners living close to the wind farm acquires additional information on aesthetic impacts on the landscape and actual noise impacts of the turbines to see if any of their concerns materialized.	https://puc.sd.gov/commission/dockets/electric/2017/el17-055/exhibit4.pdf?bcsi_scan_fd86d3dd427d821e=/TrGAHDGcFNr+lzvBBagkJ9KIqQCAAAAcmTvCQ==&bcsi_scan_filename=exhibit4.pdf

9	The Effect of Wind Farms on Residential Property Values in Lee County, Illinois	Jason Carter	Wind farms in Lee County have not had a statistically significant or reliably quantifiable impact on nearby residential property values. GSG Wind Farm is shown to have significantly increased the selling values of nearby residential properties (not much confident).	One and a half story homes selling for an 8% premium, on average, over the price of the average two story home. It seems probable that any public unhappiness with wind development has more to do with the uncertainty surrounding where the turbines will be placed and their ultimate impacts on neighboring residents.	https://www.livingstoncounty-il.org/wordpress/wp-content/uploads/2014/11/PR-Ex.-33-2011-Wind-Farms-Effect-on-Property-Values-in-Lee-County.pdf
10	The impact of wind farms on the prices of nearby houses in Poland: a review and synthesis	Marcin Torzewski	This paper analysis different studies of UK, Netherlands, Germany, and USA about the impact of wind farms, and concludes that there is no general result that can be transposed to polish circumstances.	England and Wales are the only countries without distance or noise setbacks for wind turbines. Noise or flicker from wind turbines might influence property prices.	https://sciendo.com/downloadpdf/journals/remav/24/2/article-p13.pdf
11	The Effects of Wind Turbines on Property Values in Ontario: Does Public Perception Match Empirical Evidence?	Richard Vyn M. McCullough	Surveys indicate that residents often perceive that the existence of wind turbines within their viewshed will reduce the value of their property, such perceptions have not been corroborated by analyses of sales data.	There is a big public outcry regarding the construction of these turbines.	https://puc.sd.gov/commission/dockets/electric/2018/EL18-003/exhibits/dakotarange/ExhibitA13-5.PDF
12	Does proximity to wind farms affect the value of nearby residential properties? Evidence from Washington and New York States	Natalie Camplair	Properties within one mile are values at less than other properties. There is weak evidence that property values near wind turbines are on average lower than the surrounding area through negative coefficients on dummy variables indicating proximity to wind turbines. Properties near wind turbines have increase at a slower rate that surrounding properties.	Wind farms are more likely to be built in areas with lower or already declining property values. Literature suggests that wind turbines had no effect on nearby property values through nuisance, scenic vista or area stigmas.	https://digitalcommons.macalester.edu/cgi/viewcontent.cgi?article=1012&context=econaward

Co-funded by the European Union

13	Wind Turbines, Amenities and Disamenities: A Study of Home Value Impacts in Densely Populated Massachusetts	Ben Hoen Carol Atkinson-Palombo	There is an absence of evidence to support the claim that sales rate was affected by the wind turbines. Weak evidence suggests that the announcement of the win facilities had an adverse impact on home prices, but those effects were no longer apparent after turbine construction and eventual operation commenced.	Wind facilities in Massachusetts is associated with areas with relatively low home values, compared to the average values of homes more than a half mile but less than five miles away from the turbines.	https://emp.lbl.gov/publications/wind-turbines-amenities-and
14	Values in the Wind: A Hedonic Analysis of Wind Power Facilities	Martin D. Heintzelman Carrie M. Tuttle	PILOT programs account for harm to those who allow parcels on their property (economic compensation), but not for harm to others nearby, still affected by the turbines (visual effect, noise, vibrations, etc.)	Impacts of turbines decay over time, and especially if it is not the first wind farm in the area. Being very rural and somewhat isolated also makes these counties relatively immune to national real estate trends	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1803601
15	Impact of the Lempster Wind Power Project on Local Residential Property Values	Matthew Magnusson Ross Gittell	The average value of a residential property increased 3% from before to after the announcement of the wind farm. Otherwise, the region showed a decline in sales volume. There is no evidence to suggest that the Lampster Wind Power project had a consistent and statistically significant impact on residential property values.	Shadow flicker, noise and view impact are the biggest concerns for inhabitants. Iberdrola established a noise hotline after the project was constructed.	https://puc.sd.gov/commission/dockets/electric/2017/el17-055/exhibit6.pdf
16	Effects of Wind Turbines on Property Values in Rhode Island	Corey Lang James Opaluch	Houses located within 0.5mile of a future turbine site are worth 0.9% less than those houses 3-5 miles away from it. There is no evidence that the existence of the wind farm is the responsible of this difference, as these kind of projects are usually located in less desirable locations.	Turbines are sited in areas that have lower house prices conditional on property and locational characteristics (less desirable areas such as near the highway or on the grounds of a wastewater treatment facility).	https://energy.ri.gov/sites/g/files/xkgbur741/files/documents/Onshore-Wind/Final-Property-Values-Report.pdf

17	A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States	Ben Hoen Jason P. Brown Thomas Jackson Ryan Wiser Mark Thayer Peter Cappers	There is no statistical evidence that home prices near wind turbines were affected in either the post-construction or post-announcement/pre-construction periods.	"Anticipation stigma": lower community support for proposed wind facilities before construction (potentially indicating a risk-averse stance by community members) but increased support after facilities began operation	https://www.energy.gov/sites/prod/files/2013/12/f5/2013_wind_property_values.pdf
18	Modelling the impact of wind farms on house prices in the UK	Sally Sims Peter Dent G. Reza Oskrochi	Residents living within 20km of a Scottish windfarm said that the landscape being spoiled, extra traffic, noise or disturbance during construction, damage to plants and animals, noise from the turbines, reduction in house prices, interference with TV and radio reception and damaging effect on local business are the biggest problems they had, even though most people answered that the wind farm did not cause any problem. No relationship is observed between the number of wind turbines visible and a reduction in value, nor between the distance to the wind farm and house price.	The effect of stigma damage is difficult to quantify because it is created by opinion and perceptions which can change in response to media attention (e.g. Internet), time and spatial proximity. Public reactions tend to vary considerably, with more support for wind farms, when the public are involved in the decision making process. The orientation of the wind farm has a significant impact on the degree of diminution suffered with regard to electricity pylons.	https://www.tandfonline.com/doi/abs/10.3846/1648-715X.2008.12.251-269
19	Wind Farm Study - Effect on Real Estate Values in the Municipality of Chatham-Kent, Ontario	Canning G. Simmons J.	A 7.5% decrease between the average sale prices of the properties studies has been detected. This decrease is not caused only by the wind turbines, but also because of lot size, location, garage, basement finish, house condition, age, etc.	Any diminution in market value may be as a result of influences other than wind turbines.	http://amherstislandwindproject.com/effect-on-real-estate-values-in-municipality-of-chatham-kent.pdf
20	The effect of wind farms on house prices	Renewable UK	The econometric tests conducted over 5 sites in England and Wales showed no negative price impacts attributed to the installation of wind farms over the period from either the announcement, building or completion to the present day.	The county-wide property market drives local house prices, not the presence or absence of wind farms.	https://www.renewableuk.com/news/304411/RenewableUK--Cebr-Study---The-effect-of-wind-farms-on-house-prices.htm

21	Impacts of Windmill Visibility on Property Values in Madison County, New York	Ben Hoen	No significant relationship between either proximity to or visibility of the windfarm and the sale price of homes has been found, nor a relationship between homes within a mile or that sold immediately following the announcement and construction of the windfarm.	Findings suggest that respondents prefer smaller turbines over longer ones and fewer structures rather than more in each group.	https://www.nhsec.nh.gov/projects/2008-04/documents/app_appendix_30b.pdf
22	Property Stigma: Wind Farms Are Just the Latest Fashion	Sims, S. Dent, P.	No statistical relationship found between property value and wind farm, nor aural impact. The most common opposition themes are: sacrifice and disempowerment of local values, lack of trust in government, regulatory bodies and windfarm developers (quick profits), language of war, conflict and defense, foreignness, and industrialization of the environment.	Estate Agents say that the reduction in value of house pricing is due to specific market conditions, not wind farms. Inhabitants opposition issues are mainly focused on visual impact, wildlife, property values, noise, tax impacts, cultural/historic area impact, hunting, economic arguments, aerial sprayer fears hitting tower, erosion, human health and tourism/other business. Community benefits can play an important part in any proposal.	https://www.emerald.com/insight/content/doi/10.1108/14635780710829315/full/html

23	Wind Turbine Impact Study: Dodge and Fond Du Lac Counties, WI. Appraisal Group One	Kielisch, K.	From surveys, it can be concluded that people think their properties will decrease their value for the proximity to the wind farm. With the sales study it was found that sales within the wind turbine influence area sold for less than those outside this area (-20.7% approx.). Also, negative impact on health and quality of life of residents in close proximity to the wind farms have been found.	One study suggests that turbines should be no closer than $1^{1/2}$ miles from residence, in order to avoid health problems. Filtering inverters at each turbine, burying all collector lines, filtering the power at the substation before going to the grid, and installing a proper natural system to handle the high frequency return current, can be other health solutions considered. Literature says that birds and bat collision deaths are insignificant compared to the effects of other man-made structures, vehicles and pollution. According to a study, the days on market are more than double for properties within a windmill zone. Noise annoyance doesn't depend so much on the volume of sound created, it depends on what it actually sounds like. Wind turbines produce no constant tonality, making the creation of a noise standard challenging.	http://docs.wind-watch.org/AGO-WIND-TURBINE-IMPACT-STUDY.pdf
24	A Real Estate Study of the Proposed White Oak Wind Energy Center, Mclean & Woodford Counties, Illinois	Poletti, P.			NOT FOUND

25	The effect of lake water quality and wind turbines on Rhode Island property sales price	Susan Shim Gorelick	There is no evidence that wind turbines have negative effect on property values. The distance to wind turbines has a statistically significant and positive impact during pre-announcement development and post construction. Site selection should address demographic attributes, and physical attributes (wind resource or distance to housing units).	Prices are likely to recover after the wind farms are in operation and communities learn more about the benefits of wind development. The average willingness to pay varies significantly depending on the age of respondents and their experience with offshore wind farms. Also, the WTP increase proportionally as the OWF distance from shore increases (1-9% less of property value due to the presence of a nearby OWF).	https://digitalcommons.uri.edu/oa_diss/222/
26	The Socio-Economic Cost of Wind Turbines: A Swedish Case Study	Hans Westlund Mats Wilhelmsson	The study indicates a negative capitalization of proximity to wind turbines in property values in Sweden. The proximity to tall wind turbines, and proximity to many wind turbines (wind farms) have greater impacts.	The size of the turbines and the quantity of these structures per square kilometer are two of the factors that diminish the property values nearby.	https://kth.diva-portal.org/smash/get/diva2:1557759/FULLTEXT02.pdf
27	Local Cost for Global Benefit: The Case of Wind Turbines	Ben Hoen Ryan Wiser Peter Cappers Mark Thayer Gautam Sethi	Houses close to urban environments are not affected by nearby windmills, but houses in rural areas suffer from remarkable devaluation. The effect is even more pronounced for old buildings built prior to 1949 (their prices decrease by up to 23%). The urban population is used to live in an industrialized and dynamic environment, but inhabitants of rural areas may lose the impression of pristine nature and tranquility.	The effect on prices of houses close to urban environments is considerably weaker and statistically insignificant at any conventional level. Windmills tend to be installed in low-price regions. Birds, bats, noise, and aesthetic appeal are some of the disadvantages of the wind turbines, which may impact negatively the house prices.	https://docs.wind-watch.org/DE-house-prices.pdf

