Report on assessment of socio-economic impacts of offshore wind farms

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List of Acronyms

Acronym	Full term	Description
AIS	Automatic Identification System	Automatic tracking system for vessels using transponders on ships
DEA	Danish Energy Agency	Authority in Denmark responsible for planning and licencing of offshore wind farms
EIA	Environmental Impact Assessment	Project-level assessment, regulated through the EIA Directive 2014/52/EU. required under EU legislation
EIAR	Environmental Impact Assessment Report	Report that describes the assessment of significant environmental effects as per the EIA Directive 2014/52/EU, and provides recommendations to avoid, mitigate or compensate identified potential significant effects.
ESG	Environment, Social, and Governance	Framework used to evaluate businesses practices and sustainability performance of companies

ESIA	Social and Environmental Impact Assessment	Combined social and environmental impact assessment
GIS	Geographic Information Systems	Computer software that analyses and displays geographically referenced information
GPS	Global Positioning System	A global navigational satellite system that provides precise positioning, navigation, and timing services to users worldwide
GVA	Gross Value Added	Economic metric used to assess value of goods and services
IAIA	International Association of Impact Assessment	Non-profit association dedicated to the study and application of impact assessment.
OWF	Offshore Wind Farm	Wind energy installations located in marine environments, including associated infrastructure
PAC	Pre-application consultation	Pre-application consultation reports that are mandatory parts of planning applications for wind farms in the UK
SEA	Strategic Environmental Assessment	Assessment applied to plans and programmes, regulated through regulated through the SEA Directive 2001/42/EC SEA Directive.
SIA	Social Impact Assessment	Assessment of social and socio-economic impacts
ZTV	Zone of Theoretical Visibility	GIS-generated map used to identify geographic area from which a proposed development will theoretically be visible; key method for assessing visual impact

List of Tables

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List of Figures

Keywords list

- Socio-economic impacts
- Social impacts
- Communities
- Environmental Impact Assessment (EIA)
- Socio-environmental Impact Assessment (SEIA)
- Social Impact Assessment (SIA)
- Strategic Environmental Assessment (SEA)
- The International Association of Impact Assessment (IAIA)
- Offshore Wind Farm (OWF)
- Literature review
- Interviews

Disclaimer

Executive Summary

Purpose and Scope

This report (Deliverable 4.1) presents a qualitative review of prevailing socio-economic impacts of offshore wind farm developments and their assessment methods as addressed in academic literature and practice. The content and insights of this report draw on an extensive review of international scientific literature, a review of selected Strategic Environmental Assessment (SEA) reports and Environmental Impact Assessments Reports (EIARs), and interviews with expert stakeholders representing the European wind energy sector, academia and affected parties, including consultancies, public authorities, developers, researchers and local communities.

By conceptualising principal socio-economic impacts and reviewing related assessment methods, the report pursues three objectives:

1) establish a shared understanding of socio-economic impacts of offshore wind farms;

2) provide an overview of prevailing socio-economic impacts and juxtapose them with social and economic issues highlighted in the scientific literature; and

3) identify approaches and challenges of assessing key socio-economic impacts in practice.

Conceptual considerations: Socio-economic vs. social impacts

The review of scientific literature and EIARs has revealed ambiguities in utilising the terms socio_economic. and. social. impacts. Since the social dimension of effects within impact assessments has been described as either socio-economic or social, the differentiation remains blurry in theory and practice. This report uses socio-economic impacts as the overarching term.

First, the EU SEA and EIA Directives (2001/42/EC, 2001; 2014/52/EU, 2014) describes several environmental factors that are commonly associated with direct and indirect effects that projects may induce on humans, their environment and activities. These factors are associated with socio-economic impacts, in terms of economic consequences that interferences with human activities may entail. Second, the International Association of Impact Assessment (IAIA) conceives social impacts as anything that directly and indirectly affects or alters people's lives and outlines several specific social impacts, such as impacts on culture, well-being, democracy, identity, and promotes social impact assessments (SIA) as a holistic process of managing social consequences across all lifecycle phases of projects. This difference between socio-economic and social impacts is also reflected in the literature, which hints at a discrepancy between what is considered and assessed in EIARs and what citizens deem important in their everyday lives.

To make a necessary differentiation more transparent, this report uses socio-economic impacts and employs the following understanding:

- Socio-economic impacts refer to effects on human activities and material conditions as well as their social and economic consequences, while social impacts specifically refer to non-material effects on people's lives (e.g. cultural, health. well-being effects in general).

The demarcation and definition of specific impacts is context-dependent and are determined by affected receptors. In this report we innovatively utilise a taxonomy to make sense of common receptors and impacts in relation to offshore wind farms.

Socio-economic impacts of offshore wind

Despite important conceptual advancements in SIA, and their increased application across different sectors, the utilization of SIAs as promoted by the IAIA has not received meaningful attention within assessments of socio-economic impacts of offshore wind farm developments. The consideration of socio-economic impacts in Europe is usually integrated into environmental assessments (both SEA and EIA), whose legislation conceives a sufficiently broad definition of environment to incorporate both the biophysical as well as the human environment (e.g. through the topic of 'population and human health'). The types of socio-economic impacts and associated receptors addressed in SEAs and EIARs are largely determined by impact categories taken forward by the EU SEA and EIA Directives (2001/42/EC, 2001; 2014/52/EU, 2014) that prescribe the acknowledgement of different receptors including 'population and human health' and others that entail a socio-economic dimension (e.g. through provisioning and cultural ecosystem services delivered by water, biodiversity, landscape, etc.). Despite the leeway for integrating socio-economic impacts in EIARs for offshore wind farms, their assessments remain rather weak and constrained and tend to be reduced to economic effects. Even more so, the assessment of socio-economic impacts is made less explicit in strategic or sectoral planning documents, whose aim is to designate and select appropriate sites for future offshore wind developments by avoiding conflicts with other marine users. Hence, the focus of strategic environmental assessments is on screening and scoping of potential population and human health effects rather than a detailed assessment of impacts.

The establishment of physical infrastructures and barriers associated with offshore wind developments represent the main pressures that effectuate changes to different human receptors. An important feature of impacts caused by the development and deployment of offshore wind turbines and associated infrastructures is that they may not only occur offshore but can also affect receptors onshore. First, socio-economic impacts emerging offshore are related to spatial constraints for existing marine uses that can be displaced or their access to areas can be restricted by the siting of offshore wind farms, which can have negative economic effects on other users whose activities depend on access to marine resources in such areas. Second, the development, installation and operation of offshore wind farms require land-based construction works for associated infrastructures, e.g. transmission lines and substations, but also the increased use of port facilities, which also necessitate physical changes and cause both negative and positive socio-economic impacts onshore. For example, benefits can emerge through necessary infrastructure enhancements or the creation and diversification of employment. Third, the presence of turbines at sea and their potential visibility from the coast can also have effects on social conditions of coastal communities and economic activities taking place at the coast, most notably tourism.

Considering relevant receptors, physical changes and the spatiality of effects induced by offshore wind farm plans and developments, the following socio-economic impacts are commonly addressed in SEAs/EIAs.

- Impacts on commercial fishing
- Impacts on shipping and navigation
- Landscape and seascape impacts / visual impacts
- Impacts on coastal tourism
- Impacts on cultural heritage
- Impacts on harbours / ports / infrastructures
- Impacts on recreational fishing
- Impacts on other marine uses (such as military and resource extraction) and material assets

In contrast to impacts predominantly addressed in SEAs/EIAs that tend to be narrowed down to economic and value-related considerations, scientific literature has increasingly approached socio-economic impacts more broadly and has put much more emphasis on the human dimension of potential impacts. This literature addresses a wider range of topics, and socio-economic impacts have been implicitly addressed through research under the umbrella of social acceptance. While socio-economic impacts have been variously conceptualized and operationalized to describe changes, disruptions and inequalities related to the social context, and the understanding of social impacts has been more closely aligned with the one promoted by the IAIA. In addition, scientific literature also focuses more on positive socio-economic impacts or benefits than EIARs.

Assessment tools for socio-economic impacts

Assessments of socio-economic impacts examine the scope of effects through various steps that involve scoping, baseline studies, predictions, and impact modelling to estimate the significance and magnitude of the effects (i.e. impact). Although predictions of impacts are inaccurate due to an unclear materialization of effects and their variable long-term consequences in relation to existing conditions, impact assessments aim to reduce uncertainties associated with the implementation of offshore wind farm projects and have the potential to provide insights into enhancement measures and benefits. Methodologies for assessing socio-economic impacts are largely descriptive and qualitative, and draw on the following methods and data:

- Socio-economic impacts are generally assessed by describing a baseline of socio-economic conditions related to specific receptors that provide reference data used to evaluate potential changes.
- The assessment of impacts on specific receptors usually comprises a combination of baseline studies and predictive modelling.
- Assessments are judged based on the expected magnitude of effect and sensitivity of the receptor/conditions.
- Estimations and predictions of socio-economic impacts often rely on expert judgement.
- Data used for assessments consists mainly of secondary data (e.g. employment data) or primary data (e.g. surveys) that are acquired through investigations to establish the baseline.
- Data is gathered from publicly available sources, desktop studies, or acquired through site visits and surveys.

Despite common assessment frameworks across countries and national guidelines, the application and combination of specific methods as well as the assessment level of detail vary. The need for combining methods indicates that no single method sufficiently captures the multitude of potential socio-economic effects. However, there are patterns in how different receptors are assessed, with variation in the level of quantification and modelling applied. Impacts on some receptors (e.g. fishing and shipping) are assessed using more quantitative methods, depending on the availability of data.

Current challenges in assessment practice

Socio-economic impacts tend to be understudied in comparison to environmental impacts in offshore wind farm (OWF) planning. In practice, socio-economic issues are commonly limited to impacts on sectors like fishing and tourism, and assets like cultural heritage and landscape/ seascape that have economic repercussions or affect social values ascribed to existing conditions. Broader social impacts that essentially and variously affect the quality of life of individuals and coastal communities (e.g. place identity, culture, seascape values, stress, etc.) are rarely investigated, even though they reflect issues that may matter most to people. The extent of which different countries attach importance to socio-economic issues also differs. For instance, in the UK, there is more focus on such issues than in Denmark.

Uncertainties in the assessment emerge through the quality of data due to the absence, incompleteness or inaccuracy of specific data required for establishing the baseline for certain receptors, and the explanatory power of assessment methods. This results in temporal and spatial limitations for identifying a sufficiently informative and meaningful baseline. Since assessments are mainly based on predictions and estimations of impacts, there is also uncertainty about the exposure pathway of receptors and the magnitude of the effect.

The assessment of socio-economic impacts is challenged by procedural deficiencies:

- A recurrent issue refers to limited or inappropriate methods for sufficiently assessing impacts, even if data sources are available for describing baselines.
- The meaningful description of the baseline and assessment of some impacts requires active involvement of affected communities, who can be reluctant (e.g. fisheries) to engage.
- The assessment of impacts often involves expert judgement as the final step to estimate the magnitude of the effect (i.e. impact), which also depends on knowledge and personal experiences of consultants and are prone to different interpretations and conclusions.

There are also challenges related to the temporal scope of impact assessments:

- Socio-economic impacts are dynamic and tend to materialize over longer periods throughout the operational lifetime of offshore wind farms, while assessments provide a snapshot in time.
- A lack of long-term monitoring of actual effects once an OWF has been established leaves assessments unverified and is claimed to obscure differences between predicted and actual impacts (e.g. effects on tourism).
- Socio-economic conditions are dynamic and fluctuate over time, which creates difficulties in determining effects and pressures originating from offshore wind farm developments alone.

Basis for further work

The results and insights from the findings of this deliverable provide a basis for subsequent project tasks and deliverables in relation to:

- Discussing and clarifying terminological obscurities for obtaining a shared understanding of socio-economic impacts.

- Identifying a priority list of socio-economic impacts taken further in the research project and for integration in the planned decision-support tools.
- Developing a foundation for requirements for stakeholder engagement in impact assessments by identifying key impacts and associated stakeholders.
- Addressing specific methodological challenges in socio-economic impact assessments for OWF development.

Table of Contents

1. Introduction

1.1. Background and rationale

The expansion of offshore wind energy in Europe relates to EU's ambitious energy and climate targets for 2030 and 2050 (EC, 2020). Providing ways forward to support the long-term sustainable development of the sector, the strategy set Commission targets for an installed capacity of at least 60 GW of offshore wind and 1 GW of ocean energy by 2030, and 300 GW and 40 GW, respectively, by 2050 (EC, 2020)

The large-scale deployment of OWFs does not only interact with marine ecosystems, but also already existing marine activities as well as coastal communities which have given rise to conflicts and contestations.

Research on social acceptance of renewable energy and associated infrastructures has been very prolific and productive in shedding light on various explanations and causalities for manifold social responses to the deployment of renewable energy and the underlying processes, also carving out nuances in community interactions with and contestations over offshore wind as an established and emerging technology (e.g. Desvallées & Arnauld de Sartre, 2023; Devine-Wright & Wiersma, 2020; Spyridonidou, 2025).

In line with social acceptance research, there has also been a growing focus on justice implications of the planning and development of offshore wind (Bates et al., 2025; Park et al., 2024; Skjølsvold et al., 2024). The issue of justice within OWF developments is associated with questions of participation and fairness by paying critical attention to the decision-making process as well as the distribution of burdens (e.g. visual impact or loss of fishing grounds) and benefits (e.g. employment, harbour development, community benefit funds) engendered by developments. In contrast to onshore wind, offshore wind has often and allegedly been seen as less conflict-laden just because potentially disruptive infrastructures are placed out at sea (Haggett, 2008). However, public support is also crucial for successful and legitimate future developments in marine areas, which, in theory, requires an incorporation of social issues in marine governance and policymaking (Soma & Haggett, 2015). The objective of achieving acceptance has mainly resulted in instrumental practices, aiming at stakeholder acceptance through public engagement that is often promoted as a way for involving people in decision-making processes, rather than influencing decisions.

Nevertheless, the significance of procedural and distributional issues embedded in the expansion of offshore wind farms blatantly points to the importance of considering socio-economic impacts in both strategic planning and licensing processes of individual projects. The prominence of social contentions over deployment practices and impacts do not only negate that OWFs are 'out of sight, out of mind' but also hint at challenges and deficiencies in the governance of impacts.