28	Wind power and real estate prices in Oklahoma	Becca Castleberry John Scott Greene			https://www.emerald.com/insight/content/doi/10.1108/IJHMA-02-2018-0010/full/html
29	Windfarms and residential property values	Iona Mccarthy Hatice Ozer Bally	The time period considered takes into account the announcement of the construction of the wind farms. The results indicate that the turbines had no significant impact on sale price of residential properties close to them. In localities similar to Ashurst the construction of wind turbines is unlikely to have a detrimental impact on residential property values.	View variables should be taken into consideration when doing an impact study. For example, turbine visibility form the road front was used but not account was taken of the orientation to the wind farm.	https://journals.vilniustech.lt/index.php/IJSPM/article/view/3452
30	Assessment of the Impact of Wind Farms on Surrounding Land Values in Australia	Preston Rowe Paterson	The majority of wind farms erected in Australia appear to have had no quantifiable effect on land values. Houses less than500m away were found to have lower than expected sale prices, and it is possible that audio and visual aspects of wind farms contributed to this. A "perception" stigma has been identified, that usually manifests itself in the initial or planning stages of a project when the impact of change, uncertainty and opposition is at its highest.	Wind farms have been developed in locations generally removed from densely populated areas. Some studies identify anticipation stigma as possible precursor to a decrease in values. The time it takes to sell a property might vary by a wind farm development.	https://static1.squarespace.com/static/58bdfe87d2b857325390ba1c/t/5e4b5158190cbb27f14b73dd/1581994333468/assessment-of-the-impact-of-wind-farms-on-surrounding-land-values-in-australia.pdf
31	Assessing the impact of the Melancthon phase I wind project on nearby agricultural property values: a hedonic approach	Ryan Mitchell Mccullough	After the announcement, the value of vacant properties had a loss in value. This effect extended approx. 20 km and disappeared over time. The decrease in price around the announcement is most likely due to anxiety about future property values. If such anxiety could be allayed, the announcement effect could be reduced.	A debate between large properties (whose owners would benefit from the monthly payments) and small properties (whose owners would not benefit) was created, due to the proximity of the wind turbines. A town hall meeting to discuss residents' questions and concerns (setbacks and property devaluation) took place.	https://atrium.lib.uoguelph.ca/xmlui/handle/10214/20920

32	The Windy City: Property Value Impacts of Wind Turbines in an Urban Setting	Corey Lang, James J. Opaluch	There is no statistical evidence for negative property value impacts of wind turbines before the announcement of the wind farm, after the announcement but before the construction, nor after the construction. Houses within half a mile have had essentially no price change post-construction.	General industrialization of the landscape is one of the reasons for opposition. Several turbines are built near highways and industrial areas.	https://digitalcommons.uri.edu/cgi/viewcontent.cgi?article=1011&context=enre_facpubs
33	Wind turbines and housing prices: valuing the impact of wind farms on transactions	Nathan Guzman	EDPR Renewables paid more than $27.7M to landowners, which could have diminished the initial effect of announcing the wind farm. Twin Groves wind farm may have had a negative effect on home prices; however, it has not been statistically proven.	Some wind farms are built on private land, which means the company managing farm leases the land from its owners, which could increase a home's price.	https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=1142&context=studentpub_uht
34	Implementing hedonic pricing models for valuing the visual impact of wind farms in Greece	Konstantinos Skenteris, Sevastianos Mirasgedis, Christos Tourkolias	House prices of Evia (small size, visible from several villages and towns) increase as their distance from the nearest wind farm grows. On the other hand, Kefalonia (relatively isolated and extremely sparsely populated area) has not noticed any price change. House prices in Evia at distances of up to 2 km from the installed wind farms are reduced by about 14.4%	The environmental degradation associated with wind energy development typically includes noise, visual impact (shadow flicker, reflectance, and aesthetic degradation of the landscape), bird and bat fatalities, electromagnetic interference, etc.	https://www.sciencedirect.com/science/article/abs/pii/S0313592619300347
35	A Study in the Impact of Windmills on Property Values in Tucker County, West Virginia for the Proposed Beech Ridge Energy	Goldman, J. C.			NOT FOUND

36	ICS Wind Farm Research: Impact of Wind Farms on the Value of Residential Property and Agricultural Land	Khatri, M	60% of the sample suggested that wind farms decrease the value of residential properties. 67% of the sample indicated that this impact starts when a planning application to erect a wind farm is made. These impacts do not occur in a uniform way, as the circumstances of each development can be different. The negative impact decreases after 2 years of completion. There was evidence of some positive impact on agricultural land.	The three main reasons for this negative impact on property values are the visual impact after completion, the fear of blight and the proximity of residential property to a wind farm development.	https://docs.wind-watch.org/RICS-impactpropertyvalues.pdf
37	Economic Impacts of Wind Power in Kittitas County, WA	Grover, D. S.	There is no evidence for reductions in property values. Views of wind turbines does not negatively impact property values (based on a nation-wide survey conducted of tax assessors). Property tax revenues increase 11% over current ones, due to the property tax paid on the wind turbines.	Lincoln (Wisconsin) assessor noted that the wind turbines had negatively impacted television reception for nearby properties, but the utility company provided the impacted homes with better antennas or a satellite dish to bring reception back to previous standards.	https://journals.sagepub.com/doi/abs/10.1260/030952402321160615
38	Wind energy development and perceived real estate values in Ontario, Canada	Chad Walker Jamie Baxter Sarah Mason Isaac Luginaah Danielle Ouellette	Despite different community experiences, a total of 32% agree with the statement that turbines do lower values. The effect of turbines being visually unappealing is statistically significant. Turbine-related real estate loss is perceived to already have occurred for some residents in both communities surveyed.	Local impacts are intimately shaped by the social and cultural contexts in which they are experienced. This explains why concerns relating to community and health impacts appears as more important than phenomena we might normally expect like housing characteristics.	https://www.researchgate.net/profile/Chad-Walker-3/publication/268982611_Wind_energy_development_and_perceived_real_estate_values_in_Ontario_Canada/links/550afe430cf265693cef5483/Wind-energy-development-and-perceived-real-estate-values-in-Ontario-Canada.pdf
39	Wind turbine impact study	Appraisal Group One			

40	Danish offshore wind: key environmental issues	Dong energy Vattenfall Danish energy authority Danish Forest and nature agency	The willingness to pay to have wind farms moved completely out of sight is limited, but it increases to move them away from the shore to reduce their visual impact. Nearly all people interviewed had a positive attitude towards offshore wind energy development. About future wind farms, an amount of people would prefer them as an extension of the existing ones, and others, in other places to reduce the nuisance. After the construction of the wind farm further from shore, all the opposition had faded or became positive.	There are clear differences between the attitudes towards the offshore wind farm at local and national level. Positive attitudes were motivated by environmental concerns, reliability of supply, exports and employment benefits. Negative attitudes were motivated by visual instructions and nature impact.	https://tethys.pnnl.gov/sites/default/files/publications/Danish_Offshore_Wind_Key_Environmental_Issues.pdf
41	Sustainability and tourism: the effect of the United States' first offshore wind farm on the vacation rental market	Andrew Carr-Harris Corey Lang	Construction of the Block Island Wind Farm caused an increase in nightly reservations, occupancy rates (19%), and monthly revenues ($3,490) for Airbnb properties during July and August. The installation of the BIWF acted as a tourist attractant.	Airbnb visited the islands nearby the wind farm to increase the number of Airbnb listings in those locations, encouraging existing boutique hotel and B&B properties The Block Island Ferry, local for-hire fishing boats, and helicopter charters have all capitalized on the BIWF by adding new tours around it. New fishing opportunities and thus drawn praise from the recreational fishing community.. The for-hire fishing boat owner said that the business level picked up more than expected.	https://legacy-assets.eenews.net/open_files/assets/2019/05/07/document_pm_03.pdf

42	Analysis of the Effects of the Block Island Wind Farm (BIWF) on Rhode Island Recreation and Tourism Activities	T. Smythe, H. Smith, A. Moore, B. D. Bidwell, J. McCann	Individuals and tourists seeing the wind farm from land and sea responded to the survey with indifferent recognition and the occasional demonstration of interest or excitement. New tourism services have been developed since the offshore wind farm was constructed.	The wind farm acts as an "attractant" for some tourists (own destination or auxiliary attraction to other activities). Some business utilize the wind farm's status to promote their own products. Literature says that individuals are more concerned about marine life impacts than visual ones. The argument sing climate change as the driving factor for the installation of the wind farm seemed to outweigh any costs possibly associated with it.	https://www.crc.uri.edu/projects_page/analyzing-of-the-effects-of-the-block-island-wind-farm-on-rhode-island-recreation-and-tourism-activities/
43	Retour d'expérience tourisme & eolien en mer	Michèle Cabanis			https://dieppe-le-treport.eoliennes-mer.fr/wp-content/uploads/sites/2/2018/09/retourdexperiencetourismeeolienenmer-20172018-vuessurmer.pdf
44	Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism	George Parsons Jeremy Firestone	the conclusion is that offshore wind power projects are likely to affect visitation on the East Coast Ocean beaches. The effect in many beaches will be positive because of curiosity trips. At larger beaches, the amenity effect is less likely to overcome the disseminate effect and some net loss is expected. As trip loss is proportional to visitors but curiosity trips are not, larger and smaller beaches have similar gains. The net effect is that medium and smaller beaches can have positive economic outcomes.	The closer the turbines are to shore, the more likely a respondent is to report a worse experience on the survey. The dominant reason reported for why an offshore wind farm would have made a beach experience worse was the visual disruption of the seascape. For a better one, was knowing something good was being done for the environment.	https://works.bepress.com/george_parsons/59/