The governance of socio-economic impacts of offshore wind developments is mainly handled at the EU level. The Maritime Spatial Planning (MSP) (2014/89/EU Marine Strategy Framework Directive, 2014) Directive and Strategic Environmental Assessment (SEA) Directive (2001/42/EC, 2001) mandate the consideration of socio-economic issues in strategic planning with the aim to avoid conflicts of interests and interference between different uses at the sea. The EU Environmental Impact Assessment (EIA) Directive (2014/52/EU, 2014; Office of the European Union, 2024) regulates and guides the assessment of socio-economic impacts within project planning. At the national level, the assessment and consideration of socio-economic issues is usually embedded in planning-related legislation and policies for renewable energy development. Further EU policies that inform the integration of socio-economic impacts are related to regulations that mandate the inclusion of qualitative criteria in offshore wind public tenders, which include the EU State Aid Guidelines for Climate, Energy, and Environment (Communication.from.the.Commission._.Guidelines.on.State.Aid.for.Climate?.Environmental.Protection.and.Energy, 2022), the Commission Recommendation on auction design for renewable energy (Office of the European Union 2024) and the Net-Zero Industry Act (NZIA) (2001/42/EC, 2001).

However, there is limited evidence juxtaposing how socio-economic impacts are addressed in academic literature and practice. Thus, and in light of the prominent role of social implications in academic literature on OWF planning and in legislations, there is a need for a review of socio-economic impacts of OWFs across scientific research and practice, and to consider how socio-economic impacts have been addressed in planning processes.

1.2. Objectives and Scope

This deliverable pursues three objectives: 1) to establish a shared understanding of socio-economic impacts of offshore wind farms; 2) to provide an overview of prevailing socio-economic impacts and juxtapose them with issues highlighted in the scientific literature; and 3) to identify approaches and challenges of assessing central socio-economic impacts in practice.

In doing so, the deliverable aims to:

- identify what socio-economic impacts of OWFs are addressed in scientific literature and practice by means of selected EIARs and interviews
- review and juxtapose how socio-economic impacts are considered in literature and practice
- outline methods and challenges for assessing selected socio-economic impacts in practice

Insights are envisioned to build the foundation for prioritizing socio-economic considerations for subsequent tasks in this and other work packages of the SUSTAINOW project and for addressing specific methodological challenges currently hampering a meaningful assessment of particular impacts.

The scope of the deliverable is limited to socio-economic impacts that are associated with the planning, development, deployment, operation and decommissioning of OWF projects. Impacts are only considered insofar as they relate to strategic or sectoral planning, locational and project-related licensing processes. Therefore, the deliverable does neither consider wider socio-economic implications that are related to the supply chain of wind turbine manufacturing and social life cycle analyses of wind turbines and wind farms, nor does it provide details related to the social performance of the offshore wind industry and developer-focused approaches to managing impacts and benefits (e.g. Social Licence to Operate; Environment, Social, Governance (ESG)).

1.3. Terminology

The report provides a conceptual framework to make sense of and add more clarity to the causality of various socio-economic impacts of OWFs. Nevertheless, given the manifold interactions of affected communities with OWF developments, it is necessary to clarify terms used to describe the influence that OWFs have on the human environment.

The report uses the term 'impact' to refer to any change on a specific receptor caused or induced by activities underlying the planning and deployment of OWFs (e.g. impact on fisheries). A benefit describes a positive impact, which can also be proactively created and steered.

Strategic planning refers to spatial and sectoral planning of several OWF areas and/or sites within a certain jurisdiction, usually at national or regional level, and is subject to SEA. Project planning refers to the permitting and licensing process for individual OWF projects and their sites, which is subject to EIA.

1.4. Structure of deliverable

The structure of the deliverable is as follows:

Section 2 describes the research methodology, data sources utilised in the review and the analytical framework. Section 3 conceptualises socio-economic impacts and impact assessments. Section 4 provides a review of socio-economic impacts within academic literature and EIA/SEARs. Section 5 outlines assessment methods for socio-economic impacts used in practice and their limitations identified through reviews and interviews. Section 6 summarises key findings across the selected countries.

2. Methodology

2.1. Data Acquisition

To examine the socio-economic impacts of offshore wind energy, a systematic literature review of academic publications was conducted. Scopus was used as the main database due to its broad coverage of peer-reviewed literature. The search string combined social and economic keywords with offshore energy terms using Boolean operators. A search was first done using the title, abstract, and keywords (TITLE-ABS-KEY), which found 10,196 documents. To improve precision, the initial search was narrowed to a Title-only search (TITLE) this substantially reduced the number of documents to 1,179. In addition, a sensitivity analysis was conducted to evaluate the impact of specific keywords (Lagisz et al., 2025). Further details and the complete search string are provided in the Annex.

The rationale for selecting EIA/SEARs for review was to include countries that partner in the SUSTAINOW project (Denmark, Germany, United Kingdom, Spain, Estonia, Ireland) and to cover both strategic and project-related planning documents. The review focused on projects that are currently being developed, which also reflects current assessment methods. An overview of examined reports (n=15) can be found in Annex 4.

Primary data was collected via structured and semi-structured interviews, i.e. a qualitative research method that uses a flexible framework of themes and open-ended questions. For structured interviews, the interviewers followed a prepared set of questions, while semi-structured interviews provided more freedom to probe deeper, asking unscripted follow-up questions that adapt to the interviewee's unique responses. Interviews with EIA practitioners, developers, and affected stakeholders were used to gain a deeper understanding of the relevance of socio-economic impacts. In addition, interviews helped shed light on how different stakeholders view challenges in the assessment of socio-economic impacts of offshore wind developments in both strategic and project planning. Interviews were conducted online by the SUSTAINOW research team with 22 people and lasted between 30 minutes and 1 hour. An overview of interviewees can be found in Annex 3.

2.2. Data Analysis

The resulting dataset (n ≈ 1,179) of the literature review was exported from Scopus in CSV format on 13 February 2026. It included abstracts and metadata. The data were then pre-processed and analysed using Python. A prerequisite for the subsequent topic modelling was that each document contained an abstract. Document embeddings were created using the Sentence Transformer model "all-mpnet-base-v2", which converts each document (title and abstract) into a numerical vector. These vectors capture the semantic meaning of the text, allowing similar documents to be grouped together even if they do not share identical keywords (Swab, 2026).

Clustering was performed using HDBSCAN with a minimum cluster size of 15. This parameter defines the smallest number of documents required to form a topic. A value of 15 was chosen to balance detail and robustness. Smaller values tend to produce many very small, less meaningful clusters, while larger values can merge distinct topics and reduce thematic resolution (Kumar, 2025). This number has been proven through trial and error and has resulted in a practical number of topics (Figure 1).

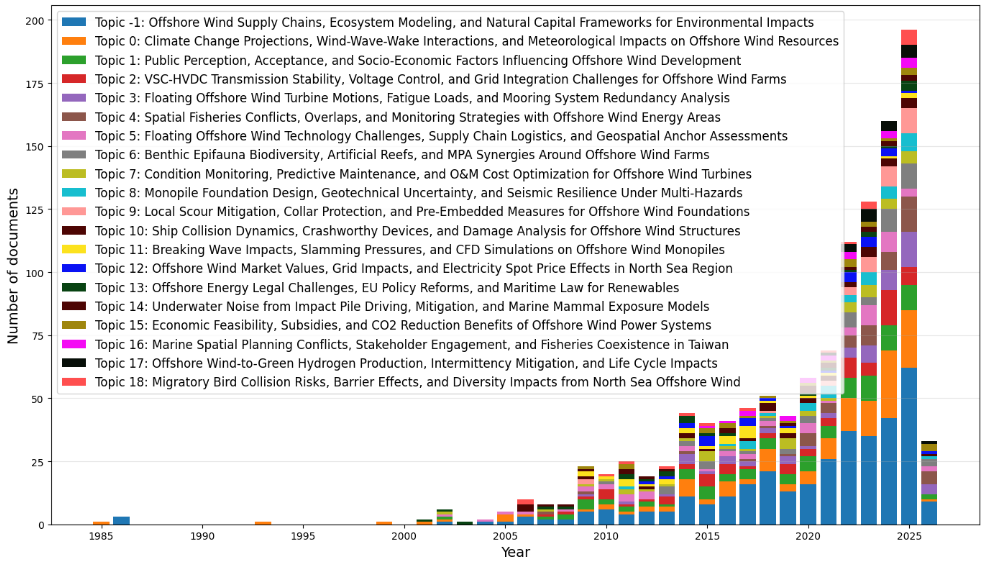

Figure.7¿Distribution.of.documents.by.topic

Topic representations were generated using a CountVectorizer with n-grams ranging from 1 to 3 words, while removing common English stopwords (like “the”, “and”, “is”). Removing them reduces noise and the number of elements (tokens), which improves computational efficiency and the quality of topic models by highlighting terms that distinguish documents. The use of n-grams (e.g., single words, two-word phrases, and three-word phrases) allows the model to capture more meaningful expressions such as “offshore wind”, “fishing industry”, or “marine spatial planning”, rather than relying only on individual words (Kumar, 2025). This improves the interpretability of topics.

To further enhance topic descriptions, multiple representation techniques were applied. These included KeyBERT-inspired methods (which identify representative keywords based on semantic similarity), Maximal Marginal Relevance (which balances relevance and diversity of keywords), and Part-of-Speech filtering (which prioritises informative word types such as nouns) (Kumar, 2025). Together, these methods produce clearer and more descriptive topic labels.

Topics with fewer than 15 documents were assigned the label “-1”, indicating that they were considered outliers not belonging to any stable cluster (Figure 2). These outlier documents

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were reviewed manually. During this process, documents were either reassigned to existing topics where a clear thematic fit was identified or retained in the outlier category. Outliers were further evaluated in terms of their relevance to the research focus and classified as either important or not important for the literature review.

Following the initial modelling, topics were manually reviewed based on keyword relevance to core research themes, including fisheries interactions, community impacts, and policy dimensions. Topics with a primarily technical or engineering focus were excluded.

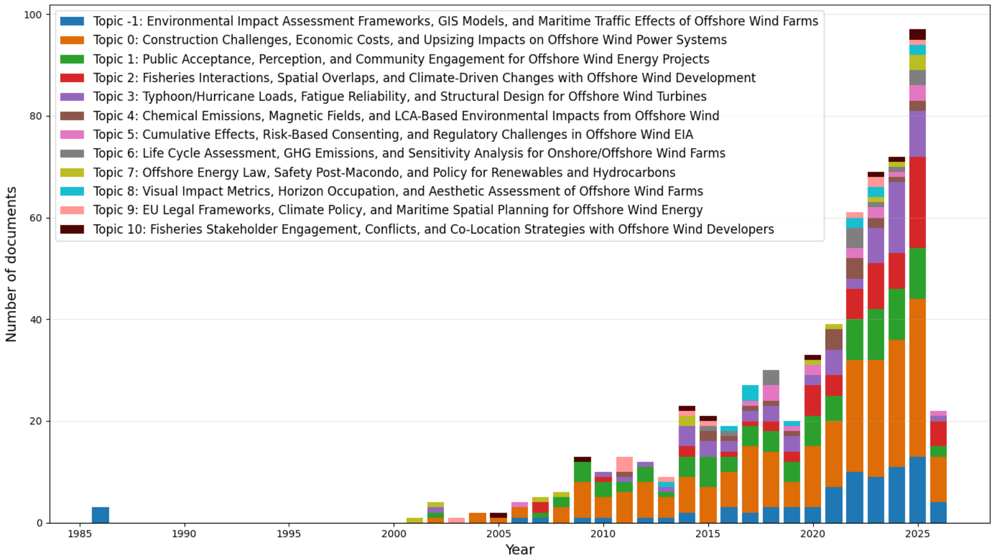

Figure.8¿Refined.distribution.of.documents.by.topic

The filtered subset retained 618 of the original documents, consistent with prior sensitivity analysis. BERTopic was then re-applied to this refined corpus using the same modelling pipeline, with minor parameter adjustments (e.g., increased minimum document frequency in the vectorizer) to enhance thematic granularity. This iterative approach enabled more detailed identification of sub-themes within socio-economic impact research.

The review of 12 EIARs and 3 SEARs was conducted manually and individually with the aim to identify common receptors and impacts/pressures, and obtain information about how impacts on common receptors are assessed, what data is used for the assessment and what challenges are stated. The review followed a template with a small set of predefined categories, which were then refined and expanded inductively as additional themes emerged during the process. Predefined categories included overarching stages and methods of assessments. Each EIAR was assigned an identification code to facilitate referencing throughout the study (see Annex 4).

Qualitative interviews were recorded, transcribed, and analysed through thematic coding focusing on types of impacts, assessment methods and challenges as well as underlying data foundations. Thematic coding was implemented inductively, through which specific themes were identified from the interview material and constantly revised throughout the analysis. Each interview was assigned a unique code to ensure anonymity (e.g. I1, I2, I3), while information on the general affiliation of the interviewees (e.g. government bodies, consultants, developers, NGOs and researchers) is provided in Annex 3. Two longer interviews were analysed based on notes that were taken during the interviews.

3. Conceptualization of socio-economic and social impacts

This section provides an overview of challenges underlying the conceptualization of socio-economic impacts, their consideration in impact assessment practice, and outlines a conceptual framework for the subsequent systematic review of socio-economic impacts of OWF developments.

3.1. What are socio-economic impacts?

Socio-economic impacts are central to contestations over the planning and deployment of renewable energy projects. However, there is uncertainty as to how socio-economic impacts differ from social impacts, and how they are defined and demarcated in practice (Bachnik et al., 2024; Hurst & Johnston, 2025). The international EIA framework is based on a broad concept of the environment that allows for the consideration of social dimensions of impacts beyond the biophysical environment (i.e. population and human health). Although there is growing attention on socio-economic impacts both in theory and practice, there is neither a clear-cut definition nor common consensus about what socio-economic impacts entail. Hence, despite being different in nature, the consideration of socio-economic and social impacts remains largely ambiguous and vague in theory and practice.

While broader categories and domains are predefined by supranational legislation, especially under the EU's EIA Directive (2011/92/EU, amended by 2014/52/EU, on the assessment of the effects of certain public and private projects on the environment) and SEA Directive (2001/42/EC), the definition of specific social impacts is context-dependent, and their demarcation is largely determined by affected receptors (Hurst & Johnston, 2025). However, most environmental assessments predominantly deal with direct environmental impacts, while many citizens are concerned with specific socio-economic impacts, which tend to contribute to conflicts due to perceived discrepancy between what is assessed and what citizens deem important (Larsen et al., 2018).

Without going into detail about the ontological, terminological and conceptual foundations, the social dimension of impacts within impact assessments has been described as either socio-economic or social, whereas the differentiation has remained blurry. We consider socio-economic impacts as encompassing social impacts in the understanding that:

- Socio-economic impacts refer to effects on human activities and material conditions as well as their social and economic consequences, while social impacts specifically refer to non-material effects on people's lives (e.g. cultural, health, well-being effects) [1]

This difference is also reflected in practice: On the one hand, the EU EIA Directive (2014) describes several environmental factors that are commonly associated with direct and indirect consequences that projects may have on the human environment. These factors tend to be mainly associated with socio-economic impacts, in terms of economic consequences that interferences with human activities may entail but also include impacts on populations and human health. On the other hand, the IAIA conceives social impacts as anything that directly or indirectly affects or concerns any (impacted) stakeholder group or anything that changes people's lives and outlines several broader social impacts (Vanclay & Franks, 2015).