45	Wind Turbines and Coastal Recreation Demand	Craig E. Landry Tom Allen Todd Cherry John C. Whitehead	There is very little impact of coastal wind turbines on aggregate recreational visitation. Lost consumer surplus under the wind energy scenario is about $17, or 1.5% per year. There is evidence of preference heterogeneity for wind farms that can be seen from shore.	Areas with greatest energy potential are often those with scenic vistas (mountain ridges and coastal landscapes).	https://economics.ecu.edu/wp-content/pv-uploads/sites/165/2019/07/ecu1012.pdf
46	The Impact of Offshore wind Energy on Tourism. Good practices and perspectives for the South Baltic Region	German Offshore Wind Energy Foundation Mareike Korb REM Consult	Most fears of offshore wind energy towards tourism are the impacts on the landscape, due to wind turbines and overhead electrical lines. To reduce impacts, they could be constructed in a manner which make them suitable to the landscape and represent a landmark. Another impact could be the use of sea space, that might pose a problem for boat tourism. The conclusion nis that there are very few negative effect compared to the positive ones.	General public has become more familiar with offshore wind due to rising exposure in the media and an increasing attention paid to renewable energy sources. A good communication strategy is a crucial factor, including proactive information campaigns. Tourism attractions such as offshore info. center, viewing platform from telescopes, info. boards, boat tours, sightseeing flights, routes for motor and sailing boats, offshore restaurants and merchandising products, are suggested.	https://www.offshore-stiftung.de/sites/offshorelink.de/files/documents/Offshore_Stiftung_2013_04SBO_SOW_tourism_study_final_web.pdf
47	The economic impacts of wind farms on Scottish tourism	Glasgow Caledonian University Moffat Centre CogentSi	The impact of current applications would be very small, and provided planning and marketing, there is no reason why tourism and wind energy are incompatible. There is a need to make clearer to the general public that in some "scenic/wilderness" areas they will not see large commercial wind farms and that some other areas are positively marketed as green centers of renewable energy (few very large farms are better than a large number of small ones).	Overseas visitors seem to be more positive about wind farms than domestic tourists. Also, respondents that had seen a wind farm were less hostile than those who had not.	https://www.gov.scot/binaries/content/documents/govscot/publications/research-and-analysis/2008/03/economic-impacts-wind-farms-scottish-tourism/documents/0057316-pdf/0057316-pdf/govscot%3Adocument/0057316.pdf

48	The Impact of Wind Farms on Scottish Tourism	Elizabeth Dinnie	83% of Scottish respondents said their decision on where to visit and where to stay would not be affected by the presence of a wind farm. There is no evidence to say that wind farms have an adverse impact on tourism in Scotland.	Respondents do not feel that wind farms are an eyesore on the landscape and ruin the tourist experience.	https://www.climatexchange.org.uk/media/1686/the_impact_of_windfsarms_on_scottish_tourism.pdf
49	The case for offshore wind farms, artificial reefs and sustainable tourism in the French Mediterranean	Vanja Westerberg Jette Bredahl Jacobsen Robert Lifran	A wind farm can be located from 8km and outwards without a loss in tourism revenues if accompanied by a coherent environmental policy and wind farm associated recreational activities. The compensation requirements of visitors decrease if they are younger or mature, of Northern European origin, frequent visitors, and when their vacation is for visiting friends and family or enjoying cultural and historical experiences. There is a considerable scope for "greening" the tourist communities, which could facilitate increased destination loyalty o recommending behavior.	Potential visual nuisance may be compensated by wind farm associated reef-recreation or by adopting a coherent environmental policy. Visitor numbers could be maintained/increased by lowering accommodation costs or compensating visitors through community resort initiatives. Turbine foundations can create artificial reefs, which would enable observational boating during educational excursions, scuba and skin diving.	https://hal.inrae.fr/hal-02806953/file/DR2012-11_1.pdf
50	Challenge Navitus Deadline IV Response Tourism Impacts of the Navitus Bay Wind Farm	Challenge Navitus			NOT FOUND
51	East Anglia ONE North and East Anglia Two Offshore Windfarms	Biggar Economics			https://biggareconomics.co.uk/offshore-wind-farm-construction-and-tourism

52	The Effect of Wind Power Installations on Coastal Tourism	Meredith Blaydes Lilley Jeremy Firestone Willett Kempton	85% of respondents perceive wind power in general as either positive or very positive. About the effect on landscape appearance, more than half are neutral about its effect. Visible wind farms would likely deter some visitors, and it is recommended to locate offshore wind turbines at distances greater than 16 km from shore, if not out of sight. Some beachgoers report that they would avoid beaches with visible turbines.	While a wind farm might decrease tourism in the locality tourism would presumably increase in another location. There is a strong attraction to a beach with visible turbines, from residents and out-of-state tourists.	https://www.mdpi.com/1996-1073/3/1/1/htm#:~:text=The%20Local%20Economic%20Importance%20of%20Coastal%20Tourism%20One,will%20negatively%20impact%20local%20tourism%20%5B%207%20%5D.
53	Maritime tourism (incl. local communities) and offshore wind	European Marine Spatial Planning (MSP) Platform	Dutch government organized an information event to explain their plans for the new offshore wind farms to the coastal municipalities. Another solution for tourism concerns is to develop a Tourist Impact Statement (statements by developers on the likely impacts of the development on the local tourist industry and the methods to minimize cost and maximize benefits, as part of the SEA or EIA)	Offshore wind farming is mostly a problem for coastal tourism on account of its aesthetic landscape impacts, while it can be both a problem (safety of sailing) and an attraction (visitor attraction).	https://maritime-spatial-planning.ec.europa.eu/sites/default/files/sector/pdf/1_tourism_offshore_wind.pdf
54	The impact of offshore wind farms on beach recreation demand: Policy intake from an economic study on the Catalan coast	Louinord Voltaire Maria L. Loureiro Camilla Knudsen Paulo A.L.D Nunes	Respondents would change their trip behavior significantly if an offshore wind farm was installed, bringing along with it a significant welfare loss to Catalonia's beach visitors estimated to range between 67.3€ and 203€ million per season.	If offshore wind power is generated along the Catalan coast, such installation will cause significant shifts in visits flows to the beach. Consequently, the annual welfare loss will not be equally distributed but rather concentrated to those areas where the fins farms are located.	https://www.sciencedirect.com/science/article/abs/pii/S0308597X16303189

Co-funded by the European Union

55	Attitudes towards offshore wind farms—The role of beach visits on attitude and demographic and attitude relations	Jacob Ladenburg	Usual visitors (at least once a week during summer and winter seasons) have a worse attitude towards the wind farm development than visitors at a less frequent level. The latter might see the coastal landscape as a resource with a multi provision of different types of goods (industrial types of use such as wind energy and recreational usage), the usual visitors perceive it as being more of a pristine resource.	Male respondents are found to have a more negative attitude when compared to females. Furthermore, attitudes covariate negatively with household income and covariate positively with level of education and residential view to on-land turbines-	http://www.mresearch.com/pdfs/docket4185/NG11/doc57.pdf
56	The amenity costs of offshore wind farms: Evidence from a choice experiment	Sanja Lutzeyera Daniel J. Phaneuf Laura O. Taylor	55% of existing customers would not re-rent their most recent vacation property if wind turbines were placed offshore. If turbines are placed further than 8 miles from shore, rental population will not be affected. While others may exit the local market and rental prices would fall in the short-run, other potential renters will be attracted by these lower prices and will sort into the affected local market.	Respondents who only view daytime images of turbines react less negatively than respondents who viewed both daytime and nighttime images. Negative effects of wind farms are primarily attributable to proximity of the farm to shore, rather than the number of turbines.	https://ageconsearch.umn.edu/record/264972
57	Study into the Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector	Regeneris Consulting	There is no evidence of significant impacts on tourism by existing Welsh onshore wind farms.	During construction, noise, traffic, closure and diversion of public footpaths or other popular routes were a concern for many businesses. There were some rights of way or trails which were enhanced. Rerouting public access, clear signage and effective communication of disruption are ways to minimise disbenefits.	https://powys.moderngov.co.uk/Data/Planning,%20Taxi%20Licensing%20&%20Rights%20of%20Way%20Committee/20140501/Agenda/xSection%201-%204%20Study%20into%20the%20Potential%20Economic%20Impact%20of%20Wind%20Farms%20and%20Associated%20Grid%20Infrastructure%20on%20the%20Welsh%20Tourism%20Sector%20-%20February%202014.pdf

58	Gone with the wind? The impact of wind turbines on tourism demand	Broekel, Tom. Alfken, Christoph.	66% of the surveyed individuals are found to be interested in visiting wind turbines when information centers are available. The construction of wind turbines near populated areas shows a negative relation to tourism demand in German municipalities. There is a bad relation between wind farms and tourism demand.	Visual dimension is among the most important predictors of a tourist destination image. Wind turbines may conflict with "romantic tourist gaze" and "green tourism", as they do not fit in traditional close-to-nature landscapes. It is essential to coordinate planning process within larger areas including multiple municipalities. Collaboration with tourist agencies might also be helpful.	https://www.sciencedirect.com/science/article/abs/pii/S0301421515300495
59	Not in my hiking trail? Acceptance of wind farms in the Austrian Alps	Thomas Brudermann Rafia Zaman Alfred Posch	There is a high acceptance of wind technology in general and fairly high acceptance for the existing projects. This acceptance is reduced when it comes to wind farms in the Alps in general, but no major resistance to wind power can be identified within mountain visitors. There is particular preference for projects in agricultural lowlands. One promising solution to overcome the status quo bias might be the application of virtual reality tools in order to gather more consistent and accurate information on the factors that influence the acceptance of future wind farms.	The negative effects perceived by humans towards wind farms depend on how the decision for a project is being made, and who is included in the process (ordinary citizens involving participatory, procedural and distributive justice) Promoting everyday green behaviors could prepare the grounds for increasing acceptance of more far-reaching sustainability policies.	https://link.springer.com/article/10.1007/s10098-019-01734-9

60	Wind farms and tourism in Scotland: A review with a focus on mountaineering and landscape	David S. Gordon	Wind farms do have an effect on tourism if located in the wrong places. This is restricted to the 25% of visitors who are particularly drawn by the quality of upland and natural/wild landscapes, with mountaineering visitors among those highly affected. The main effect is likely to be displacement within Scotland, benefitting areas seen as still retaining the desired sense of naturalness. This could rise in future depending on strategic and local planning decisions on the individual siting and collective spatial pattern and extent of wind farms.	When wind farms are refused planning permission in mountain or wild land areas the reasons given are typically landscape and visual, but an unrecognised side-effect has been to limit potential for tourism impacts.	https://www.mountaineering.scot/assets/contentfiles/media-upload/Wind_farms_and_tourism_in_Scotland_-_a_review,_Nov_2017_20171106.pdf
61	Not in my back yard or not on my playground: Residents and tourists' attitudes towards wind turbines in Icelandic landscapes	A.D. Sæþórsdóttir R. Ólafsdóttir	Tourists and residents are positive towards the existing experimental wind turbines in the area, but residents perceive them more positively. Residents are also more positive than tourists towards wind turbines in Iceland. Both groups believe that wind turbines decrease the attraction of an area for tourists and, although neither group would avoid travelling in an area because of wind turbines, tourists would be more sensitive to them.	People's approval of renewable energy development is socially constructed depending on the way they perceive the landscape.	https://www.sciencedirect.com/science/article/pii/S0973082619309913
62	The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis	Hoen	No evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities.	There is a possibility that individual or small numbers of homes have been or could be negatively impacted, but if these impacts do exist, they are either too small and/or too infrequent to result in any widespread and consistent statistically observable impact.	The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis | Electricity Markets and Policy Group (lbl.gov)