Table.7¿Classification.of.social.impact.categories.employed.by.EU.EIA.and.IAIA.Directive¡

Factors specifically relevant for social dimension of impacts based on EU EIA Directive	Social impacts according to IAIA
• Population and human health • Land • Landscape • Material assets • Cultural heritage	Changes to people's: • Way of life • culture • community • political systems • environment • health and wellbeing • personal and property rights • Fears and aspirations

3.2. Social impact assessments

In Europe, nowadays directives on environmental assessments mandate the consideration of socio-economic impacts and Environmental Impact Assessment Reports (EIARs) reflect the inclusion of several socio-economic impacts in EIAs. SIAs are utilized globally to assess socio-economic impacts of projects, plans, or events (Vanclay, 2003). The consideration of social impacts of planned interventions began in the 1970s alongside the emergence of EIA (Vanclay, 2020). The implementation of SIA initially tried to mimic EIAs to a larger extent, but there has been a gradual realisation that social and economic consequences play out and manifest in very different ways compared to impacts related to the biophysical environment and should therefore also be considered and managed differently. Thus, the scope of SIA diverged and went beyond the planning-related and processual character of EIAs as a regulatory tool and has

[1] This understanding draws on Busch et al. (2011), who conceptualise human well-being through the concept of quality of life, differentiating between 'objective conditions of life' that encompasses economic and structural indicators and are measured at the level of society, and 'subjective well-being' based on personal perception and experiences and includes immaterial values.

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argued to become both a paradigm and discourse in its own right (Vanclay, 2020). In theory, SIA has become a process that deals with the management of social consequences at all phases of a project lifecycle or social issues before, during and after planned interventions. In practice, SIA is usually handled as an integral part of EIA, taking account of essential human elements of interventions, thus complementing the biophysical focus of EAIs. Various international standards, planning and financing mechanisms, and legislations require the assessment of social impacts of planned interventions (Aucamp & Vanclay, 2026), which go beyond SEA and EIA regulations. Despite SIA being generally understood to involve the management of social issues along the lifecycle of a proposed project, SIA practice remains to be predominantly restrained by ex-ante predictions of potential social impacts induced by the project (Aucamp & Vanclay, 2026). Thus, and in contrast to a narrow incorporation of social impacts in EIA, SIA scholarship has advocated for a broader practical understanding of social assessments that goes beyond a mere descriptive prediction step of limited issues in addition to environmental assessments (Vanclay, 2003). The generally used SIA definition is:

»Social.Impact.Assessment.includes.the.processes.of.analysing?.monitoring.and.managing.the. intended. and. unintended. social. consequences?. both. positive. and. negative?. of. planned. interventions.(policies?.programs?.plans?.projects).and.any.social.change.processes.invoked.by. those.interventions¡‹ (Vanclay, 2003:6)

This means that SIA cannot be based on a general checklist of potential impacts but should derive social impacts from an understanding of how a planned project is likely to affect what is deemed important by affected stakeholders. This also implies that SIA does not only refer to the analysis of socio-economic impacts, but also explicitly includes people's experiences of impacts and social change. Therefore, SIA has also been discussed as a means of conflict management (Larsen et al., 2018) that includes both ex-ante and ex-post procedures for managing social impacts (Vanclay, 2024). Like EIA, SIA are forward-looking in the way they approach impacts but differ in how enhancement-oriented considerations are incorporated. Environmental assessments have historically followed a mitigation logic, embedded in regulatory requirements to identify adverse impacts and mitigate or compensate for potential harms on the environment. In contrast to these reactive and control-oriented rationales, SIA follows the principle of providing enhancements for impacted stakeholders to actively produce desirable social outcomes in addition to the actual project, e.g. through benefit-sharing, especially for those who are exposed to unavoidable impacts (Vanclay, 2003).

A guidance note on SIA (Vanclay & Franks, 2015) published by the IAIA builds on International Principles for Social Impact Assessment (Vanclay, 2003) and aims to provide advice to practitioners and stakeholders on good practice in social impact assessment processes. This guidance advocates for SIA as a process of managing socio-economic impacts that goes beyond what is legally required through EIA regulations. Given the complexity, nature and range of socio-economic impacts, their assessment necessitates both qualitative and quantitative methods to estimate potential effects, and their prediction will always remain imprecise (Hurst & Johnston, 2025). Consequently, the scope of their assessment has been rarely handled systematically across different sectors and contexts.

3.3. Analytical framework

Although it is difficult and not conducive to provide a unified definition of socio-economic impacts, more clarity and rigour is needed in what is meant by socio-economic impacts in different contexts. Without approaching what is meant by socio-economic impacts beyond broader categories, the task of assessing and evaluating impacts becomes impossible (Bachnik et al., 2024). Since the consideration, relevance and demarcation of specific socio-economic impacts varies according to different contexts, it is necessary to systematically describe and problematise impacts while allowing for sufficient leeway for their conceptualization and operationalization across different contexts. Referring to social instead of socio-economic impacts Hurst and Johnston (2025) suggest a relational framework based on attributes and properties of social impacts that provide a classification of impacts which takes account of context-related particularities. To make sense of socio-economic impacts of OWFs, this report utilises a definitional framework that broadly draws on the categories suggested in the taxonomy by Hurst and Johnston (2025) as outlined in Table 2.

Table.8¿Social.impact.taxonomy.(adjusted.from.Hurst.™ Johnston.868❶)¡

Attributes	Description
Context	Research area or topic in which social impact is defined
Who	Whom is being impacted (i.e. the receptor, unit of analysis)
What	What is being impacted
Cause	What or who is causing the impact
How	How the impact comes about
Direction	Direction of the impact
Temporality	When the impact is realised or manifested
Intention	If the social impact was intended or not

The context that determines socio-economic impacts is the expansion of offshore wind energy, and the selected attributes help describe common socio-economic impacts emerging from the deployment of offshore wind farms (Table 4).

4. Socio-economic impacts of offshore wind

In OWF planning, the assessment of socio-economic impacts is usually integrated in EIA processes and statements. Like environmental impacts, the consideration of socio-economic impacts needs to clarify the type, duration, spatial extent and distribution of impacts across stakeholders. However, there are two key differences that fundamentally sever socio-economic impacts of OWFs from environmental impacts.

First, a particular feature of OWFs and associated infrastructures is the spatiality of impacts, which emerge both at sea where wind turbines are deployed as well as on land where construction works take place. Land-based impacts and benefits involve physical-material changes caused by installation, operation, maintenance and decommissioning activities that predominantly occur at the coast, but also construction works related to the transmission infrastructure and substations. Indirect socio-economic impacts also emerge through the potential visibility of offshore wind turbines from the coast. In addition, negative and positive socio-economic impacts are also caused in the wider hinterland of OWF projects through supply chain effects and employment, which are not considered in this report.

Second, stakeholder engagement plays a dual role in the assessment of socio-economic impacts. On the one hand, SEA/EIA regulations inform stakeholder engagement and address potential conflicts with other marine and coastal uses. On the other hand, stakeholder engagement is not only a necessary means to identify impacts in the first place but also provides a meaningful way to enhance planned projects or interventions through local knowledge.

The following sections identify and juxtapose socio-economic impacts of OWFs as they are considered in academic literature and practice. A more detailed review of specific findings from the report's selected case countries (UK, Ireland, Denmark, Spain, Portugal and Estonia) can be found in Annexes 2.

4.1. Key findings from literature review

The initial analysis of all documents (Figure 1) identified 20 topics including the outliers. After refining the initial topic structure, only the refined subset of documents was retained for further analysis. The results (Figure 2) show a significant increase in thematic diversity and publication volume over time, especially after 2014. The number of publications increased a lot from around 2018 onwards, indicating a growing research interest in socio-economic issues of offshore wind. It also shows a more diverse range of topics. The largest topic concerns construction challenges, economic costs, and upsizing impacts of offshore wind power systems. Public acceptance, perception and community engagement are the second most important topic.

Fisheries interactions, spatial overlaps, and climate-driven changes emerge as substantial topics, while a specific topic focuses on fisheries stakeholder engagement conflicts, and co-location strategies with offshore wind developments. Together, these results indicate that fisheries are one of the most persistent socio-economic concerns in the offshore wind literature, particularly where spatial competition and negotiation processes are involved.

Although topics 3, 4, and 7 were identified by the framework, they were not included in the scope of this study because they primarily concerned technical, environmental, or broader legal issues of offshore wind energy rather than socio-economic impacts. These topics were therefore retained only as marginal findings.

The detailed results show (Figure 3) that planning authorities were mentioned most frequently, followed by fisheries, developers, coastal residents, and local communities. These represent relevant stakeholders across the offshore wind lifecycle, regardless of whether they experience positive or negative impacts.

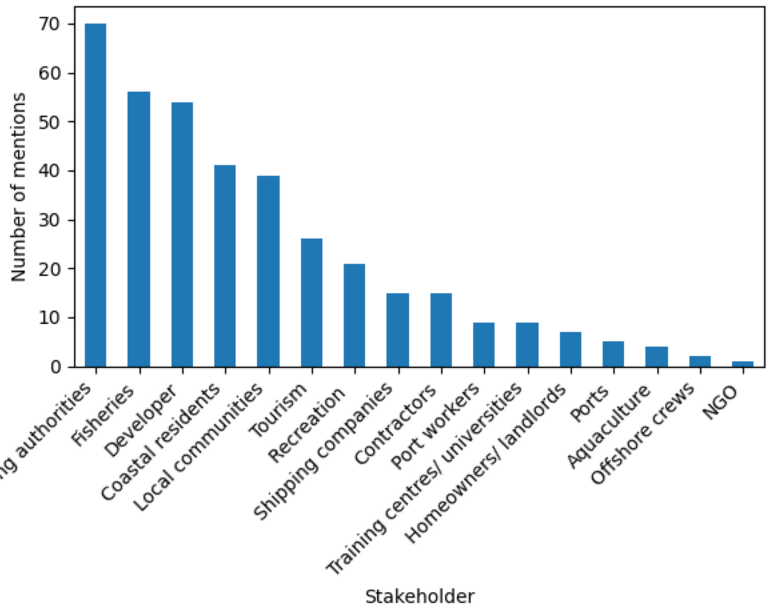

Figure.9¿Stakeholder.frequency

When looking at the distribution of these stakeholders across life cycle stages, the highest number of mentions is concentrated in the operations and maintenance phase, as well as in the planning and project management phase. In these stages, several topics appear with relatively high frequencies, including fisheries conflict, local employment, local infrastructure and services, public acceptance, tourism and recreation, and visual amenity. The planning and installation stages also contain multiple categories with moderate numbers of mentions. In contrast, the manufacturing, living with turbines, and decommissioning and repowering stages show fewer mentions overall, with most categories remaining at low levels.

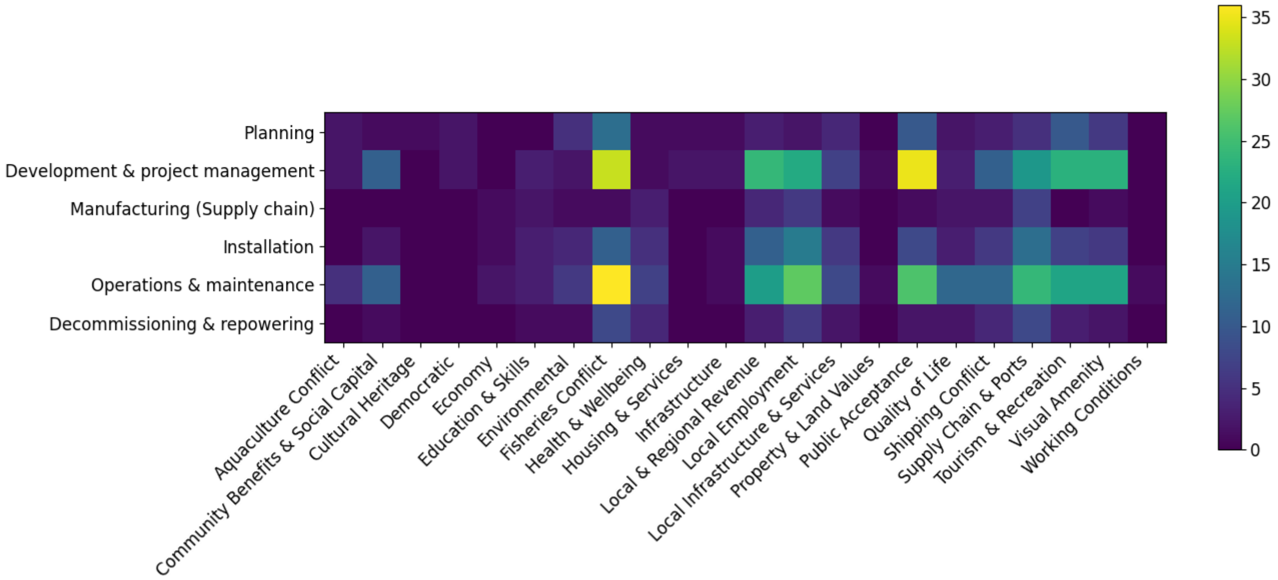

Figure.0¿Co_occurrence.of.socio_economic.impacts.and.life.cycle.stages

While no single assessment challenge (Figure 5) dominates across the publication period, an initial overview shows that three challenges are appearing more often, that is “data availability/ gaps”, “stakeholder engagement gaps”, and “uncertainty in projections”, especially in the early years of life cycle stages. This may reflect the fact that early assessments relied on limited empirical evidence, fewer established monitoring data, and stronger assumptions about future outcomes, while stakeholder processes were still evolving. The strong emphasis on “social acceptance” in 2011 suggests that early assessments were limited by evidence and also by the need to secure legitimacy and public support for a relatively new and contested development context.

The remaining challenges can be divided into two additional groups. The first group relates to the structure of impact assessment itself. “Methodological inconsistency” and “quantification difficulties” occur frequently, indicating that socio-economic impacts are often difficult to measure in a comparable and standardised way. This is especially relevant for impacts that are indirect, context-dependent, or distributed across multiple sectors, where the choice of indicators and methods can strongly influence the conclusions.

The second group includes the challenges “temporal and spatial scale mismatch”, “cumulative effects assessment”, and “monitoring or long-term evaluation”. These are all present across several years, showing that many studies struggle to align short-term project assessments with longer-term and wider regional effects. “Baseline Comparability” issues further complicate this, as studies often rely on different reference conditions, making it difficult to compare findings across sites or projects.

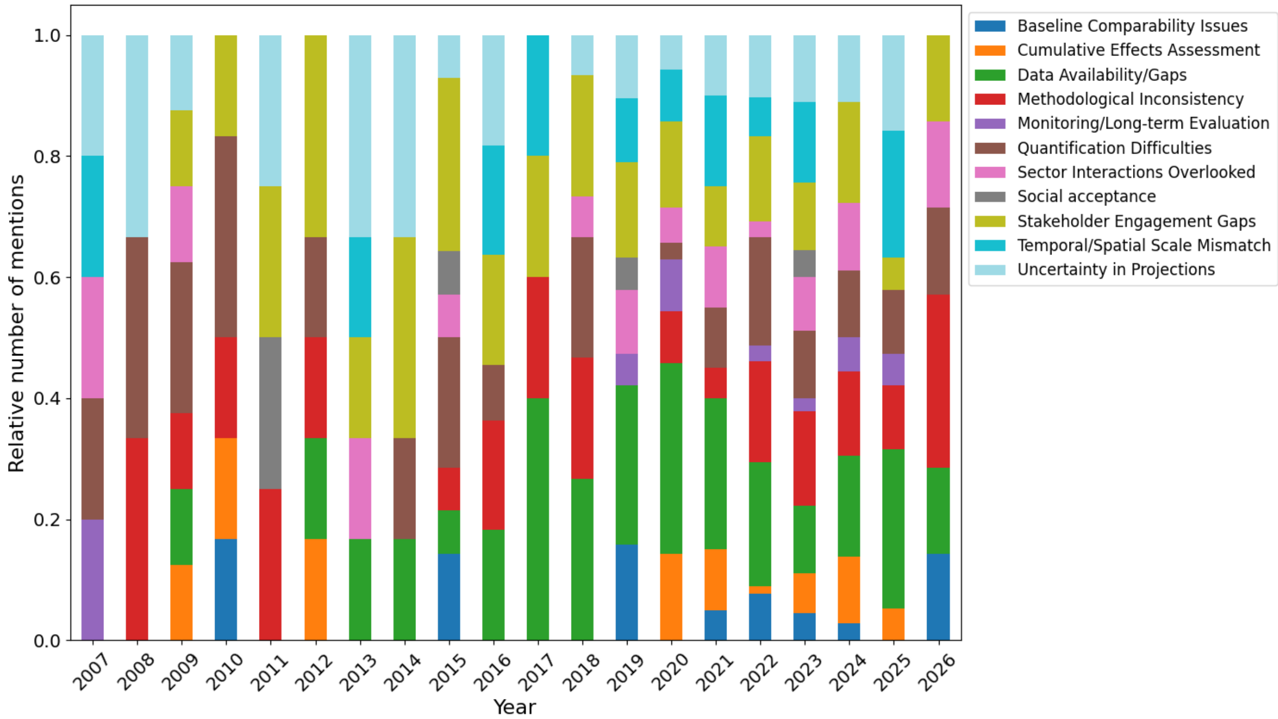

Figure: Relative prominence of challenges in assessing the impacts

Recognition of social impacts

Academic literature has increasingly framed social impacts in terms of social acceptance. There has been growing recognition of the importance of social acceptance from affected communities and that OWFs cannot be detached from the social-cultural context even if they are placed far out at sea. Social acceptance of OWF projects by affected communities involves issues of procedural and distributional justice in terms of trust and fairness of the governance and planning processes and the distribution of impacts and benefits (Bates et al., 2025; Park et al., 2024; Ruscetta et al., 2026). Research on social acceptance of OWF has highlighted several issues that can be directly related to socio-economic impacts, such as tourism, fishing, place attachment or community benefit schemes.

For example, place attachment and place identity have been considered as not only informing people's views about proposed wind farms, but also their perception of impacts that OWF may have. The concepts of place attachment and place identity point to and characterise a person's connection to a place and describe emotional bonds between people and their physical and symbolic surroundings as well as physical attributes of a place that allow for certain activities (Devine-Wright & Howes, 2010), e.g. economic exploitation on natural resources. Physical changes to a place can alter the symbolic meanings attributed to the place and people's place-based identities and dependencies. The deployment of OWF can thus be construed as an impact on a place that alters social and physical connections to the place (Batchelder et al., 2026; Brownlee et al., 2015).

Another complex social issue addressed in the literature refers to impacts on the livelihood and well-being of affected coastal communities. Several studies assessed impacts as changes that

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the deployment of OWFs may impose upon or indirectly have on the quality of life, livelihood and well-being of humans and their activities. These impacts include changes in employment and income opportunities, tourism, access to marine resources, or community identity. For instance, (Busch et al., 2011) examine how changes in marine ecosystem service associated with OWF may affect both material and non-material aspects of well-being, while Hattam et al., (2017) suggests a broader well-being perspective that considers impacts on economic, social, natural, human, and cultural capital. It is noteworthy that these studies have a regional or national focus, or address specific communities, rather than assessing impacts of individual wind farm projects, thus pointing to the importance of strategic planning.

Building on this broader understanding of well-being, literature also highlights how OWFs may also alter social dynamics within affected communities by influencing the cultural identity and community cohesion through an unequal distribution of impacts and benefits (Skiniti et al., 2026). Social impacts emerging from intra-community tensions and pressure on social cohesion can be caused through potential gains in some industrial sectors and losses in others and depend on how the installation and operation of OWF is embedded in the local socio-economic context, e.g. through an influx of workers.

However, academic literature mainly focuses on planned or proposed OWF projects even if projected social impacts are expected to manifest during the operational lifetime of wind farms without long-term studies on how impacts play out.

4.2. Country description and key findings from EIARs

The EIARs show that permitting requires the assessment of both environmental and socio-economic receptors, with particular attention to issues that may generate spatial conflict or public concern. OWF projects are therefore not just seen as energy infrastructure, but also interventions to the shared marine space with multiple existing uses.

The selected countries (Figure 6) represent different stages of offshore wind development, with clear experienced countries (Denmark, Germany and the United Kingdom) and newcomers (Spain, Ireland and Estonia). While the more experienced countries tend to show more standardised and process-rich EIAs, with clearer scoping and structured baseline work, newcomers tend to focus more on describing the initial situation and receptor-specific studies. However, this distinction is subtle, and the documents should not be read as reflecting a strict divide in quality or completeness. Not least because the analysis is based on only a small number (n = 15) of SEARs/EIARs, which does not allow for a comprehensive overview. Additional details are provided in the Section 5.1.

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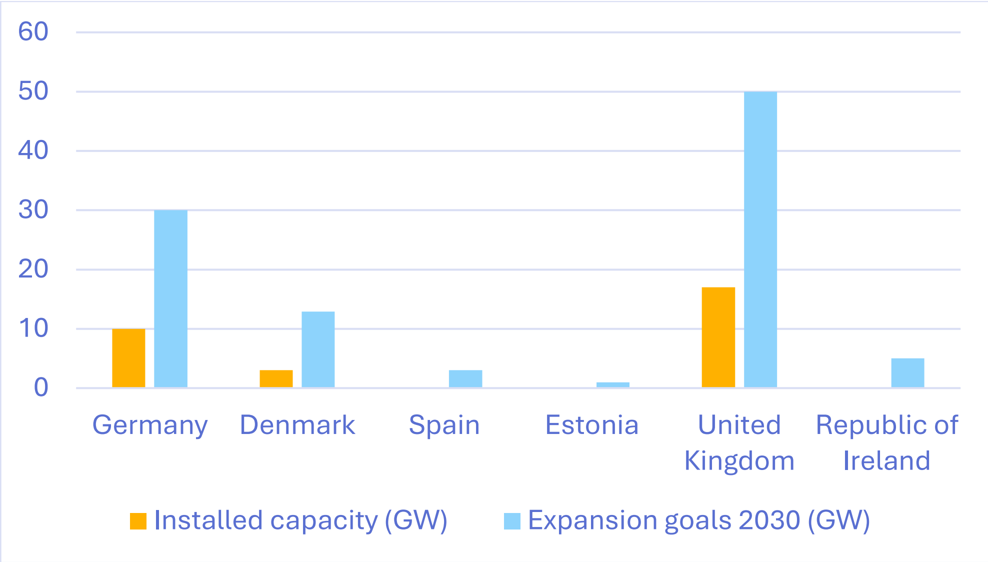

Figure.❷¿Current.installed.offshore.wind.capacity.and.expansion.goals.in.selected.European.countries¡.(Source¿WindEurope? supplemented.with.national.policy.document.for.Estonia)

Across the reviewed EIARs, the analysis focused on predefined receptors described in Table 1. The literature review highlights that socio-economic impacts are diverse and multifaceted and are often unevenly distributed depending on the life cycle stage. However, the way these impacts are translated and considered in EIARs is more selective. For example, while social issues such as well-being, livelihood, community cohesion and place attachment are frequently emphasised in the literature as key components of local acceptance, in EIARs these are only partially captured in broader categories like "population and human health" and "employment", because of requirements in the EU EIA Directive. In addition, while some issues (such as the impact of offshore wind projects on shipping and navigation or on visual resources) are also systematically addressed in almost all EIARs through detailed and quantitative modelling approaches, other socio-economic impacts such as on regional economic effects, tourism dynamics, or community well-being are typically assessed through descriptive analysis or through the use of proxy indicators (e.g. employment rates, housing value, visitor numbers), making it more difficult to fully capture the long-term implications on these receptors. This reflects the challenges identified in the literature regarding not only the conceptualization of socio-economic impacts, but also the difficulties on measuring and assessing these indicators and issues. As a result, a gap emerges between the academic literature that highlights a broad range of socio-economic issues, and the more limited set of related impacts that are considered within EIAs. Cumulative effects (e.g. additive, synergistic and antagonistic) of these impacts also need to be considered and assessed in practice[2].

[2] See Deliverable 3.1 of the SUSTAINOW project: Enduring Sectoral Challenges

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Table.9¿Impacts.considered.in.research.and.practice¡.Receptors.in.italics.indicate.common.issues.emphasised.in.interviews. and.addressed.in.SEARs.and.EIARs?and.that.are.considered.in.more.detail¡

Relevant overarching categories acc. to EU SEA / EIA Directives	Socio-economic / social issues identified in OWF literature	Key receptors considered in EIA reports	Social impacts acc. to IAIA
Population and human health	Well-being / Livelihood, community cohesion Place attachment & Identity	Employment	Way of life Community Health & well-being
Landscape	Landscape, seascape Visual impact	Seascape.and. Landscape.— Visual.resources	Quality of environment
Material Assets (socio-economic)	Fishing Shipping Tourism Harbours Displacement and Co-location of uses	Commercial.fisheries Recreational.fisheries Tourism Harbour.development Shipping.™ .Navigation Other.marine.users.	
Cultural Heritage	Cultural ecosystem services	Cultural.Heritage	Culture
	Acceptance, community benefit schemes, justice		Property Rights Fears and aspirations Political systems

4.3. Description & taxonomy of key socio-economic impacts considered in EIARs and SEARs

This section considers key impacts addressed in SEARs/EIARs by briefly outlining how they have been considered in scientific literature and provides a taxonomy of each impact[3] (Table 4).

Impacts of offshore wind developments on commercial fisheries are mainly related to potential economic losses for fishing businesses that emerge through the displacement of fishing activities from wind farm sites and safety zones around wind farms or restricted access to wind farm sites for certain types of fishing that may result in altered catch volumes and landings (Van Hoey et al., 2021). Adverse economic effects for fishery businesses are also related to increased costs due to longer travel times to new fishing grounds. Cumulative impacts are likely to be generated through designations of future priority areas for wind farms that lead to greater competition within remaining sites (Stelzenmüller et al., 2022). Policies and

[3] Similar issues have been identified about cumulative environmental impacts, described in Deliverable 3.1 of the SUSTAINOW project: Enduing Sectoral Challenges

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regulations for accessing operational wind farm sites and compensations differ between countries (Schupp et al., 2021; Szostek et al., 2025).

Impacts of offshore wind developments on recreational fishing are related to the potential displacement of leisure-oriented fishing activities, their restricted access to wind farm sites or a deterioration of the private fishing experience. Significant economic effects have been deemed less likely since recreational fishing tends to take place in nearshore areas, and access to wind farm sites is less restricted (Hooper et al., 2017). In contrast, restricted access to wind farm sites for commercial fishing sites may also encourage recreational fishing and angling within wind farms due to catch-related factors (Smythe et al., 2020). Social impacts on recreational fishing are associated with effects on well-being and an altered quality of life, livelihood and recreational experience (Dalton et al., 2020; Shrestha et al., 2025).

Impacts of offshore wind developments on tourism refer to effects on tourism as an economic sector of coastal areas. The impact is caused by a potential economic decline in tourist businesses in coastal communities that are dependent on maritime tourism due to a decreasing number of visitors in coastal areas that are claimed to be deterred by the presence of wind turbines off the shore (Rudolph, 2014). The underlying rationale is that visitors and tourists stay away from the areas because of visual changes in the landscape and seascape induced by turbines and a perceived incompatibility between wind turbines as industrial installations and the envisioned destination choice of tourists. However, research has found no significant evidence of economic losses in tourism business or changed tourism behaviour in coastal areas due to the presence of offshore wind farms or offshore wind industry (Glasson, Durning, & Welch, 2022; Machado & de Andrés, 2023; Voltaire et al., 2017). In contrast, offshore wind farms are also considered to attract tourists and contribute to tourism as novel attractions (Bidwell et al., 2023). Commercial boat visits to offshore wind farms are popular tourist attractions[4]. The direction and magnitude of effects remain ambiguous and case-dependent.

Impacts of offshore wind developments on shipping and navigation refer to economic repercussions for the shipping industry caused by the displacement or relocation of maritime traffic. Negative economic effects may mean longer travel times around OWF and increased cost burdens. Indirect effects relate to an increase in traffic through clustering in other shipping lanes leading to potential navigational safety risks (Mehdi et al., 2018).

Impacts of offshore wind farms on landscape and seascape, and visual impacts, refer to physical changes in the landscape and their individual perceptions through the visibility of wind turbines. Changes in the landscape and seascape are therefore strongly associated with visual impacts and optical disturbances that may alter the scenic amenity of landscapes or values and meanings attached to certain landscapes. While visual disamenities are reduced with larger distances to the shore, impact assessments tend to separate landscape impacts of land-based construction activities and impacts on seascape linked to the deployment of offshore

[4] E.g. In Copenhagen boat trips to Middelgrunden offshore wind farm can be booked at https://xn--vindmllesafari-uqb.dk/

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turbines. A specific feature of visual intrusion is caused by obstruction lights mounted on turbines that has also been described as ‘light pollution’. Although the visual impact of OWF can to same extent be quantified (Gkeka-Serpetsidaki et al., 2022; Gkeka-Serpetsidaki & Tsoutsos, 2023), it also constitutes a subjective local concern that challenges deep-rooted perceptions of the seascape (Bidwell, 2017; Firestone et al., 2018a) potentially affecting quality of life and well-being (Hattam et al., 2015) There is also national guidance on assessing visual and landscape impacts aimed at establishing minimum assessment standards and coherent approaches (SNH, Visual Representation of Wind Farms, 2017).