63	Wind turbines in tourism landscapes: Czech Experience	Bohumil Frantál, Josek Kunc	Almost two thirds of respondents expressed an interest in visiting the wind farms as long as there would be an information center.	There is no statistically significant relationship between the implementation of projects and the proximity of a location to a national park or protected landscape area.	(18) (PDF) Wind turbines in tourism landscapes: Czech Experience (researchgate.net)
64	Energy tourism: An emerging field of study	Bohumil Frantál	Cooperation between energy companies and regional and local bodies seems to be a critical point in the more effective exploitation of energy tourism potential. Some modern energy facilities in the Czech Republic are ranked among the most visited regional attractions, with attendance rates higher than those of most regional museums, galleries and castles.	Boat tours or sightseeing flights to offshore wind parks or climbing on and abseiling from a wind turbine or from a power plant's cooling tower are examples of energy tourism extending even into adventure tourism.	(18) (PDF) Energy tourism: An emerging field of study (researchgate.net)
65	Gone with the Wind: Valuing the Visual Impacts of Wind Turbines through House Prices	Stephen Gibbons			https://www.sciencedirect.com/science/article/abs/pii/S0095069615000418
66	Wind farm announcements and rural home prices: Maxwell ranch and rural Northern Colorado	Laposa, S.P. Mueller, A.			Wind Farm Announcements and Rural Home Prices: Maxwell Ranch and Rural Northern Colorado: Journal of Sustainable Real Estate: Vol 2, No 1 (tandfonline.com)
67	Relationship between Wind Turbines and Residential Property Values in Massachusetts	Ben hoen Carol Atkinson-Palombo			lbnl-6371e.pdf (lbl.gov)

68	The impact of wind farms on property values: A locally weighted hedonic pricing model	Sunak, Y. Madlener, R.			The impact of wind farms on property values: A locally weighted hedonic pricing model (wiley.com)
69	The Effect of Wind Development on Local Property Values	Sterzinger, G., Beck, F., Kostiuk, D.			
70	Socio-economic impact of a 200 MW floating wind farm in Gran Canaria	J. Schallenberg-Rodriguez F. Inchausti-Sintes	In terms of employment, the project could demand around 1246 to 983 short-term annual employments (average contract period of 2 years during the CAPEX phase), from which between 345 and 684 correspond to regional annual employment, in addition to 180 permanent or long-term annual employments, from which 90-100 are regional ones and, finally, 285 local temporary employments. Thus, the estimated national annual employment ratio ranges from 8.54 to 7.21 jobs/MW.	An important part of the project components can totally or partially be manufactured or procured locally (between 71 and 67/ of the whole value-chain can be developed in Spain). Only part of the employment demand by the wind farm construction and installation will be of new creation, not all of it.	

71	Assessing the impacts to vessel traffic from offshore wind farms in the Thames Estuary	Rawson, Andrew Rogers, Edward	Several of the wind farms are located in areas of minimal vessel traffic and therefore the impacts on navigation are minor, demonstrating the importance of marine spatial planning. Engagement with developers, stakeholders and regulatory bodies throughout the consenting process is therefore necessary.	For vessels navigating around wind farms, there are three factors which dictate how they plan their passage. Firstly, the distance should be a comfortable buffer so that if an incident was to occur on board, or another vessel was encountered, there would be sufficient sea room to make an evasive maneuver. Secondly, concerns have been raised over the visibility of a wind farm. Visually a wind farm may obscure smaller craft, such as recreational, fishing and maintenance vessels. Finally, the safety distance a vessel chooses to navigate around a wind farm is weighed against commercial pressures associated with additional distance, fuel and passage time requirement.	(15) (PDF) Assessing the impacts to vessel traffic from offshore wind farms in the Thames Estuary (researchgate.net)
72	Navigation In the Vicinity of Offshore Renewable Energy Installations	Steamship Mutual	There is evidence that in areas of strong tides or currents scouring of the seabed in way of a turbine base structure may occur, leading to significant deposits of seabed material in other locations. Vessels navigating in the vicinity of wind turbines will have to bear this in mind, especially when proceeding with limited under keel clearance.	Information of Offshore Renewable Energy Installations (OREIs) will be found on navigational charts and updated as necessary by Admiralty Notices to Mariners. Any urgent information regarding OREIs will be promulgated by navigational warnings.	
73	Ship Collision Risk for an Offshore Wind Farm	C.F.Christensen L.W.Andersen P.H.Pedersen	It is of great importance to initiate a risk analysis activity at an early stage of a project, to ensure that proper action can be taken in the detailed design phase if any needs are identified.	The risk of ship collision will depend on existing routes, human errors, failure on propulsion machinery and steering failure.	

74	Perceptions of Commercial and Recreational Fishers on the Potential Ecological Impacts of the Block Island Wind Farm (US)	Talya S. ten Brink Tracey Dalton	Most interviewed fishers noted: - There was increased recreational fishing in the area since the turbines were constructed. The influx of recreational fishers around the wind farm caused displacement of commercial fishers. - The turbines could be a navigation hazard. - The wind turbines created a new structure for fish habitat and served as an artificial reef. Many fishers also noticed mussel growth and fish attraction as a description of the artificial reef. - Additional fish species in the area. - There were fewer fish in the area of the wind turbines during construction (worse water quality and underwater noise). - The wind farm had no major ecological impact on fish	Some impacts from active offshore wind farms include the creation of an "artificial reef", increased fish assemblages, and disturbance of existing ecosystems. Almost all of the commercial fishers described how Deepwater Wind (the developer of the OWF) provided some funding to fishers who could prove that they fished in the areas that would be closed for construction to compensate for their lost time fishing when those areas were closed.	
75	Changes to fishing practices around the UK as a result of the development of offshore wind farms - Phase 1 (revised)	Mark Gray Paige-Leanne Stromberg Dale Rodmell	The fisherman who claimed to have operated on fishing grounds now occupied by wind turbines, the majority stated they had not returned or had reduced their fishing effort within the OWF's two or more years after construction. A compensation for the loss of fishing opportunities could be maintaining the viability and profitability of fishing businesses.	The main obstacles that limited the co-existence of fishing and offshore wind energy generation were the risks associated with turbines and cables, the excessive disruption to fishing, loss of fishing gear and increasing steaming distances to fishing grounds, a poor relationship and inadequate communication between fishermen and wind farm developers, and the cumulative spatial encroachment of wind farms on traditional fishing grounds.	

76	Offshore Wind Projects and Fisheries	Claire Hagget, Talya ten Brink, Aaron Russell, Michael Roach, Jeremy Firestone, Tracey Dalton, Bonnie J. McCay	Many recreational fishers were attracted to the environs around the Block Island Wind Farm (US) for increased fishing, especially spearfishing. Commercial fishers were pushed into less productive areas due to crowding around the turbines and their placement around the turbines. Some positive benefits are artificial reefs near the structures, that provide surfaces for colonization of sessile benthic species.	Support of fishers depend on differences of scale, methods, and other factors within the fisheries and to experience. Cooperation during planning processes has led to successful co-location of specific types of fisheries and OWFs. There are barriers to co-location, including commercial fisheries' resistance to setting gear within OWFs because of safety, legal, and insurance issues; developers' demands for licensing; and concerns about losing access. Some compensation actions are: fisher compensation fund to address losses, a trust fund to support fisher navigational and safety equipment and to deflect any increases in insurance costs, and an innovation fund with program and research project grants.	
77	Community Benefits from Offshore Renewables: Good Practice Review	David Rudolph, Claire Haggett, Mhairi Aitken, University of Edinburgh			
78	best-practice-guidance---final-oct-2020 Guidance on assessing the socio-economic impacts of offshore wind	impact on human enviroment		Type of socio-economic study	

	farms (OWFs) VATTENFALL				
79	Community benefits and UK offshore wind farms - 2021 - Glasson				
80	community-benefits-offshore-gpp			The focus of a community benefit package should be driven by the local community, who should play an active role in determining how funds are spent.	
81	eng-evidence-report-315-seascape-and-visual-sensitivity-to-offshore-wind-farms-in-wales			Put in table, de relation between height, distance and visual effect.	
82	Estudio_cadena_de_valor_empresas_canarias_eolica_offshore_CMC-min			It explains the value chain, the different sectors to be reviewed, but without going into detail.	
83	Maine OSW DNV Socioeconomic Analysis of Offshore Wind in the Gulf of Maine Final Report			They make some measurements regarding interviews with citizens. They only put whether they have done the interview or not, we could put the answers and opinions of the citizens of the town.	

84	OFFSHORE WIND AND COMMUNITY BENEFITS IN KITTY HAWK NC			In Alaska, a percentage of the oil profits are earmarked for public benefit. To improve the leisure, the city. We could allocate a percentage to help maintain the affected town(s). Give some ideas of how they use that money.	
85	Offshore-Wind-Report_v70918			Explain some ideas on how to have a good relationship between citizens and those who do the work. More accessible documentation, exchange of opinions...	
86	Offshore-Wind-Report_v70919			List of different community benefits	
87	Offshore-Wind-Stakeholder-Engagement-KEEGAN-May-31st-2021			Stakeholder concerns. Possible socio-economic study factors. Still stressing funds for the town/city and what they could be used for. In general, for village improvements. Relate CAPEX; OPEXX... to work.	
88	presentation-socioeconomic-impacts-of-offshore-wind-01.07.2020			There is nothing very new in it. It makes a study of the possible jobs in the installation of a wind farm. The direct, indirect and induced ones.	
89	report-impact-socioeconomics-wind-2019			Diagram of study factors in socioeconomics. Interesting, there are many.	

90	report-impact-socioeconomics-wind-2020			Image with possible three blocks, studies, in each socio-economic study. Economic, environmental and social. Economic and environmental accounting of CO_2 savings. Water saving. Possible economic growth. Help in gender equality. VERY WELL DONE.	
91	sroi-methodology-guidance-nef-consulting			Table of possible factors for socio-economic study in relation to stakeholders	
92	technical-report-socioeconomic-impacts-of-offshore-wind-01.07.2020-			Benefits of an offshore port. More ideas of study factors. They are very similar in general, in the different documents.	
93	1. OFFSHORE WIND TURBINES VISUAL IMPACT ESTIMATION			It makes a study of visual pollution following two different parameters, from different points of the coast. Aesthetic indicator and distinguishable turbines. And that it is better to make a good distribution of aerosols, to reduce visual pollution.	
94	A VISUAL IMPACT ASSESSMENT PROCESS FOR WIND ENERGY PROJECTS			It doesn't give much information that we don't already know. He says a few obvious things. He talks a lot of theory, but nothing concrete to study.	
95	BEST MANAGEMENT PRACTICES FOR REDUCING VISUAL IMPACTS OF RENEWABLE ENERGY FACILITIES			Study of the terrain, before considering the construction. They give you different elements to study.	