Impacts of offshore wind developments on cultural heritage refer to alterations to historic coastal landscapes, specifically designated sites, cultural services and traditions, and seabed disruptions of submerged heritage during construction. Cultural or archaeological heritage is related to material assets to the extent they are considered and designated as assets that hold cultural values, and consist of movable, permanent or intangible entities. Impacts emerge from the physical-material presence of offshore wind turbines, construction works or land-based alterations in relation to the heritage sites that should be preserved and made accessible. Social impacts emerge from the risk of diminishing cultural values of the assets (Gee & Burkhard, 2010) or indigenous populations (Bacchiocchi et al., 2022).

Impacts of offshore wind farm developments on ports and infrastructure emerge indirectly through an increased use of harbour facilities for the construction, operation and maintenance, and decommissioning of offshore wind farms. The expansion of offshore wind requires an appropriate port infrastructure to support the installation, operation, maintenance and future decommissioning of offshore wind turbines that can logistically challenge the functionality of existing ports and necessitate infrastructure development (Jolly et al., 2023; Kosek et al., 2025). This leads to economic spillover effects in harbour areas in terms of new businesses, employment and enhanced port infrastructure, but also bears the risk of displacing other sectors and altering the physical characteristics of harbours. Increasing the port storage area and the capacity of the access roads may affect nearby residential areas as many ports are located in the middle of a city.

Impacts of offshore wind developments on material assets and other marine uses include functional effects on both human-made and natural assets that constitute resources of social and economic value. Impacts relate to reduced access to resources and pressure on existing assets that are caused by the expansion of offshore wind areas. Other common marine uses affected by offshore wind development commonly include military uses of the sea (Barquet & Sjölander, 2025) and extractive industries exploiting submarine resources.

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Table.0¿Taxonomy.of.key.socio_economic.impacts.considered.in.EIA.reports¡

	Impact on Commercial fisheries	Impact on Recreational fishing	Tourism impact	Impact on Landscape / Seascape (visual impact)	Impact on Cultural Heritage	Impact on harbours / ports / infrastructure	Other marine uses and material assets
Who / receptor	Fisheries using the area where wind farm is located	Tourist and leisure communities	Coastal tourists, tourism businesses	Stakeholders depending on or making use of landscape or seascape conditions	Designated heritage sites and assets	Individuals and businesses whose activities make use of harbour	Stakeholders whose economic activities depend on marine areas
What	Commercial fishing activities	Recreational use of sea for fishing, well-being, leisure activity	Touristic value and quality of area; tourism-based employment and income; perceived quality of life	Value and appearance of landscape and seascape	Value and significance of heritage site	Functionality and size of individual harbours	Use of and access to marine areas
Cause	Restriction of fishing activity or certain types of fishing; loss of fishing ground or restricted access	Restricted access and use of fishing activity	Changed perception of tourist value of affected area through presence of wind turbines	Visual presence of turbines; government authorities designate sites and developers build turbines at chosen sites	Physical presence of turbines interferes with heritage conditions	Increased use of harbours for installation and O&M activities by offshore wind industry	Installation and operation of wind farms at selected sites; government authorities designate sites and developers build turbines at chosen sites
How	Displacement, loss of fishing ground, decline in catch volume and income from fishing; longer travel time	Loss of fishing ground and recreational value through displacement	Alteration of seascape and visual changes leads either to decrease or increase in tourist use of coastal area	Alteration of seascape through presence of wind turbines or landscape through land-based construction works	Alteration of condition of sites	Expansion, enhancement and repurpose of harbour areas; new employment, infrastructure enhancement, potential displacement of existing activities	Displacement or restriction of other marine activities with social and economic effects, e.g. military, mining, oil and gas extraction
Direction	Negative,	Negative or positive	Negative or positive	Negative	Negative	Positive and negative	Negative
Temporality / phase	During construction and operational phase	During construction and operational phase	Operational phase	During construction and operational phase	During construction, operational phase, and decommissioning	Construction, operation, decommissioning	Operational phase
Intention	Direct unintended, but expected	Direct unintended, but expected	Indirect and unintended	Indirect, unintended but anticipated	Indirect, unintended but anticipated	Indirect and intended	Direct, unintended but anticipated

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Indirect socio-economic impacts and benefits

Socio-economic impacts of the development of OWF can be generated by direct (e.g. employment in project development; displacement of other marine activities), indirect (e.g. enhancement of auxiliary infrastructure) or induced effects (e.g. local expenditures of employees; employment and working conditions in supply chain), which all have different spatial and temporal extents. Direct, indirect, and induced positive effects are increasingly considered for specific OWFs as part of the project planning to outline economic contributions of individual wind farm projects in support of their development (e.g. Inch Cape OWF, Inch Cape Wind 2026). In contrast, the consideration of indirect socio-economic effects has rarely been assessed at national scale for strategic or sectoral planning of offshore wind energy.

Wider socio-economic impacts have been predicted for strategic planning based on forward-looking scenarios that consider regional variations which draw on different expansion goals that assume a continued growth of a domestic offshore wind sector. Only Scotland has conducted an extensive socio-economic impact assessment (SEIA) for sectoral marine planning of offshore wind (Scottish Government, 2025), which aimed to identify and assess potential positive and negative economic and social impacts of the implementation of envisioned offshore wind development plans on the lives of people, communities, society, including businesses and other marine sectors. Otherwise, wider socio-economic impacts have been considered in academic and grey literature (Bates et al., 2025; Connolly, 2020; Denmark, 2020; Glasson, 2020; Kandrot et al., 2020), either through forward-looking predictions or appraisals estimating the state of current economic spillover effects. These predictions and estimation base their assessment on investment costs, employment effects and the distribution of economic value added.

A particular indirect economic benefit is created through the provision of community benefit schemes, which reflect a common approach in the UK (and the US and recently Ireland) to proactively distribute positive socio-economic impacts from OWF and enhance distributive equity (Glasson et al., 2020; Kandrot et al., 2020; Ruscetta et al., 2026). Community benefit schemes are voluntary payments provided by developers of OWFs to host communities that allow for the formation of positive long-term impact, mainly in absence of direct economic benefits. Community benefit schemes commonly make use of benefit funds in which the developer invests a certain amount of money throughout the lifetime of an OWF project depending on the size and capacity of the OWF, which is administered by a community group and reinvested locally to address community needs (Rudolph et al., 2018). The demarcation of beneficiaries, i.e. communities benefiting from these benefit mechanisms, is based on different criteria, for example nearest distance to shore, affectedness of communities, or localities of onshore construction works. However, there is a lack of research on the long-term effects of benefit mechanisms. The provision of such benefit schemes is discussed during the planning phase, but usually presents a non-material planning consideration, which means they are not considered as part of the EIA and consenting process.

Scotland also uniquely considers direct and indirect social impacts of OWF development at strategic planning through a dialogue with coastal communities to gain a better understanding of values that communities have regarding their lives and places and how they may be impacted by the development of offshore renewables (Twigger-Ross et al., 2022). The study also explored how relevant social impacts can be better identified and assessed to improve SIA practice in the offshore renewables sector. This hints at the need of community engagement to assess the relevance and significance of social impacts in OWF planning.

4.4. Impacts addressed in literature vs. practice

This section juxtaposes key issues discussed in scientific literature with those in EIA practice, whereas as the latter draws on insights from the review of SEARs / EIARs and interviews. Since socio-economic impacts are usually integrated into EIA reports, separate SIAs for OWF projects are rare in practice. Dedicated and focused SIAs were only identified for OWF projects in Asia, notably two OWF projects in Taiwan (Hai Long and Greater Changhua Northwest offshore wind farms). However, these focused SIAs have a limited scope as they merely screen social aspects that are potentially impacted and the considered receptors, pressures and impacts largely correspond to the topics addressed in EIA reports (e.g. population, visual amenity, fisheries livelihoods, cultural heritage, noise emissions, livelihood-related infrastructure). However, additional receptors specifically considered in the baseline description for these wind farms include ethnicity, religion, human rights and indigenous peoples. The limited practical application of SIA for offshore wind is also reflected in the literature, where only one study of OWF development in the UK was identified that explicitly puts OWF into dialogue with SIA (Glasson, Durning, Welch, et al., 2022; Glasson et al., 2020).

While the definition of socio-economic impacts of OWF remains ambiguous in the literature, and only few studies (Gee & Burkhard, 2010; Hattam et al., 2017; Veronez et al., 2026) have made a clear attempt to separate social from socio-economic impacts, EIARs are less clear-cut in the typology of impacts and allocate or combine various receptors under different impact categories. Although overall impact types in EIARs do not differ between reports and countries, their arrangements vary hinting at differences in rationales, relationships and weights in considering impacts. For example, recreational fishing usually plays a minor role and can be associated with fishing, tourism (e.g. IE2, ES1) or presented as an individual issue (e.g. DE1). Likewise, visual resources are usually included in landscape / seascape impacts (e.g. SC1, IE1, DK2), but are also listed as a separate impact (e.g. DE2, EE2, ES1), and underpins the rationale of tourism impacts.

Socio-economic impacts in the literature include both economic and social effects induced by the deployment of offshore wind energy, while socio-economic impacts in EIARs tend depict economic impacts in a stricter sense. EIA reporting in the UK also involves mandatory reports as part of the application material that should give evidence of the compliance with community engagement requirements. So called, Pre-Application Consultation Reports (PAC) should state

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how, when and where consultations were conducted, and inform about the issues raised by the public about planned OWFs and how the developer has addressed their concerns or not (The Marine Licensing (Pre-application Consultation (Scotland) Regulations 2013; Planning Act 2008 Sections 42, 43, 44 for England). In theory, these reports allow for a more nuanced representation and reflection of social dimensions of impacts and a more qualitative consideration of specific issues, such as seascape values or recreational uses of the coast.

4.4.1. Economic impacts

Concerning the relevance of impacts on certain types of receptors, fishing and landscape/seascape/visual resources appear as significant themes both in research and practice. One important receptor "category.includes.those.who.earn.their.income.from.marine. activities?.such.as.fisheries.and.shipping" (I7). In the literature, the assessment of impacts on commercial fishing gains particular attention related to methodological constraints. As it is problematic to quantify and compare the information provided by fishermen (I7, I24), it is difficult to estimate the socio-economic consequences. Similarly, interviewees from all case countries refer to the limitations of the typically qualitative and descriptive assessments of impacts. For example, as there is limited data on income losses for fishermen because of restricted access to fishing areas, all countries rely primarily on statistics, which are not always up to date and cause contentions. As a result, impacts on fisheries are often avoided in assessment with compensation used as a solution instead. This does not solve the underlying issue but bypasses it.

As mentioned, visual impacts are also associated with economic impacts, especially for coastal tourism businesses. A similar finding occurs in the interviews. Five interviewees mention how this impact is, in terms of data and economic consequence, seems to be even more complicated than the one of commercial fishing. Particularly in the UK and Denmark this issue is seen as contentious because of alleged impacts on house prices (I32) and tourism (I24; I34). Although the assessment of visual impacts usually draws on the same approach including the assessment of ZTV (Zone of Theoretical Visibility), people are often questioning why and how visual impacts are being assessed at all as there are no actual rules or thresholds for how much visual impact should be allowed (I7).

The alignment between impacts on certain types of receptors, seen in fisheries and visual effects, does not seem to occur for other impacts, even if tourism is reflected as an important receptor in both. However, while research does not provide clear evidence for a significant negative impact on tourist activities or tourism businesses (Glasson, Durning, & Welch, 2022; Machado & de Andrés, 2023), it is recurrently considered as a potentially negative impact in almost all EIARs (although, in some cases, considered temporary and reversible, as mentioned during ES2). In contrast, research also suggest that the novelty of OWF can also attract tourism rather than deterring visitors. For example, research on the Block Island Wind Farm in the United States found that the project became integrated into local tourism and recreation activities, creating wind farm-focused ferries, and even new fishing destinations (Smythe et al., 2020). This has also been mentioned by interviewees (I22, I24). In addition, although (Lilley et al., 2010; Smythe et al., 2020) found that some beach visitors reported they would avoid beaches with visible OWF, the attractiveness of offshore-wind related tourism opportunities (e.g. boat tours and beaches to view turbines) outweighed the reported avoidance behaviour. Amongst the cases considered in this report, the observation occurs that OWF can also have a positive impact on tourism. Two interviewees from research institutions in respectively Spain (I21) and Portugal (I18) highlight how OWF development has also created the basis for OWF tourism. This more nuanced perspective of impact is mentioned to a lesser extent in EIARs. The prominence of tourism points to its practical relevance as a recurrent contentious issue as well as to a lack of monitoring of long-term effects on the tourism sector.

4.4.2. Social impacts

The most blatant difference between research and practice is reflected in the heavy focus of literature on various expressions of social impacts that do not find explicit consideration in EIARs. For example. notions of social impacts have been conceived through concepts of place identity, place attachment, acceptance, social license to operate, distributional justice, livelihood, well-being, ecosystem services and perception of impacts (Bates et al., 2025; Busch et al., 2011; Bush & Hoagland, 2016; Chen et al., 2015; Devine-Wright & Howes, 2010; Firestone et al., 2018b; Klain et al., 2018). All these aim to make sense of changes, disruptions, or benefits related to the social context that are directly or indirectly caused by the development and deployment of OWF and associated infrastructures. These concepts take outset in individuals or affected communities, their practices and relations to the socio-environmental context to describe and explain negative and positive impacts. Even if research has been very prolific and innovative in making sense of contestations and various impacts under the umbrella of social acceptance (Batel, 2020; Ellis & Ferraro, 2016), these aspects are not mirrored in EIARs.

This discrepancy in what is discussed in the literature and impacts on fisheries, seascape and tourism that are highlighted in the EIARs, may, on the one hand, be informed by the impact factors prescribed through the EIA Directive (2001/42/EC, 2001) that include an unspecific description of 'population'. Yet, there is no mandatory requirement to conduct SIA processes for OWF to the extent promoted by the IAIA (e.g. including place identity or wellbeing).

Social impacts, such as effects on community or social cohesion and community health, have not found sustained attention, neither in OWF literature nor in EIARs. Likewise, social and socio-economic impacts of end-of-life processes, i.e. repowering and decommissioning, have only recently been taken into account in the literature, especially for offshore wind developments (Stranddorf et al., 2026).

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4.4.3. Methodological considerations

Research has predominantly focused on local and social contentions over the planning and development of OWF, which fostered an advancement of novel conceptual contributions to make sense of impacts rather than providing coherent methods for their assessment. Consequently, academic literature – regardless of a few exceptions (Chaji & Werner, 2023; Depellegrin et al., 2014; Maslov et al., 2017; Willis-Norton et al., 2024) has rarely dealt with methodological issues of assessing specific socio-economic impacts beyond qualitative and quantitative studies putting people's perceptions and expectations at the centre. Exemptions mainly include approaches for assessing visual impacts and impacts on fishing). The lack of methodologies to capture socio-economic impacts, creates challenges for planning, both in terms of efficiency and democratic legitimacy, as it increases the risk of errors and dampens social acceptance. The data types and methods for analysing interactions and relationships between OWFs and other marine use are seen as limited and require novel perspectives that combine different scientific disciplines to understand their relations (I23). A related issue raised in the interviews points to limitations of integrating socio-economic dimensions of land-based conditions into marine spatial planning (I33).

Interestingly, literature dealing with socio-economic impacts tends to focus on countries where OWFs present an emerging technology, mainly to explore social contentions either from a hypothetical and ex-ante perspective or drawing on initial projects to infer insights for future projects (Dwyer & Bidwell, 2019; Kim et al., 2019; Oh et al., 2023; Westerberg et al., 2015). In practice, the review of EIARs shows that there are no significant differences in the types of receptors and impacts assessed in countries with advanced offshore wind developments (e.g. Denmark, Germany, UK) and newcomer countries that are about to begin the offshore wind endeavour (e.g. Spain, Ireland, Estonia). However, within the sample analysed in this study, Estonia appears to stand out for its explicit consideration of acceptance and community perceptions (perceived benefits and concerns, community well-being, local identity, cultural values, and community cohesion) through public surveys and stakeholder engagement (EE1, EE2).

However, among the case countries, the UK is highlighted by other national stakeholders as being more experienced and advanced in terms of methodologies (I32), although even in the UK the lack of coherence in and interaction between methods are being emphasised (I33)..

Overall, these findings suggest that, although academic literature has advanced our understanding of socio-economic impacts, there is a research gap regarding systematic approaches and methods for their assessment and evaluation. As illustrated in both the interviews and the reviewed EIARs, these gaps create practical challenges and limitations within the impact assessment process, which will be explored in greater detail in Section 5.2.

4.5. Temporality and spatiality of socio-economic impacts of OWF

This section discusses temporal and spatial implications of how socio-economic impacts have been considered across literature, interviews and EIARs.

4.5.1. Temporality of impacts

The temporal scope of socio-economic impacts is typically associated with the OWF project timelines and their operational phases, whereas the long-term manifestations of these impacts are usually delayed and non-linear.

As revealed by literature (Glasson, Durning, & Welch, 2022) and raised by interviewees, most socio-economic impacts caused by overlapping marine uses and a potential displacement of specific uses, such as fishing and navigation, are considered during strategic planning stages to identify appropriate sites and avoid conflicts (I24). In general, socio-economic impacts are considered in more detail during project planning, as they play out and become relevant during the construction and operational phases due to the tangible presence of the wind turbines at sea that are likely to interfere with other marine users, and land-based construction works.

In contrast to economic repercussions of an immediate displacement or restriction of other marine activities, socio-economic impacts tend to have an unclear temporal frame. Socio-economic impacts, in terms of indirect changes to people's lives tend to manifest over a longer period once the wind farm has been deployed. This was reflected in interviews (I24, I32), where it was argued that effects on community development, local employment and tourism activities become visible years after project implementation rather than during construction.

There is also a trend in the governance of OWFs towards the consideration of non-price factors in the procurement projects (Portela de Carvalho, 2025). The inclusion of qualitative criteria, such as employment, community benefits, and supply chain, in tenders aims to mitigate impacts or enhance environmental and socio-economic benefits in the planning and development of OWFs through rewarding compliance with social standards, enhancing social sustainability of projects and social responsibility of developers, and adherence to ESG practices. The objective of non-priced based tenders is to initiate and secure positive long-term socio-economic effects and establish greater legitimacy and community support of OWF projects beyond the production of energy.

In practice, the EIAR review suggests that considerable emphasis is typically placed on identifying and predicting socio-economic impacts that emerge during project construction and those that are experienced during operation. However, little attention is paid to the actual monitoring of impacts during the operational phase, as articulated in two interviews (I24, I34). Decommissioning or repowering impacts are usually considered to a limited extent due to the large gap between project-related assessments conducted during planning and the actual time of when end-of-life decisions become relevant[5]. In addition, decommissioning requires separate EIAs prior to removal (Hall et al., 2022), also to take account of future technological advancements. Likewise, social considerations of end-of-life decision-making including possibilities for repowering and decommissioning have only been considered in research more recently (Spielmann et al., 2021; Stranddorf et al., 2026).

Temporal ambiguities have been raised regarding two key economic sectors, fishing and tourism. Two interviewees (I32, I34) from Denmark and Spain (a consultant and a researcher) pointed to a mismatch between estimations and predictions of socio-economic impacts conducted during project planning and the lack of long-term monitoring of how effects play out during the operational phase for these sectors. This has also been criticised in research (Glasson, Durning, Welch, et al., 2022), despite the requirement for EIA-follow-up for OWFs in several countries (Malvestio et al., 2026). Both interviewees and scientific literature specifically refer to potential negative economic impacts on tourism businesses. Although research and interviews (I24) have hinted at a largely negligible effect of OWF on tourist activities, this has been claimed to have not been backed by evidence through follow-up surveys despite a larger number of operational OWFs (Glasson, Durning, Welch, et al., 2022).

A specific temporal issue was raised by a Danish consultant (I7) for Denmark where compensations for displaced fisheries are mandatory (Bonsu et al., 2024). To be eligible for compensation, individual fishermen must document their economic losses, which will only become visible and assessable over time. Although their affectedness through losses of fishing grounds, longer travel times, or reduced amounts of catch can be determined during the planning phase, the actual magnitude of impact will only be assessable once the fishermen have been relocated and may vary throughout the lifetime of OWF projects and can thus only be compensated retrospectively. This raises questions about the long-term viability of these compensation schemes, considering the continued offshore wind expansion plans, as expressed by the Danish consultant: "Usually⸮projects.still.go.ahead.with.the.impact.and.the. sector.is.compensated¡.But⸮of.course⸮as.we.take.more.and.more.area.for.offshore.wind⸮that. problem. will. also. change. in. magnitude⸮ and. I. am. not. sure. that. we. can. keep. on. just. compensating.them.for.loss.of.income¡" (I7).

4.5.2. Spatiality of impacts

Socio-economic impacts of OWFs can be connected to both the deployment of wind turbines in the sea and the development of associated infrastructures and processes taking place on

[5] For example, this is general practice in Denmark, where developers must submit a plan for physical decommissioning plan including a detailed assessment of environmental impacts, which should provide the Danish Energy Agency, as the planning authority, with a decision basis of whether an actual EIAR is required (formalised in Executive Order 767 on simplified and rapid application and permit process for repowering of existing offshore electricity generation plants, 22 June 2024).

land. EIARs therefore increasingly separate offshore impacts from those that emerge onshore (e.g. IE1, IE2, SC1, SC2, ES1, ES2), which also depends on national legislations and responsibilities for transmission infrastructures. In addition, whilst increasing complexity, the deployment and physical presence of offshore wind turbines out in the sea can also have repercussions on land, mainly through visual intrusions of nearshore turbines along the coast.

It is therefore expedient to differ between offshore and onshore impacts - although (most) socio-economic impacts are related to activities offshore, their consequences are manifest onshore (I24, I33). Socio-economic impacts usually materialise over a longer period, especially for large-scale infrastructure projects, which involve physical-material changes at different locations both onshore and offshore and induce cumulative effects over time. In general, interviewees acknowledge cumulative impacts across space, whereas land-based cumulative impacts are deemed to have received less attention than cumulative impacts at the sea through an extension of spatial constraints, especially for fishing (I24, I18).

Spatial considerations reflected in literature (Pettersen et al., 2023; Stelzenmüller et al., 2021) and interviewees (I18, I24), are also concerned with the possibility of different marine uses occupying the same area, which necessitates a mapping of traditional uses like shipping and fishing that is claimed to be easily managed to reduce negative impacts. However, issues of co-location or combined uses, like aquaculture and on-site hydrogen productions, are seen as “less.controllable and disrupting.the.spatial.planning.control‹ .as indicated by a Portuguese planner (I18). Regarding spatially cumulative effects, these are also related to augmented constraints of other material assets provided by the ocean. Interviewees from Spain, Portugal, Denmark and the UK (I6, I7, I18, I24) especially hint at cumulative impacts of a continuous displacement of fisheries with the future expansion of offshore wind.

4.6. Socio-economic impacts in strategic and project planning

Several strategic OWF plans have been developed in European countries, all of them characterised by intentions for large-scale developments. As EIA is mandatory for OWF projects, SEA is mandatory for OWF plans and programmes. However, the focus on socio-economic impacts differs considerably between strategic and project planning.

Considerations of socio-economic impacts are not deemed to weigh heavily in SEAs in general (I24). Although socio-economic impacts, such as fishing, shipping and landscape/visual impacts are considered in SEAs, specific social impacts (e.g. identity, culture) tend to be largely absent in strategic planning. The integration of socio-economic aspects into marine spatial planning is required to better understand the conditions of coastal areas and how they depend on different marine resources (I33). Socio-economic impacts are considered in strategic planning to the extent they become relevant for avoiding conflicts with other marine and coastal uses or for potentially creating benefits. Already existing socio-economic connections in strategically appointed areas are also strategically considered in planning as they may allow for a generation of synergies and accumulated benefits, as described by a British environmental organisation: »For.example?.off.the.East.Coast.[in.the.UK]?.you.might.say.that. there.is.already.an.established.hub.of.workers?.factories?.and.ports?.and.therefore.creating. another.wind.farm.there.will.further.strengthen.that.economy?.create.local.jobs?.improve.port. logistics.and.viability?.and.create.additional.jobs¡.So.clustering.wind.farms.can.be.seen.as.a. positive.socio_economic.benefit.from.an.economic.and.employment.perspective‹ (I24).

In addition to competing marine uses, another indirect negative socio-economic impact that is considered at the strategic level are visual impacts which are seen to pose a very concrete risk for opposition and refused planning permission, especially for nearshore wind farms. As pointed out by the same representative of a British consultant, specific locations in proximity to protected landscape areas represent the main instance where strategic socio-economic considerations come into play: »For.example?.Navitus.Bay.[in.the.UK].was.rejected.partially. because.of.its.proximity.to.the.Jurassic.Coast?.Bournemouth?.and.the.Isle.of.Wight¡.It.would. probably.be.very.difficult.to.develop.nearshore.wind.farms.of.heavily.protected.landscapes. such.as.Pembrokeshire¡.At.a.strategic.level?.you.might.say.that.it.is.a.national.park.coast.with. highly.protected.landscape.areas?.and.that.putting.in.a.very.nearshore.wind.farm.is.unlikely.to. be.acceptable.to.local.communities‹ (I24).

An thorough assessment of socio-economic impacts at strategic planning stages remains less covered in practice. If considered in planning, like sectoral planning in Scotland, it serves a better management of negative and positive impacts that come with both the increased deployment of OWFs and an envisioned growth of a domestic offshore wind industry. Otherwise, a detailed strategic consideration of socio-economic impacts is usually embedded in industrial appraisals rather than in planning (e.g. in Ireland and Denmark). A more detailed assessment of spatially confined socio-economic impacts remains largely subject to project planning but differs in how they are arranged and presented within EIA reports across projects and countries.

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5. Assessment methods

SEAs and EIAs examine the scope of impacts, including the type, duration, spatial extent and distribution, through various steps that involve scoping, baseline studies, prediction and assessing impact significance and magnitude, mitigation or enhancement of impacts, and monitoring measures. These steps involve analysing the existing situation, describing the predicted change and assessing the significance of the impact. Socio-economic assessments usually include employment, GVA and specific sector effects for different project stages, time periods and spatial areas, demographic data and surveys on local condition. On the one hand, the assessment and prediction of economic impacts of OWFs are less accurate due to an uncertain materialisation of effects on socio-economic baselines. On the other hand, the assessment of socio-economic impacts rather seeks to reduce uncertainties associated with the implementation of the OWF projects by avoiding future costs and conflicts and provide insights into potential enhancement measures and benefits (Glasson et al., 2020).

Literature on OWFs has rarely dealt with assessment methods of socio-economic impacts. The practical advancement of assessment methods has been mainly concerned with the conceptualisation and practical operation of assessing visual impacts (Depellegrin et al., 2014; Gkeka-Serpetsidaki et al., 2022; Maslov et al., 2017) and fishing impacts (Silva et al., 2026; Willis-Norton et al., 2024). The methodology for assessing socio-economic impacts is largely descriptive and qualitative, including predictions that involve expert judgements. Some social aspects are more difficult to assess as they relate to people's perceptions and everyday life, including place attachment, practices, quality of life, local culture, identity, etc. Thus, their assessment requires an active involvement of affected communities to understand their values attached to places and how they may be impacted by proposed OWFs and to identify meaningful ways of how negative social impacts can be mitigated and community benefits can be created (Glasson, Durning, Welch, et al., 2022; Malvestio et al., 2026; Veronez et al., 2026)

5.1. Description of identified approaches and key methods

Across the reviewed EIARs, a consistent set of assessment steps can be identified, including screening and scoping, baseline surveys, impact modelling, analysis of significance, cumulative effects assessment, and monitoring and mitigation (Table 5). In general, EIARs rely on a combination of baseline surveys and predictive modelling. However, the listed methods are exemplary rather than comprehensive. Baseline studies provide the reference data used to evaluate potential changes. Predictive modelling is then used to estimate how projects might affect specific receptors. The assessment of the significance of impacts is judged against the magnitude of the impact and the sensitivity of the receptor. Assessments of cumulative impacts are often conducted as another step in SEAs and EIAs.