96	BEST MANAGEMENT PRACTICES FOR REDUCING VISUAL IMPACTS OF RENEWABLE ENERGY FACILITIES			Better aero lower and more, than a lot of high ones. This pdf is not very funny. Except for these two ideas, there is not much mystery.	
97	Danish offshore wind key environmental issues			environmental monitoring program, it gives you guidelines to make a study of the consequences of construction.	
98	Danish offshore wind key environmental issues			It talks about the variations that the fixed wind farm has had on marine life. There is not much variation with respect to marine or aerial life, except for a few species.	
99	Degraer-2019-Offshore-Wind-Impacts			Study of chemical pollution. Methodology followed.	
100	Degraer-2019-Offshore-Wind-Impacts			In the OWFs in operation and under construction, fishing is still carried out under construction, although it is actually forbidden. They show graphs with the evolution of fishing activity, pre-construction, construction and post-construction. There is not much decrease in activity, in some places it is even increasing.	
101	Degraer-2019-Offshore-Wind-Impacts			Table of birds before and after construction of the park. And study of each bird species observed.	

102	Economics_of_Wind_Energy			It makes a study of the economics of installing a park. The price of kwh etc. But only focused on $ and kw	
103	ei-understanding-the-impacts-of-offshore-wind-farms-on-well-being			Table of benefits of offshore wind	
104	ei-understanding-the-impacts-of-offshore-wind-farms-on-well-being			Talks about percentages of tourists. In relation to whether they are inconvenient or not, the fact of wind farms.	
105	ei-understanding-the-impacts-of-offshore-wind-farms-on-well-being			It talks about impacts, but without bringing anything new to light. It talks about the different factors that we already know. Visual, social, sound, environmental pollution... without going into too much detail. But as a guide it is good. It talks about all the points and adds some experience in the UK.	
106	INNOVATION OUTLOOK OFFSHORE WIND INTERNATIONAL RENEWABLE ENERGY AGENCY	Current status and prospects		Offshore wind's expected development and its impacts on Tech, Innovation, Cost reduction, Industrialization and Market Expansion. Identifies market opportunities and future steps for R&D demonstration projects.	

107	The regional economic impacts of offshore wind energy developments in Scotland	Potential economic impacts on Scotland arising from both the construction and operation of OWF		Analyses, using two different models; Input-Output model and Computable General Equilibrium, DEVEX AND CAPEX breakdown per MW in Scotland OWF development, in order to discuss the results about Absolute cumulative impacts for Employment obtained.	
108	technical-report-socioeconomic-impacts-of-offshore-wind-01.07.2020-	Modulation of offshore wind investments and its related socioeconomical impacts		Using an impact model for offshore wind investments predicts local impacts in development, installation, O&M, and local economy. Also provides local study cases to apply the results obtained.	
109	Estudio_cadena_de_valor_empresas_canarias_eolica_offshore_CMC-min	Estudio de la cadena de valor de la eólica offshore en Canarias		Estudio de la cadena de valor del sector eólico off-shore, compuesta por la suma de la cadena de valor del sector eólico on-shore y la cadena de valor del sector Oil&Gas.	
110	gpwind_thematic_case_studies_en	Case studies and good practices			
111	On the reality of fishing in Viana do Castelo and coexistence with offshore wind energy	Asociación Empresarial Eólica	Measures to be adopted Strategies to prevent and mitigate the conflict		

112	Sea Share Hywind Static Fishing Gear Trials	Kirsty Wright James mair Robert Watret Jim Drewery	In Scottish waters, while there are no legal barriers to fishing within wind farms, safety measures like exclusion or advisory zones are implemented during different phases of wind farm construction, operation, and decommissioning. These zones apply to all vessel activities to ensure safety, such as a temporary 500-meter exclusion zone during construction and decommissioning and a 50-meter advisory buffer during operation. A trial within the Hywind floating offshore wind farm showed that, under suitable sea and weather conditions and following safety parameters, fishing using static gear can be done safely near turbines. The trial yielded insights on catches, indicating an increase in brown crab moving offshore towards winter but no significant change in cod numbers. Prawn catches were absent as the area historically isn't suitable for prawns. Despite reduced drifts in poor weather, the trial's success in testing prawn creels within the wind farm achieved its core objective. Additionally, the wind farm's artificial reef structures attracted fish species preferring rocky habitats, although formal observation of fish aggregation near turbines was limited due to safety concerns.		

113	Quick scan of cumulative impacts on the North Sea biodiversity	R.H. Jongbloed, J.E. Tamis, J.T. van der Wal, P. de Vries, A. Grundlehner, G.J. Piet		• Focused on birds populations • Cumulative Impact Risk decreases for most components but increases for birds, mainly due to OWF. • Benthic trawling poses the highest risk, while OWF contribution remains relatively small. • OWF disproportionately affects specific bird and mammal species, with varying spatial overlaps. • OWF impact on cumulative risk increases over time, with birds most affected during the operational phase and mammals during construction.	

114	Conditions for just offshore wind energy: Addressing the societal challenges of the North Sea wind industry	Tomas Moe Skjølsvold, Sara Heidenreich, Ida Marie Henriksen, Rita Vasconcellos Oliveira, Dorothy Jane Dankel, Julian Lahuerta, Kristin Linnerud, Espen Moe, Birgitte Nygaard, Isabel Richter, Jon Birger Skjærseth, Ivana Suboticki, Mikaela Vasstrøm,	• Highlights societal challenges in advancing offshore wind, emphasizing a co-creation process involving industry, public authorities, and social scientists • Challenges conventional techno-economic framing in offshore wind discussions. • Aims to address societal aspects, emphasizing social justice and legitimacy. • Involves diverse stakeholders to articulate new conversations and issues. • Aims to avoid path-dependencies and lock-ins, fostering a more just transition. • Urges the translation of broad recommendations into practical execution in concrete projects. • Contrasts with past technology-centric debates in socio-technical sustainability transitions literature. • Advocates for cultivating new spaces of debate and engagement to ensure a more legitimate and just transition over time. • Acknowledges challenges shaped by participating actors, with reflections on the absence of civil society representation. • Identifies the need for broader involvement, especially regarding environmental challenges and tourism interests. • Recognizes the difficulty in measuring the degree of change achieved. • Emphasizes the importance of shifting discourses, building new links, and legitimizing concerns beyond techno-economic considerations		

115	Case Study on The Development of the wind industry in New Zealand	Wind Energy Association	• Early academic interest provided valuable understanding of New Zealand's wind resource and highlighted the potential of wind generation. • Agility of smaller organizations in the electricity sector played a crucial role in exploring and initiating wind generation projects. • Installing a single wind turbine significantly boosted confidence in wind technology. • Initial wind projects are expected to be expensive; government support can help reduce costs and facilitate industry learning. • Developing scenarios for wind development assists in understanding wind characteristics within the electricity system, fostering confidence and innovation. • Local engineering companies can contribute significantly to the wind industry by providing innovative solutions to operational and maintenance challenges. • Considering smaller, distributed wind farms alongside larger ones offers benefits such as greater public acceptance and improved grid resiliency. • Establishing a wind industry association is crucial for industry growth, and government support may be needed during its establishment. • Developing tools like noise assessment frameworks and landscape methodologies is essential, led by the government for independence from the industry. • Establishing clear procedures for identifying		

			and managing issues is essential, meeting the expectation of robust processes in the affected community. • A clear and robust decision-making process is crucial to address opposition to wind generation, providing a platform for opponents to be heard.		

116	Qualitative meta-analysis of the socioeconomic impacts of offshore wind farms	Alem et al.,	-The paper analyzes socio-economic effects of offshore wind farms, focusing on four categories identified in Environmental Impact Assessments. Advocates for proactive community education to dispel preconceptions and communicate the lack of conclusive evidence on certain socio-economic aspects during project early phases. Post Construction Monitoring: Stresses the need for post-construction monitoring to assess the actual long-term performance of wind farm projects against initial assumptions. -Advocates for proactive community education to dispel preconceptions and communicate the lack of conclusive evidence on certain socio-economic aspects during project early phases. -Post-Construction Monitoring: Stresses the need for post-construction monitoring to assess the actual long-term performance of wind farm projects against initial assumptions		

117	The local socio-economic impacts of offshore wind farms	Glasson et al.,	-The paper emphasizes the increasing significance of local impacts, particularly in terms of jobs and economic contributions, as part of a broader green energy transition. -Economic impact predictions, especially during offshore construction, have been challenging. The paper suggests that predictions often involve wide-ranging scenarios, with potential overestimation of impacts. -The focus on construction stages has led to an underestimation of other elements, such as onshore construction and the Operations and Maintenance (O&M) stage, which can significantly impact local communities. -Social impacts, including demographic, housing, and local services, are highlighted as important considerations. Engagement strategies and Community Benefits Funds (CBFs) play a role in addressing these impacts.		
118	Learning from the social impacts associated with initiating a windfarm near the former island of Uk, The Netherlands	Martijn Langbroek and Frank Vanclay	Number of jobs depends on the level of skills available in the local community.		

9 ANNEX 4 INTERVIEWS

9.1 Greece

9.1.1 Energy community

1. Sector Context:
   - Regarding the deployment of floating offshore wind, can you describe the current situation in your sector? How is your activity currently developing?
   - How the sector in general is positioned with respect to this technology? How do you think are other sectors positioned?

(e.g. Areas in proximity to Crete where a floating offshore wind farm is being planned)

Response:

The current situation regarding the deployment of Floating Offshore Wind Technologies (FOWTs) in Greece is still immature, with no development or deployment of floating offshore wind (or bottom-fixed) projects yet. The technology is primarily at an early stage in Europe, with only Portugal, the UK, and Norway having initial applications of FOWTs deployed.

Regarding the development and deployment of FOWTs in Greece, in theory there is positive attitude among energy communities, yet skepticism persists regarding actual implementation. The initial selection of locations for floating offshore wind parks predominantly favors major investors, effectively excluding other potential stakeholders.

FOWTs offer distinct advantages, such as the ability to be situated far from coastlines, maximizing wind potential efficiency while avoiding negative impacts on human activities. However, the maximum distance for siting FOWTs in Greece is restricted to 6 nautical miles, thus making great difference compared with other countries. Locations chosen for FOWT development in Crete have faced opposition from local communities due to their close proximity to the coast, raising concerns about visual impact and impacts on tourism, particularly in areas like Elounda and Spinaloga Island.

The Greek Ministry's focus has primarily been on optimizing economic and financial terms of projects, rather than addressing concerns such as tourism, visual impact and nuisances. Requirements for FOWT project development, such as short distance from the coastline and high wind potential (The northern area of Mykonos Island is identified as having the maximum wind potential), tend to favor investors as it reduces the required investments.

One critical issue in Greece is the grid connection and its capacity, particularly in remote areas like Crete, where insufficient grid capacity exists to transfer energy from new floating offshore wind parks.

While FOWT technology offers numerous benefits, it's not being effectively demonstrated in design and business aspects. Existing requirements and criteria for obtaining licenses for FOWT projects heavily favor large investors, making it challenging for smaller stakeholders to participate. A nice example that could be followed is like in Belgium, where The SeaCoop model enables active citizen participation in the energy transition, ensuring price stability and local sustainable anchoring. This model aims to take 20% ownership of the wind farms and supply 20% of the electricity to citizens.

2. Impact on Core Activities:
    - How do you think the offshore wind activity impacts or enhances your core business?
    - Do you think it is necessary that sectors other than technology developers should be involved in the project development process? What aspects do you think are not being taken into account today?
    - What benefits/damages do you identify for your sector from the development of offshore wind energy?
    - What challenges or concerning aspects arise?
    - Do you see collaboration opportunities or synergies between your sector and the development of offshore wind energy? In the event of such synergies, would your position change?

Response:

The impact of floating offshore wind activity is contingent upon proper siting of FOWTs, with a sufficient distance of 6 nautical miles to minimize impact on human activities along the coastline. While specific locations requiring special facilities for FOWT projects may see negative impacts on tourism, overall, adverse effects on marine routes are not anticipated when properly siting the FOWTs. However, challenges may arise when connecting FOWTs to existing local grids, potentially impacting energy communities operating on land-based Renewable Energy Sources (RES). Grid limitations may result in energy loss and reduced profits for these communities, necessitating grid expansion or alternative mainland connections for efficient energy transfer.

Concerns regarding noise and vibrations from FOWTs exist, but it hasn't been conclusively demonstrated that they significantly affect marine environments or organisms. In fact, FOWTs have the potential to create new ecosystems at their bases, as materials like copper and cement attract marine organisms, promoting colony formation. To mitigate environmental pollution, plastic components are avoided in FOWT construction.

Despite the benefits, FOWT projects entail high investment and deployment costs. Collaboration opportunities, similar to those seen in Belgium's legal framework, are crucial for effective project development. However, such initiatives have yet to materialize. Proposed offshore wind turbine locations may remain unchanged due to various reasons, but this doesn't preclude involvement from energy communities in corresponding investment schemes.

3. Maximizing Positive Impact and Reducing Negative Impact:
    - How do you believe the positive impact of offshore wind energy in your sector could be maximized?
    - What actions do you think could minimize potential negative impacts?
    - Do you think that setting up a R&D platform or a pre-commercial park would help this?

(e.g. Positive impact on the energy bill, access to environmental data to researchers, citizen participation through investing in the project?)

Response:

Maximizing the positive impact of offshore wind energy in our sector relies heavily on selecting proper wind farm location, which simultaneously maximizes benefits and minimizes negative impacts. The involvement of local communities in FOWT projects holds great potential for positive influence. For example, public bodies' participation can streamline procedures like licensing, facilitating project development.

Furthermore, energy communities play a pivotal role in fostering sustainable development. Although Greece has significant energy community presence, including Sifnos, Chalki, Karditsa, Minoa, and Hyperiona, their potential impact is often overshadowed by state grants favoring major investors. To counter external pressures, energy communities must assert themselves and advocate for their interests. The FOWT projects are financially viable even with a smaller profit margin for the large investor-owner. Considering that, engaging energy communities in investment schemes, the profit could be increased and applied directly to citizens.

To mitigate negative impacts on Renewable Energy Source (RES) utilization and performance, proper spatial planning and independent grid connection projects are crucial. Instead of focusing solely on geographical aspects, emphasis should be placed on leveraging existing mainland grid networks and their respective capacity.

The proposition of developing a pilot FOWT project in Greece would not help the whole process, because the world no longer needs more pilots for wind turbines. Maybe a FOWT pilot makes sense to see people's reactions to such projects, but at the cost of running the risk of people's existing speculations becoming real arguments/issues. Nevertheless, there are citizens who oppose the FOWT development at all levels, even with proper siting, because they do not accept that this source of wealth (wind potential at the local level) is exploited by external private investors.

4. Local Perception of Renewable Energy:
    - If there are offshore wind energy farm or other renewable energy farm in your area, how does your sector perceive the presence of these technologies?
    - What was the position like initially? What is it like today?
    - The reasons for the positive/negative perception of this example of renewable technology, similar to those applied today with floating offshore wind? How did it change from one position to the other?
    - If there was a conflict between the developers and the affected platform, how was it resolved?

Response:

There will always be backlash, regardless of the number of FOWT projects, but these are now a minority. The only way to reduce them is for civil society to participate widely in the FOWT projects because they feel that the local wealth is returning to them.

9.1.2 INSETE

Aris Ikkos – Institute of Greek Tourism Confederation (INSETE) – Scientific Director

Theofilos Kyratsoulis - Institute of Greek Tourism Confederation (INSETE) – General Manager MINDHAUS

1. Sector Context:
    - Regarding the deployment of floating offshore wind, can you describe the current situation in your sector? How is your activity currently developing?

- How the sector in general is positioned with respect to this technology? How do you think are other sectors positioned?

(e.g. Areas in proximity to touristic places where a floating offshore wind farm is being planned)

Response:

Offshore Wind Energy is welcome to the extent that conflicts are created. Considering the validity of 6 nautical miles in Greece, when FOWTs are placed at a distance of less than 6 nautical miles, wind turbines more than 100m high will be visible and will degrade and disturb the sea horizon, thus more or less affecting tourism. Therefore, it is purely a matter of location to find a place that does not affect tourism.

Whether floating or fixed wind turbines, the tourism sector perceives the issue of OWTs installation as a unified issue. What is of interest and is the immediate concern both institutionally and locally, is the natural view and the sea horizon. By misplacing the wind turbines, local tourism could be devastated, resulting in significant economic and social consequences, because it is an important activity for an island that provides thousands of jobs and people live from it.

Under this framework, there is a great possibility for local communities and interested groups to unite in a common line and oppose the OWT development. For example, fishing issues may arise if wind turbines are placed in a place where mass fishing is done (fishing grounds) or there will probably be issues with ferries and ships if the itineraries are affected.

Some past research has shown that the installation of (F)OWTs will result in:

- 23% reduction in the room-with-a-view concept (Scottish survey).
- 17% said they are less likely to visit a place with Offshore Wind Farm development (USA, England).
- 54% said they would not rent a vacation home if an Offshore Wind Farm was visible, regardless of any discount (US).
- Project Iberdrola: 25km is a good siting distance from tourist places.

2. Impact on Core Activities:
   - How do you think the offshore wind activity impacts or enhances your core business?
   - Do you think it is necessary that sectors other than technology developers should be involved in the project development process? What aspects do you think are not being taken into account today?
   - What benefits/damages do you identify for your sector from the development of offshore wind energy?
   - What challenges or concerning aspects arise?
   - Do you see collaboration opportunities or synergies between your sector and the development of offshore wind energy? In the event of such synergies, would your position change?

Response:

The most important thing for the acceptance of wind turbines by the tourism sector, but also the facilitation of their development, is that no **sustainability impact assessment** has preceded the national action plan for the Offshore Wind Farm development, resulting in serious impacts on tourism such as visual disturbance and noise.

In terms of collaboration, the tourism industry would probably be interested in a partnership/participation in an investment scheme if it had a positive impact, for example, on its energy footprint. There are 3 main points that can define the effective collaboration between the tourism sector and investors:

- Whether there is one or more investment bodies in a specific area plays a vital role in a potential synergy. The more bodies, the harder it is for collaborating in the tourism sector.
- There should be an assessment of the negative economic impacts against the economic benefits in case of cooperation.
- The time horizon must be considered. The financial benefits of FOWT projects will come in the medium-long term, while the negative effects will come in the short term.

3. Maximizing Positive Impact and Reducing Negative Impact:
   - How do you believe the positive impact of offshore wind energy in your sector could be maximized?
   - What actions do you think could minimize potential negative impacts?
   - Do you think that setting up a R&D platform or a pre-commercial park would help this?

(e.g. Positive impact on the energy bill, access to environmental data to researchers, citizen participation through investing in the project)

Response:

The OWT investment/project should result in cheap energy and reduction of the carbon footprint in order to maximize the positive impact. If tourism businesses see a reduction in their energy costs, they will see such a project positively. On the contrary, if they see that all this is done without any benefit (e.g., carbon footprint and energy price reduction), then tourism businesses and society will not see it in a positive way. In addition, it is a failure that needs to be solved the approach of the ministry to site the location of OWT, without consulting the local communities, but also the tourism industry. Additionally, there should be market research that assesses, documents and quantifies the level of impact (either negative or positive) on tourism and its sustainability.

As for the creation of a pilot park, the question is where this will be sited. If they are close to tourist destinations and visible to the human eye, there will be reactions, such as preventing the pilot from starting. In addition to the location, the scale of the pilot (of the wind turbine itself, of the park, of development) is a factor of concern.

There are tools that can illustrate an OWT project (e.g. photorealistic), without requiring a pilot OWT to be developed. The OWT project itself can be simulated to identify problems before a pilot is deployed, thereby minimizing the chance of local communities appealing to the Council of State.

4. Local Perception of Renewable Energy:
   - If there are offshore wind energy farm or other renewable energy farm in your area, how does your sector perceive the presence of these technologies?
   - What was the position like initially? What is it like today?
   - The reasons for the positive/negative perception of this example of renewable technology, similar to those applied today with floating offshore wind? How did it change from one position to the other?
   - If there was a conflict between the developers and the affected platform, how was it resolved?

Response:

The existing projects were made at a time when wind turbines were of smaller scale and were mainly sited in places of little interest to tourists (non-touristic areas). It is widely acknowledged that Greece is mainly visited for its seas, so the different Renewable Energy Sources (RES) faced relatively smaller reactions when sited in mountains and agricultural fields.

One assessment is that, on the contrary, OWT may encounter less opposition from NGOs and environmental organizations than onshore ones, but on the other hand are more likely to cause more visual nuisance than onshore ones.

9.2 Portugal

Stakeholder	Company	Name	Anonymous
Academia	Instituto Superior Técnico (IST) - Lisbon Technical University	Ricardo Pereira	no
Technology developer	Principle Power	Aaron Smith	no
Environmentalist	SPEA	Nuno Barros	no
TSO representative	anonymous	anonymous	yes
Fishermen	Associação dos armadores da pesca artesanal de Viana do Castelo	João Pacheco	no
Fishermen	Associação Pescas Armadores Figueira Foz	António Lé	no

Questions

1. **Sector Context:**
   - Regarding the deployment of floating offshore wind, can you describe the current situation in your sector? How is your activity currently developing?