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Table.❶¿Description.of.assessment.approach.in.EIARs.(Source¿European.Commission?EC.867❸)¡

Assessment approach		Purpose
Screening and scoping		Determines whether an EIA is needed and identifies the key issues, impacts, study boundaries, and methods to assess in detail.
Baseline surveys	Tourism	Collects field data on current environmental, social, or ecological conditions so future changes can be measured against a known starting point.
Predictive modelling	Landscape/Visual	Predicts how a project will affect views, landscape character, visibility, and visual amenity.
	Noise	Estimates existing and future noise levels to assess whether project-related sound may cause disturbance or exceed relevant thresholds.
	Shipping, Collision risk	Estimates the probability of collisions involving vessels, infrastructure, or wildlife by analysing traffic patterns, project layout, and navigational or behavioural factors.
	Fishing	Evaluates potential effects on fishing activity, including access restrictions, displacement, gear interactions, and changes in fish distribution or catch.
	Material assets, Infrastructure	Assesses interactions with existing infrastructure such as cables, pipelines, and ports, including risks of damage, interference, or constraints on future development.
Field observations / Expert judgement	Cultural Heritage	Evaluates potential effects on and interactions with location and state of archaeological, historical, religious sites.
Analysis of significance of impact		Assesses likely significance of effects based on criteria for magnitude of impact and sensitivity of receptor assessed against maximum design scenarios and baseline conditions
Cumulative effects		Evaluates the combined impact of the project together with other past, present, and reasonably foreseeable actions.
Monitoring and mitigation		Tracks actual impacts during construction and operation and applies measures to avoid, reduce, compensate for, or correct adverse effects.

However, despite this common framework across countries driven by SEA and EIA Directives, the specific methods applied and level of detail vary. Figure 7 exemplarily illustrates how different methods are used to capture different socio-economic impacts. Hence the figure illustrates that socio-economic impacts are not assessed through a single and uniform method across countries, although in some cases similar methods are applied. However, although we have classified each receptor under a primary method of assessment in this analysis, in practice in the EIARs they are typically assessed through a combination of approaches. For example, impacts on commercial fisheries are often evaluated using baseline surveys (e.g. economic relevance of different catches), spatial mapping of fishing efforts, and modelling of collision risk, while shipping and navigation may combine baseline traffic data with modelling of collision risk. This combination reflects the fact that no single method is usually sufficient to capture the full range of possible effects and their significance. The same goes for other

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receptors, where the choice of method also depends on how much data is available and what kind of effect is being assessed.

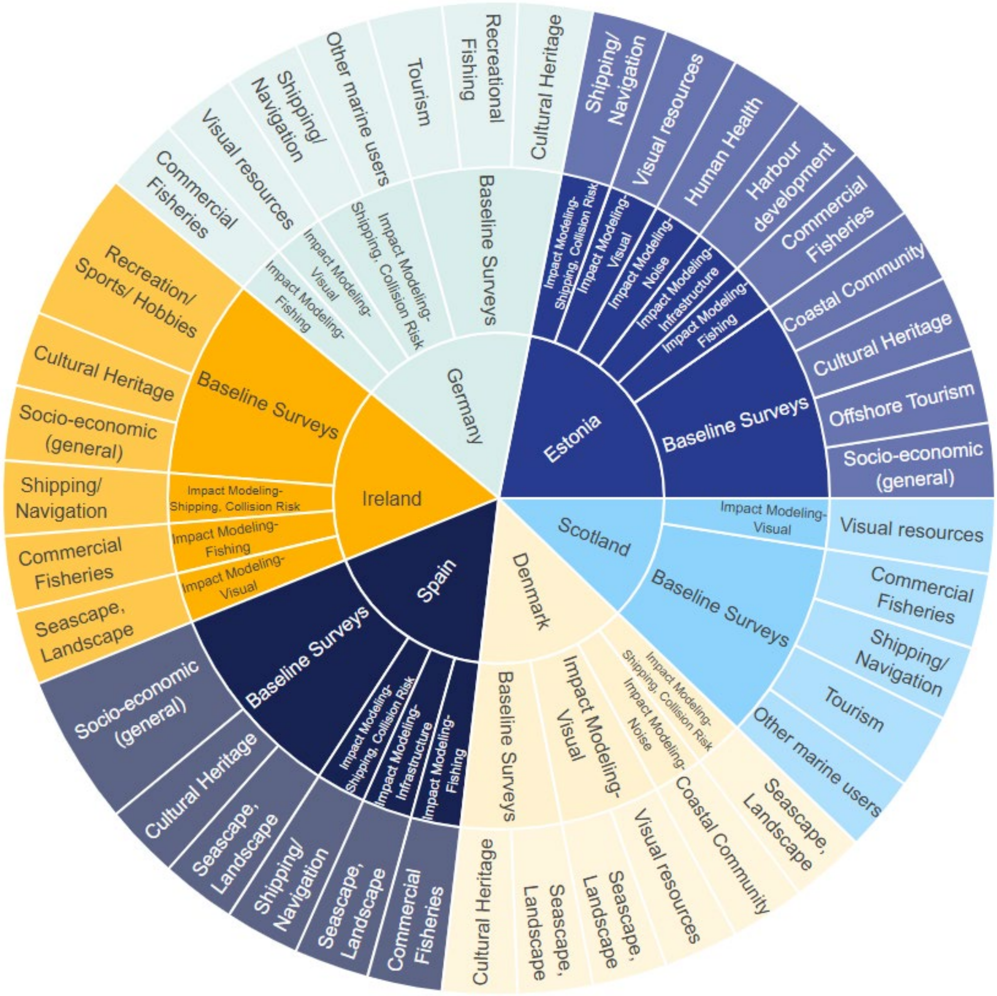

Figure 7: Receptor-specific assessment methods and approaches used in the reviewed EIARs across countries[6]

There are clear patterns in how different receptors are assessed, with variation in the level of quantification and modelling applied. For instance, shipping and navigation or commercial fisheries are assessed using more quantitative methods. Navigation impacts in projects such as DE2, EE2, SC1, IE1 are typically assessed through vessel traffic analysis and collision risk modelling, supported by automatic identification system vessel datasets and maritime traffic statistics. Similarly, impacts on commercial fisheries in projects such as ES1, ES2 SC1 are usually assessed through fishing effort data and economic indicators (e.g. catch value) and fleet characteristics. For instance, in Spain and Germany, spatial datasets (e.g. GIS-derived fishing intensity heat maps) are used to estimate potential impacts such as loss of fishing grounds on revenue. However, approaches are not uniform: while in Spain assessments tend to place stronger focus on co-existence, Germany instead offers a detailed assessment of risk of collision as well as an estimate of possible revenue losses. This difference is mirrored in the

[6] Figure 7 is based on one representative EIAR per country. Although multiple EIARs were available for some countries, to simplify the figure, it is exemplary rather than comprehensive.

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interviews. While fisheries were identified as one of the most contentious socio-economic issues (I6, I7, I18, I24), a representative from the Spanish wind energy sector argued that OWFs do not necessarily imply the full exclusion of fishing activities, pointing to the possibility of co-existence, depending on factors such as gear type and vessel size (I20).

In addition, other receptors such as visual and noise impacts are modelled across analysed case studies. Visual assessments, especially in the UK, rely on visibility thresholds or Zone of Theoretical Visibility (ZTV) analysis, and earth-curvature-based modelling. For example, visibility thresholds (<8 km high, 8–20 km moderate, >20 km low) and quantifies visible area percentages are applied in the Spanish case (ES2), supported by photomontages from key viewpoints. Scotland (SC1) similarly combines ZTV outputs with qualitative criteria such as duration, reversibility, and viewing conditions. Noise assessments in projects such as SC1, IE1, EE2, DK1 are based on predicted sound levels to estimate potential disturbance or compliance with relevant regulatory thresholds or expected disturbance levels.

In contrast, several receptors are assessed using more descriptive approaches or proxy indicators. This applies to socio-economic impacts beyond fisheries such as on tourism, cultural heritage, other marine uses, and certain land-use interactions. These impacts are often less straightforward to quantify directly, so these assessments typically rely on secondary data sources (e.g. demographic statistics, tourism capacity, employment indicators) as well as, in other cases, professional judgement. For example, assessments for SC1, IE1, IE2, EE2 draw on demographic data, tourism information and qualitative descriptions of community characteristics, while interviewees highlighted the limited availability of reliable data for assessing socio-economic impacts (see Annex 2). Therefore, expert judgment is often required to ultimately assess the significance of an impact based, which also varies due to available data, different criteria against which the judgement is made, and the experience of the expert. As a result, the level of detail and the methodological approach vary substantially depending on the receptor, the available data, and the country context. During an interview (I32), it was mentioned that EIARs have limited impact on public opinion formation, particularly where attitudes towards OWF were already negative. In these cases, the absence of credible data can reinforce mistrust and, in some cases, even exacerbate conflicts rather than mitigate them. Therefore, this challenge extends beyond a technical issue of data availability and methodology but should be understood as part of a broader governance and procedural justice process. The findings point to the need for a more inclusive, transparent and participatory process that enable a meaningful involvement of affected communities, starting, in this case, with the incorporation of local perspectives within EIAs.

Table.❷¿Examples.of.receptor_specific.assessment.methods.and.tools.used.in.the.reviewed.EIARs¡

Receptor	Subcategory	Method	Example
Seascape/ Landscape	Landscape and visual conditions (onshore)	Predictive modelling – visual	Denmark (DK1): classification of impact based on landscape character, sensitivity, and visibility at multiple scales
	Infrastructure	Predictive modelling – infrastructure	Spain (ES1): mapping of roads, railways, electrical grid, and additional infrastructure (e.g. aviation, extractive activities, wastewater treatment plants) using official datasets
Visual resources	Landscape and visual conditions	Predictive modelling – visual	Scotland (SC1, SC2): ZTV analysis combined with duration and reversibility, visibility, view range; assessment of significance
Cultural heritage	Marine archaeology and cultural heritage on land	Baseline surveys, expert judgement	Spain (ES1): overlap of archaeological sites with project area and identification of sensitive zones; proposal of pre-construction archaeological survey
Shipping/ Navigation	Marine infrastructure	Predictive modelling – shipping, collision risk	Germany (DE1): radar and safety-zone modelling combined with navigation risk analysis
	Impact on commercial vessels/maritime traffic	Predictive modelling – shipping, collision risk	Scotland (SC1): AIS datasets used to map vessel density, routes and seasonal variation and magnitude of impact using risk matrix
Commercial fisheries	Loss or restricted access to fishing ground	Predictive modelling – fishing	Spain (ES1): identification of fishing grounds and permanent fishing closures, characterisation of fleet size and activity; classification of fishing methods; analysis of catch composition and economic value by species
Coastal community	Noise on land	Predictive modelling - noise	Estonia (EE1): WindPRO modelling showing noise levels below 35 dB at residential receptors
	Social acceptance and community impacts	Baseline surveys, consultations	Estonia (EE1): public attitude survey among residents to evaluate social acceptance, perceived benefits, concerns and potential community impacts; statistical analysis
Other marine users	Recreational use and sailing safety	Baseline surveys	Scotland (SC1): mapping of recreational sailing, diving, and water sports using publicly available datasets
Socio-economic (general)	Economic structure and employment	Baseline surveys	Scotland (SC2): employment; GVA; labour market; and demographic indicators
	Regional economic effects/benefits	Baseline surveys	Estonia (EE2): assessment of local employment, municipal revenues, and supply chain opportunities
Tourism	Tourism resources	Baseline surveys	Spain (ES2): Identification and mapping of beaches, and classification by size and importance; identification of key coastal features (e.g. mapping of lighthouses); analysis of tourism supply; spatial distribution of hotels and apartments
Harbour development	Infrastructure development	Predictive modelling - infrastructure	Estonia (EE1): Assessment of opportunities for local ports during construction and operation phases, including service, maintenance and logistics functions

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5.2. Scope, data and challenges of socio-economic impact assessments

Different countries give uneven weight to the assessment of socio-economic impacts. While assessments tend to prioritise socio-economic impacts that can be narrowed down to economic effects, social impacts related to broader issues affecting the quality of life of individuals and coastal communities are rarely examined within EIA.

The assessment of socio-economic impacts included in the reviewed EIARs are usually associated with project timelines that are not aligned with the long-term socio-economic effects on different receptors (e.g. long-term variations in income of tourism businesses). The assessment of the baseline of socio-economic conditions can be time-consuming and typically includes one-off investigations or two-time investigations (e.g. for tourism, shipping and fishing) to take account of seasonal variations in economic variables. Hence, they only reflect a snapshot in time and do rarely capture effects over time or shifting baselines. Where available, strategic assessments of wider socio-economic impacts associated with offshore wind development plans cover longer periods that go beyond the lifespan of individual projects and consider cumulative offshore wind capacities.

Data for assessing socio-economic impacts at SEA and EIA level mainly consists of secondary data that is gathered from publicly available sources, desktop studies and surveys to establish the baseline of social and economic conditions for different receptors (e.g. national, regional, local statistics; GVA of affected sectors; employment numbers; tracking data of vessel movements; vessel landings; amount and value of fish catch; overnight stays and tourist spendings etc.).

The issue of insufficient data has been raised by interviews with stakeholders from most of the selected case studies in this report, who refer to lacking data and the absence of coherent methods to assess impacts based on the data. In all countries, the need for more detailed and recent datasets is emphasised, thus also problematizing the risk of using inadequate data. Where required or sufficient data is lacking, additional data is collected through different methods such as surveys, consultations and site visits that help investigate local conditions and public perceptions. While some countries (UK and Portugal) make use of dialogue (primarily with fishermen) they fail to communicate with the broader fishing community in a productive way. Whereas dialogues take place early in the process as part of a screening process (to get an overview of where the economically important fishing areas are) consultants are being accused of not using the right data or for manipulating it (I18, I23). The acquisition of new data through surveys can be time-consuming, although the necessary level of detail to make meaningful statements may still not be achievable. Furthermore, while socio-economic conditions underlying baseline descriptions may fluctuate to different degrees over time, some baseline data can capture averages over a longer period, for example mapping of shipping routes, AIS and GPS data for tracking commercial fishing vessels. However, since local socio-economic conditions are also influenced by overarching structural conditions and the political-economic context, it can be problematic to monitor, retrace and separate long-term effects that are induced by OWFs. This means there are external developments and changes that affect socio-economic conditions of certain receptors over time, which can be difficult to separate from those changes induced by OWFs.

The following overarching challenges have been identified in the literature review, EIAR review and interviews:

- Data availability for describing the baseline for receptors can be limited, missing or incomplete across regions and countries.
- There is a lack of alignment of assessment methods across countries
- Most assessments of the magnitude of impacts and sensitivity of receptors ultimately rely on expert judgements.
- A recurrent issue refers to limited or inappropriate methods for sufficiently assessing impacts, even if data sources are available for describing baselines.
- Descriptions of baselines and assessments of some impacts require active participation and cooperation of affected communities, who can be hesitant (e.g. fisheries not wanting to disclose their preferred fishing grounds).
- There is a lack of follow-up assessments of how particular effects materialise over time, which mask differences between predicted and actual impacts and may render initial predictions during project planning obsolete.