     Academia: Portuguese academia, and Lisbon Technical University (IST) in particular, is engaged in the development of FOW. We currently are pursuing and executing a couple of FOW projects, namely with national funding.

     Technology developer: Progress with demonstration. It's robust. We have experience with the Windfloat1 foundation, which we leveraged and took to commercialization with the Wind Float Atlantic project. From a project perspective, various factors come into play, including government support, regulations, policies, infrastructure readiness, port facilities, and economic development, along with the development of the supply chain. We're essentially forging a new industry, and the readiness of ports varies, with some like Korea being more prepared. Auctions initiated last year signal a promising environment for industrialization. Some shipyards are ready, and there's progress on offtake mechanisms. The process unfolds in two phases, and Korea can serve as an example of what's working well. However, in Portugal, uncertainties in policies, port readiness, and supply chain investment timelines make developers hesitant to invest. We need clarity on the timeline to place orders and invest, considering capacity and the role of business developers.

Environmentalist: We've been closely monitoring the process since the inception of the Allocation Plan, actively engaging in public consultations. Our efforts extend both nationally, where we work independently and collaboratively, and internationally through partnerships with esteemed organizations like the Bird Life Network and the Medocean Coalition. Our aim is to provide comprehensive recommendations covering all phases of the deployment process.

TSO representative: The working group in October 2022 produced a report on the sector's perspective and the situation. They developed a situation plan to minimize impacts. The plan considers the positions of various stakeholders. The report was made public, and a preliminary report identifying areas and connections was presented to the government in December 2022. Actions were taken by the government in Lisbon, Viana, Castelo, and other places.

Fishermen: The consultation process did not involve us (question 4). This led to conflict, particularly because the area in question is a fishing zone. If we had been consulted, there might have been less conflict. The proposed offshore wind farm would occupy approximately 12 square kilometers, encroaching upon fishing areas without consulting us. This highlights a broader issue in Portugal where the sea is already heavily occupied. The Directorate-General for Natural Resources, Maritime and Coastal Services (DGRM) is aware of this but does not recognize the extent of the occupation. For example, the use of octopus traps ('alcatruzes') in our fishing practices is essential, as they provide shelter for octopus during spawning, which occurs over 20 to 30 days without removal. Moving these traps farther offshore beyond the proposed wind farm would disrupt our traditional fishing practices.

- How the sector in general is positioned with respect to this technology? How do you think are other sectors positioned?

Academia: The offshore energy sector is particularly developed in IST owing to the longstanding research in wave energy.

Technology developer: Offshore wind, especially floating, differs significantly from onshore and solar. It requires a long-term commitment, typically spanning 20 years, due to the scale of components and the magnitude of transformation involved. A necessary strategy for long-term success is crucial, considering the market differences from other sectors with established strategies. In China, for instance, there's a focus on long-term planning, which sets it apart.

Environmentalist: The sector overwhelmingly supports the implementation of renewable energy solutions. We recognize the interconnected nature of the energy, climate, and biodiversity crises and understand the importance of addressing them collectively. It's imperative that our actions in one area do not exacerbate challenges in another.

TSO representative: In 2023, there were various subgroups of the working group addressing wind resources, ports, and public consultations on renewable energy impacts. Some modifications were made to the areas, eliminating some and increasing others for floating wind. The vision of the promoters since late 2022 has been to establish a procedure for capacity integration. wind areas were abandoned, and others were excluded in favor of increasing areas for floating wind. Offshore wind is seen as vital for hydrogen production, addressing electrical intensity needs. There are benefits in diversification and improved response systems, especially economically with shorter distances for floating wind. Concerns include damage and interruptions to cables, but they also offer advantages for marine life and act as barriers for trawling.

Fishermen: The establishment of new offshore wind parks has led to conflicts with traditional fishing practices, particularly with regards to trawling. Fishermen report that their fishing grounds have been pushed farther offshore, beyond their usual range of 20 to 30 miles, due to the installation of wind turbines. This displacement impacts small-scale artisanal fishing, as well as trawling operations. While promises of compensation have been made by the DGRM, fishermen remain concerned about the practicalities of operating within or around wind parks. Clarity on the number of vessels permitted within wind parks and the extent of compensation for affected fishermen is essential. Furthermore, fishermen advocate for increased consultation and transparency from developers to ensure that the concerns of all stakeholders are adequately addressed.

2. Impact on Core Activities:
   - How do you think the offshore wind activity impacts or enhances your core business?

     Academia: There is a positive impact, not only of the increase in research and development activities but also in the promotion of collaborations across universities and between different departments.

     Environmentalist: It's not our core business. While documented impacts on biodiversity exist, they haven't been specifically studied in the case of Portugal.

     Fishermen: The establishment of new offshore wind parks has led to conflicts with traditional fishing practices, particularly with regards to trawling. Fishermen report that their fishing grounds have been pushed farther offshore, beyond their usual range of 20 to 30 miles, due to the installation of wind turbines. This displacement impacts small-scale artisanal fishing, as well as trawling operations.

   - Do you think it is necessary that sectors other than technology developers should be involved in the project development process? What aspects do you think are not being taken into account today?

Academia: It is my belief that technology developers already rely on input from other sectors, even if the final decision is made by technology developers.

Technology developer: Yes, it's crucial to involve sectors beyond technology developers in the project development process. A long-term strategy is essential, but the timeline is often complicated as multiple factors unfold simultaneously. Developers typically drive development, but it's imperative to engage the supply chain, environmental experts, transmission specialists, and vessel operators, among others. The involvement of different sectors varies depending on the project's nature and development stage. Ports and grid infrastructure are particularly critical areas of focus, as delays can hinder developers' ability to place orders and instill confidence in the market. Governments have an obligation to manage the seabed as a common interest, define energy plans, and set objectives for decarbonization. However, there's a need for them to take a more active role in bringing stakeholders together, as they often defer to developers. In contrast, countries like Japan adopt a consensus culture, engaging with stakeholders such as fishermen extensively. On the other hand, Portugal takes a more passive role, with fishermen receiving more compensation, and the government avoiding exposure. Embracing a culture of 'try and fail' is essential, especially in the technology sector where failure is an inherent part of innovation. While the floating sector has faced challenges, such as the Fukushima project not yielding results for six years, it underscores the importance of rigorous testing and deploying solutions that are bankable and consented through comprehensive testing processes.

Environmentalist The project development process needs broader participation, involving all relevant stakeholders, which hasn't been the case so far. The current approach has mainly focused on the energy and fishing sectors, as outlined in the Allocation Plan for Renewable Energy (PEAR, in Portuguese). However, it's evident that strategic environmental assessments have not included consultations with experts from academia and civil society, highlighting a significant oversight.

- What benefits/damages do you identify for your sector from the development of offshore wind energy?

  Academia: The development of offshore wind energy further develops the academia sector as it brings the opportunity for real impact in the energetic transition. This translates into high level of motivation but also in increased collaboration. No negative aspects are directly foreseen for the academic sector.

- What challenges or concerning aspects arise?

  Academia: Since currently the expected growth and deployment of OW in Portugal is eminent, there is a very significant attention and project development from a number of large companies and enterprises, which leads to confidentiality issues. Ultimately this may hinder the exchange of information and thus curtail the advancement of scientific knowledge in this area.

Environmentalist: The impact on marine biodiversity and coastal communities.

- Do you see collaboration opportunities or synergies between your sector and the development of offshore wind energy? In the event of such synergies, would your position change?

  Environmentalist: Yes, I see opportunities to provide scientific expertise

  TSO representative: Yes, there are collaboration opportunities and synergies between our sector and the development of offshore wind energy. Integration with energy operators and modifications to offshore wind areas aim to address concerns and enhance opportunities.

3. Maximizing Positive Impact and Reducing Negative Impact:

- How do you believe the positive impact of offshore wind energy in your sector could be maximized?

  Academia: With more transparency, not only from technological developers but also from the Portuguese national authorities, as there has been some delay in the publication of details for OW auctions.

  Technology developer: To maximize the positive impact of offshore wind energy in our sector, key strategies are essential. Firstly, project sizing is crucial, ensuring that developments are appropriately scaled to optimize efficiency and minimize environmental disturbance. Location selection is equally important, choosing sites away from significant impacts such as shipping lanes, bird migration routes, and sensitive ecosystems. Visual impact mitigation measures are also vital to maintain aesthetic harmony with the surrounding landscape. Engaging with local stakeholders, including fishermen, is paramount, as demonstrated by the interactions of the government with fishermen in Korea, ensuring projects are strategically positioned away from offshore activities. Longer cables can mitigate visual and environmental impacts, while deeper water depths, preferably around 200 meters, can enhance project economics. Accelerating reef formation and creating safe habitats can further amplify positive environmental outcomes. Projects like the Golf of Leon initiative, designated as a natural reserve, exemplify how offshore wind developments can align with conservation efforts, contributing positively to the environment. Continuous research and development, exemplified by our recent progress with floating wind projects, remain instrumental in advancing our understanding and minimizing environmental impacts. Additionally, fostering multi-use platforms, such as incorporating weather stations and sea condition monitoring for fishermen and military communications, can unlock synergies and enhance the overall positive impact of offshore wind energy.

- What actions do you think could minimize potential negative impacts?

Academia: Harmonization and alignment of expectation of offshore stakeholders, with fishermen, as fishing activities are very important within the Portuguese context and since the ports are already experiencing high strain.

Technology developer: To minimize potential negative impacts, proactive measures must be implemented throughout the project lifecycle. As mentioned, strategic site selection plays a pivotal role, ensuring developments are situated away from sensitive areas and major shipping routes. Engaging with local communities and stakeholders early in the process allows for the identification of concerns and the implementation of mitigation strategies tailored to address specific issues. Learning from past experiences, such as floating wind projects encountering issues with marine growth upon decommissioning, highlights the importance of monitoring and managing environmental impacts throughout the project lifespan. Establishing protected areas, like the Oceanwind project in the Golf of Leon, serves as a buffer zone to safeguard marine ecosystems from potential disturbances. Furthermore, enhancing accessibility to project platforms by incorporating multi-use functionalities, such as weather stations and communication infrastructure, fosters collaboration and improves transparency with stakeholders. By prioritizing environmental stewardship and proactive engagement, we can effectively minimize negative impacts and ensure sustainable offshore wind energy development.

4. If a Maritime Spatial Planning has been performed in your country:
   - Have your sector's representatives been involved in the maritime spatial planning process concerning offshore wind energy?

Academia: To my knowledge we were not consulted.

Technology developer: Yes, our sector's representatives have been involved in the maritime spatial planning process, albeit to a limited extent. Participation primarily focused on providing input on general aspects of offshore wind energy development. This involvement centered on high-level considerations such as identifying suitable site conditions, including areas with favorable wind conditions and adequate water depths, and assessing seabed conditions to ensure compatibility with installation requirements.

Environmentalist: The zones for offshore wind energy are in the final stages of designation before being included in the planning. Involvement in defining the zones was limited, as it was conducted by an interministerial working group. However, despite limited involvement, we provided many recommendations during the zoning process.

Fishermen: The consultation process did not involve us. This led to conflict, particularly because the area in question is a fishing zone. Had we been consulted, there might have been less conflict.

- If you or your sector's representative participated, what things did you think were important to include? What things worked? What would you have changed?

  Environmentalist: In terms of defining the zones, I would have expanded the participatory process to involve other sectors of society and used sensitivity mapping as a reference.

- If not, did you wish you had been able to participate? And why? What would you have liked to say?

  Academia: Yes, because I believe academia must have a significantly positive contribution to an integrated approach to the sustainable development of OW.

  Environmentalist: Yes, because SPEA produced the first sensitivity mapping of seabirds in offshore wind energy to inform the process

9.3 Spain

9.3.1 Toni Marzoa – President of National Federation of Fishermen's Brotherhoods

1. Context of the sector
They are at zero balance; they have not lived with this sector. As a fishing sector, they see it as a rivalry for space.
A priori, fishing is a sector that has been punished for many years (without denying, says Marzoa, that it gives us food sovereignty).
In general terms, it generates concern in an activity such as fishing (mistreated and mistrusted). No experience.
They have total and absolute distrust.

Other sectors: he says that he cannot give his opinion on other sectors. Cannot get involved. That no hasty decisions should be taken, that a decision should be taken on the sensitive maritime space.

Marzoa: "The blue economy should be built on respect for existing activities, and those to come, taking into account the expansion and development that each one may have".

2. Impact on fishing
Does it affect or improve? He sees no improvement. It will have (as it has had in other areas) impacts: waves, installation, pipelines to land. Impact on fishing grounds, measuring it in %, does not work. Affecting a fishing ground by 2% or 90% has to be considered 100% (especially in the trawling fleet).

Participation. Everyone should be involved. Developers are going to defend their own project. There are going to be spherical effects, so everyone has to be involved at their own level.

What aspects are not taken into account? As a partial view, from the fishing sector, an activity that has been self-regulated. Fishermen have a great knowledge, albeit selfishly, of how to make their food/source of income last.

Marzoa: "A project like this, which will be necessary, never takes many aspects (referring to environmental and socio-economic impact) sufficiently into account".

And why doesn't it go elsewhere? Essential strategic activities such as the primary sector are not taken into account, and alternative energies are given priority.

Marzoa says that the "fault" does not lie with the offshore wind project itself, but with the consultation procedures, which are not sufficiently valued (they are perceived as dispensable).

Challenges or areas of concern. Convinced that the activity, even in a very large part or percentage, is going to disappear.

Opportunities for collaboration or synergies: they say that they do not need us. Cannot think of possible synergies to change their mind: one prevents the other and vice versa.

3. Maximise positive impact and reduce negative impact.
Maximise the positive impact: he does not see the way.
Marzoa comments on how the fishing fleet is punished with European regulation on decarbonisation. Impact studies are conducted without taking into account factors such as climate change, shipping routes, demographic pressure that affects fishing mortality, and it is concluded that it is the fishing sector that is responsible, as it is the activity with the most data recorded.
In the case of being able to fish over offshore wind farms, it does not dare to say what would happen.
Actions that could minimise these impacts: He says that 260 m windmills at 24 km, little can be minimised. He says that he wishes there were other technology, that they were not so big, or at least that they would allow them to be much further away, outside of fishing grounds or working routes.
Pre-commercial park: March comments that this would give a lot of information, with regard to maintenance and monitoring (with a long enough time sequence to have a basis for conclusions. It would be ideal, in his view, to first try and see what happens.

4. Maritime spatial planning.

They have been called to 2 meetings (few), by the responsible ministry, to talk about maritime spatial planning. Afterwards, a lot of information has been sent to them (which means a lot to review), but the Ministry moves forward without waiting for feedback, the map is closed and no position from the fishing employers or fishermen's guilds has been presented to them.

Marzo comments that the Catalan Fisheries Policy has a maritime strategy for 2030, in which they are trying to apply European criteria, leaving spaces reserved for use by other activities.

Marzoa commented that although the Catalan Fisheries Policy has made efforts to apply the criteria of co-management and governance in the Catalan maritime space, he perceives that in practical terms it does not lead to great improvements due to the excessive control of the fishing sector and the macro-policy applied to it. He perceives an excess of regulatory control against fishing that discourages the sector (Marzoa: "there are only four of us").

What is missing from management? They miss the fact that they are listened to, that they are taken into account. Marzo asks that where there are fishing grounds, other places should be found, given that they have no alternative. In addition, he claims the right that they have always used these areas, they cannot go to other fishing grounds, and the wind farms are new people in the area.

Marzoa says that there is no will from Europe to reconvert the fishing sector, so that measures are imposed that have a negative impact on the sector, without the courage to establish compensatory and accompanying measures for the European policies adopted.

They have fewer means of support to make themselves heard and asserted, compared to other interests that do have the means to carry out a communication campaign and lobbying work.

But in the face of a technology that is in the process of maturing, do we have to run so fast?

ADDITIONAL QUESTIONS

5. If the promoters had contacted the industry from the beginning and set up working groups, would this have made things easier? Marzoa says that the damages and the effect on fishing would not change because they are what they are. The parties would simply understand each other through a healthier and more peaceful dialogue.

6. As fishing is a sector that is self-regulated (closed seasons, so that fish can reproduce, etc.), do you think that a country can afford to let it lose them? Marzoa says no. However, since 2003 there has been a 60% reduction in the number of fishing boats in Catalonia.

7. In a scenario where the water temperature is getting warmer, the fish are getting smaller and smaller, why is it that whenever you take a position against a floating offshore wind farm and its possible impacts, you compare it to the current scenario and not to a future without renewable energies? Marzoa responds that the fishing sector has already made and is making an effort, creating closures to maintain the species in the area, reducing both the fleet and the possible kg to be fished. And even so, it was decided to locate the park in areas where the fishing grounds are (which is the space where fishing can take place).

8. Were you aware of the existence of PLEMCAT (Catalan Marine Energy R&D&I Platform)? I did not know about it, but I think that these initiatives are the future and are necessary for data collection.

9.3.2 Jaume Morron – Onshore wind

1. Sector Context:

- Regarding the deployment of floating offshore wind, can you describe the current situation in your sector? How is your activity currently developing?

There are projects with very different capacities, from 200 to 1000 MW, knowing that the resource is good in the LEBA-1 area (Catalonia, Spain) it is possible that it will attract external investors (outside Catalonia), and this is not of interest. It is necessary to make the most of the area (the bigger the farms the better). Bearing in mind that Catalonia will triple its energy consumption in the coming years, it is also necessary to increase production capacity, especially renewable energy, so as not to be dependent on buying fossil fuels abroad.

This is a great opportunity to position the province of Girona.

- How the sector in general is positioned with respect to this technology? How do you think are other sectors positioned?

Sectors should position themselves to improve citizen participation, betting on the population in coastal areas. Being a high investment sector, there is a lot to be said. It is important to focus on productivity, and wind farms can be far away, but in much larger areas with greater wind resources.

2. Impact on Core Activities:

- How do you think the offshore wind activity impacts or enhances your core business?

- Do you think it is necessary that sectors other than technology developers should be involved in the project development process? What aspects do you think are not being taken into account today?

- What benefits/damages do you identify for your sector from the development of offshore wind energy?

- What challenges or concerning aspects arise?

- Do you see collaboration opportunities or synergies between your sector and the development of offshore wind energy? In the event of such synergies, would your position change?

Renewable energy generation targets need to be met and a smooth path to deployment needs to be put in place. Personally, I am of the opinion that more areas such as LEBA-1 would be necessary, once this area has been tested, where larger machines can be placed and in other areas of Catalonia, such as near the industrial area of Tarragona.

With regard to the added value of other dryers, it is necessary to consider what they can contribute. The most important thing is to promote the social acceptance of the projects and to get the support of the fishing sector (improve visibility and increase economic capacity).

In the context of Catalonia, this type of technology provides energy sovereignty. In other words, it means not depending on third parties to make a country function. At times when geopolitics is so present, it is necessary to produce one's own energy.

Reconverting sectors, such as the fishing sector, which can adapt to this new job, with tasks that are similar to their main activity.

Challenges: Ignorance of society. Science has to be ahead of everything else and stop misinforming.

Onshore wind is already giving knowledge to offshore wind and vice versa.

3. Maximizing Positive Impact and Reducing Negative Impact:

- How do you believe the positive impact of offshore wind energy in your sector could be maximized?

- What actions do you think could minimize potential negative impacts?

- Do you think that setting up a R&D platform or a pre-commercial park would help this?

The positive impact is maximised by making many more MW, in appropriate locations, where protected areas are not impacted. In other words, aiming for maximum productivity.

Reduce negative impacts, where the interviewee sees few negative impacts, if he sees it as paramount to start looking for compatibility with fisheries. Putting science first.

An R&D platform is not seen as necessary now, given that that moment has already passed. In Catalonia in 2010, a research project could have been carried out, but nowadays we have to move directly to commercial projects.

4.If a Maritime Spatial Planning has been done in your country:

- Have your sector's representatives been involved in the maritime spatial planning process concerning offshore wind energy?

- If you or your sector's representative participated, what things did you thought were important to include? What things did work? What would you have changed?

- If not, did you wish you had been able to participate? And why? What would you have liked to say?

They feel represented and listened to. All the proposals made were included. Very satisfied with the results but sad that there are few areas for offshore wind development in Catalonia.

5. Local Perception of Renewable Energy:

- If there are offshore wind energy farm or other renewable energy farm in your area, how does your sector perceive the presence of these technologies?
- What was the position like initially? What is it like today?
- The reasons for the positive/negative perception of this example of renewable technology, similar to those applied today with floating offshore wind? How did it change from one position to the other?
- If there was a conflict between the developers and the affected platform, how was it resolved?

As an example of onshore wind power, where there was also public opposition, it should not be forgotten that the majority of the population is in favor (75%) while 10% are undecided and the rest are those who make the most media noise, but they are still a minority. In the Catalan context, opposition is often political, but there is no shame in admitting that you want to install renewables.

Countries such as Germany, where the minister of economy and climate action is the same, are given as an example to follow.

Establishment of wind farms. Initially they had to be escorted by the police, due to opposition, but going house to house, neighbor to neighbor, despite being a much slower process, practically all the people understand why the installation of renewable parks is necessary and are no longer against this type of project.

Co-funded by
the European Union