Main challenges in the assessment of specific impacts can be largely related back to uncertainties, procedural deficiencies, and temporal mismatches. Key uncertainties include missing, incomplete or outdated data sources for establishing baselines, ambiguities in the exposure pathway for receptors and unspecific effects, and interpretations of the magnitude of effects that often rely on expert judgements (see Annex 2). The handling of social and economic data at certain granularities also differs from country to country. Even if socio-economic impacts cannot be modelled or easily measured, procedural deficiencies emerge from methodologies that aim to quantify impacts by inferring potential risks and magnitudes of impacts from existing conditions and predictions of effects, while largely omitting insights, aspirations, values and fears of affected stakeholders. Hence, there is a need for a better integration of different data types, particularly data on perceptions and values of affected communities, and a better understanding of interactions and causalities of effects. Data gathered through community engagement is meant to enable a more grounded and context-sensitive interpretation of what is considered meaningful, valuable and significant by affected community (Veronez et al., 2026). There is a need for a greater understanding of the relationship between socio-economic conditions of coastal communities and marine resources, and the types of indicators to analyse the relationship and interactions (I33). Likewise, while the magnitude of impacts and sensitivity of receptors are usually judged based on matrixes (e.g. low, medium, high), there are no clear or common thresholds of what defines unacceptable impacts. An observed lack of monitoring of socio-economic impacts and the involvement of affected communities in the assessment of impacts hints at requirements for adaptive management in EIA governance and the incorporation of learnings in future practice (Glasson et al., 2020; Malvestio et al., 2026). Temporal ambiguities also emerge from the fact that socio-economic impacts are dynamic and tend to materialise and change over longer periods, while assessments provide a snapshot of existing conditions. Although this may not be different from environmental impacts, the effects are co-shaped by changing rationales and underlying practices and responses by human receptors.

These observations are also discussed in interviews with practitioners. A more detailed description of challenges and underlying rationales reflected in interviews is included in Annex 2. Table 7 depicts key challenges related to the assessment of specific receptors.

Table.❸¿Key.limitations.and.challenges.in.the.assessment.of.receptor_specific.impacts.in.EIARs?literature.review.and. interviews¡

Receptor – impact	Limitation	Challenge
Fishing impacts	Assessments are often qualitative because precise data on income losses, for example, are limited. Actual magnitude of effect can only be assessed after displacement.	Lack of quantitative data reduces the ability to plan OWF in a way that creates the least possible loss of income for other affected stakeholders - e.g. fishermen. Fishermen may be reluctant to disclose preferred fishing areas, rendering predictions of impacts and losses difficult. GPS data can be outdated.
Landscape, Seascape, Visual impacts	ZTV and visualisations provide standardised outputs but do not capture individual perceptions.	Lack of ability to capture individual attitudes towards visual disturbance implies an inaccurate picture of the real visual impact on e.g. residents and tourism
Tourism	Lack of follow-up studies and monitoring to assess actual long-term impact.	The absence of follow-up studies creates an uncertain foundation for future planning, adaptive management and a risk of repeating mistakes.
Cultural heritage	Known heritage assets can be mapped, but unknown archaeological remains may not be fully identified in advance.	Accidental finds remain possible, especially offshore and along cable routes, which creates uncertainty in impact prediction.
Shipping/ Navigation	Assessments often rely on availability of existing AIS, radar, and desktop data.	Patterns of activity (e.g. vessel moverments) may be incomplete in the dataset, and final risk conclusions may depend on later navigation requirements and mitigation rules.
Coastal communities	Community impacts, such as identity, acceptance, and perceived benefits, necessitate an active participation of communities.	As public participation procedures do not function very well, the risk arises of a lack of integration of socio-economic impacts in OWF planning and a lack of social acceptance.
Harbour development	Benefits and constraints are often assessed through logistics and port-function studies rather than direct long-term monitoring.	Effects on harbour operations can be hard to separate from other economic and transport changes.

Human health/ noise	Noise models estimate exposure, but they do not fully capture nuisance or annoyance as experienced by individuals.	Perceived disturbance depends on receptor sensitivity, background conditions, and the difference between modelled and real-world exposure.

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6. Summary and outlook

The research underlying this report aimed at advancing a shared understanding of socio-economic impacts of OWFs, juxtaposing their consideration between scientific literature and practice, and identifying main methods for and challenges in their assessment. In doing so, the report applied a taxonomy to describe and explain underlying causalities of common impacts and reviewed scientific literature as well as SEA and EIA reports and conducted interviews with different stakeholders.

The physical presence of offshore wind farms and related barriers at sea cause the main socio-economic risks of offshore wind on other sectors. However, the development of OWFs does not only create effects on other marine uses and users but can also have direct and indirect effects on land-based activities due the potential visibility of offshore wind turbines and onshore construction works. Socio-economic impacts are usually included within EIARs, which tend to prioritise those impacts that can be modelled spatially or those that can be assessed by means of economic variables. Socio-economic impacts cannot easily be quantified but are inferred from existing socio-economic conditions. Hence, most impacts remain weakly assessed through interpretations, predictions and estimations that are embedded in expert judgements. Thus, socio-economic impacts remain contentious aspects within SEA and EIA due to their uncertain and contested effects, involving competing values, deviating perceptions, subjective data, uncertain predictions, but a high relevance for affected communities.

In contrast, scientific literature predominantly focusses on social contentions of offshore wind and therefore variously, but often implicitly, highlights the social dimension of impacts. Scientific literature deals with more qualitative expressions of impacts, in terms of place attachment, identity, acceptance, perceptions and contestations, to describe the relationship between offshore wind farm projects and affected communities and changes that OWF may bring to people's lives.

Across the analysed countries, the research findings from the different sources reveal both differences and similarities. On the one hand, there is a high level of consistency in the types of receptors considered across countries which are systematically included across all cases. On the other hand, differences emerge in how these impacts are assessed and prioritised. While some countries emphasise coexistence and different marine uses, other countries focus more strongly on risk identification and a quantification of the impacts. Stakeholder interviews suggest that these differences are not only methodological but reflect underlying legal and institutional frameworks. In particular, the existence of fixed compensation schemes in some countries (e.g. Denmark), where fishers are compensated for economic loses, can reduce the perceived need of a detailed impact assessment (see Annex 2).

In addition, data for and knowledge about specific receptors is deemed to differ across countries and sea basins. Variations across countries become especially clear in terms of data availability and their use in understanding socio-economic impacts. While all countries rely mostly on secondary sources and baseline surveys, some countries incorporate primary data and stakeholder input as well, such as public attitude surveys or other consultations insights. However, even in these cases, the integration of these perspectives remains limited in the considered EIARs.

These challenges and limitations affect the overall credibility and validity of socio-economic assessments of OWFs. Throughout this study, the lack of precise and local data, particularly regarding impacts on local communities is highlighted. Many socio-economic impacts cannot be directly measured or modelled but instead are assessed through descriptive analysis and inferred from proxy indicators. Interviews with consultants highlight these limitations and the scientific knowledge gap in issues such as property values, tourism, and local livelihoods. As a result, consultants often rely on assumptions rather than established empirical findings – not only for potential negative impacts, but also for projected effects such as harbour development, local employment and economic benefits. Therefore, both burdens and benefits tend to remain speculative rather than based on concrete evidence (see Annex 2), reinforcing the need for more systematic data collection and analysis.

Limited use of primary data also affects the engagement and public attitudes within affected communities. A weak integration of local opinions and context-specific knowledge reinforce limitations of EIARs in shaping public perceptions and acceptance and may reduce the perceived legitimacy of the assessment process (Portman, 2009). Participation is not only essential to improve the quality and validity of EIAs, but also to ensure fairness and trust in the decision-making process surrounding OWF developments.

The results and insights obtained in this deliverable will provide a basis for further discussion and subsequent tasks in the SUSTAINOW project that focus on stakeholder engagement (T4.2) and the inclusion of socio-economic impacts in decision-support tools (T4.3). The highlighted socio-economic impacts are envisioned to be taken further, explored in more detail and put into dialogue with issues of social acceptance, energy citizenship and procedural justice to inform a reconsideration of meaningful stakeholder engagement for OWF projects. Relevant social and socio-economic impacts as well as insights into challenges of their assessment are expected to contribute to a joint foundation across the research project for elements to be incorporated in intended decision-support tools.

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Annexes

Annex 1. Search string development

Several search strings were developed, and are presented in Table 8. To assess the relative impact of each buzzword, the socio-economic keyword string was combined separately with each individual buzzword. This made it possible to compare how strongly each term contributed to the number of retrieved documents. The results show substantial variation in sensitivity across the tested terms. For example, "offshore wind" returned 14,548 title hits in total, of which 1,078 also matched the socio-economic string, corresponding to a sensitivity of 7.4%. By contrast, "nearshore wind" returned only 35 title hits, all of which matched the socio-economic string, resulting in a sensitivity of 100%.

Keywords: socio-economic OR socioeconomic OR sociocultural OR cultural OR social OR land-based OR benefits OR place OR impacts OR local OR community OR conflicts OR public OR politics OR nearshore OR municipality OR fisheries OR shipping OR challenges OR port OR government

Buzzwords: "offshore wind" OR "offshore renewable energy" OR "offshore energy" OR "nearshore wind"

Table 8: Sensitivity of buzzword occurrences in socio-economic-related titles.

Buzzword	TITLE (Buzzword)	TITLE (Socio-economic string + Buzzword)	Sensitivity
Offshore wind	14,548	1,078	7.4%
Offshore renewable energy	255	28	11.0%
Offshore energy	271	40	14.8%
Nearshore wind	35	35	100.0%
Total	15,109	1,181	

Each term was then combined with the socio-economic search string to evaluate relative sensitivity. Results ranged from 7.4% for "offshore wind" (1,078 hits) to 100% for "nearshore wind" (35 hits).

Overall, these differences helped to refine the final search strategy. The aim was to balance recall and precision: the search needed to be broad enough to capture the diverse ways socio-economic issues are discussed in offshore wind literature but focused enough to avoid retrieving a large number of irrelevant documents.

The complete search string was constructed by combining the keyword set with the full set of buzzwords: TITLE (socio-economic OR socioeconomic OR sociocultural OR cultural OR social OR land-based OR benefits OR place OR impacts OR local OR community OR conflicts

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OR public OR politics OR nearshore OR municipality OR fisheries OR shipping OR challenges OR port OR government "offshore wind" OR "offshore renewable energy" OR "offshore energy" OR "nearshore wind") AND (LIMIT-TO (LANGUAGE , "English"))

Annex 2. Insights from interviews on impact assessment challenges

Data

A key challenge across countries is the lack of precise data on effects for local communities. Challenges are related to the quality, reliability, and availability of data for assessing socio-economic impacts have been explicitly mentioned by eight interviewees. Limited or lack of available data has been raised as a major concern for Denmark (I7, I32) and Spain (I33), but also the UK (I24). A general experience is that there is a scientific knowledge gap in terms of documenting the actual effects of OWFs on local communities. Fears of losing property value, tourism and so on have been too poorly documented, as there have been too few follow-up studies in this area. From the perspective of consultants conducting EIAs this knowledge gap affects the quality of working with socio-economic impacts as there are limited studies to refer to. Hence, instead of building evaluations on scientific findings, assessments are rather based on assumptions (I32).

However, the ability to access and handle data for assessing socio-economic impacts also varies from country to country. In Denmark, for example, there is the perception amongst consultants that compared to other countries, it is particularly difficult in a Danish context to obtain datasets that deal with socio-economic aspects. This is related, among other things, to a historical tradition in Denmark of not having access to datasets on distribution of economic or demographic data, like gender or age. As described by a Danish consultant who points to other countries and their abilities of getting access to data: »Some.countries.are.very.good.at. publishing.data.about.these.things¡.I've.seen.some.datasets.from.the.UK?I.think.from.Sweden. as.well¡.In.Denmark?we.have.a.very.high.level.of?it's.very.difficult.to.obtain.datasets.that.work. with.these.aspects¡.So.the.whole.Danish.datasets.in.terms.of.populations.are.quite.difficult.to. get.a.hold.on?and.to.work.with?even.on.a.more.generic.scale?where.you.could.say.you.can't. identify.anyone?because.the.mentality.and.the.approach.has.been.historically.that.you're.not. allowed.to.work.with.this.dataset.at.all¡.Then.it's.actually.quite.difficult?because.it's.a.generic. assessment?but.you.can't.really.base.it.on.anything?because.you're.not.able.to.say.anything. about.distribution.of.age?or.anything.like.that¡.That's.an.authorities.approach?and.if.we.have.an. offshore.wind.development?and.it's.the.DEA.who's.the.authority?then.they're.not.gonna.ask.the. given. municipality. to. deliver. a. dataset. with. age. distribution. or. gender. distribution? or. employment. rate? all. things. that. could. be. interesting. to. work. with. in. a. discussion. about. socioeconomic.effects.and.jobs‹ .(I32).

Furthermore, the need for using and integrating different data types was explicitly emphasized by three interviewees (I2, I7, I32), with the aim of understanding interactions better. Hence, even though data exists on various impacts, the type of knowledge and data needed to properly analyse the interactions and relations between them – e.g. between OWFs, fisheries behaviour and vessel tracking (I32), data is seen as not good enough and is not being properly combined. There is also the need to align data sources to allow for joined-up approach of strategic, sectoral and project planning when considering offshore wind, fishing and protected areas (I2). Access to more detailed datasets as well as the analytical ability to combine these datasets across countries in the North Sea is therefore seen as a necessary improvement (I33). Also in the UK there is a call for more interactions between different sources of data. Suggestions as to how this may be improved necessitates the involvement of more disciplines. As described by a consultant: »–•– –we.need.economists.and.social.scientists.that.can.really.understand.the. reaction.of.the.community.to.the.new.presence¡.So?we.need.a.lot.of.people.to.work.together. because.a.lot.of.people.are.doing.a.lot.of.stuff.and.there.is.no.integration‹ (I23).

Approach and Methods

Ten interviewees across countries explicitly mention methodological challenges in the assessment of socio-economic impacts. It is criticized that there is limited awareness of consistent methods for assessing social impacts (I4). The assessment of socio-economic impacts generally does not have the same focus, while competences and experiences are lacking across countries. A lack of alignment of methods, and guidance in assessing socio-economic has also been lamented (I14, I5, I32).

There is also the understanding that since environmental consultants are conducting EIAs and not ESIAs, social impacts are not considered a major component (I9). Apart from assessing fisheries, noise and visualisations, social impacts are not being seen as mandatory parts of EIAs (I9).

Similarly, onshore assessments of human quality of life focusing on traditional material issues such as noise, pollution, dust, construction traffic, and contamination of watercourses have been assessed for decades, making these methodologies well established as well. Pollution management, noise management, traffic management plans, and related mitigation measures are all considered quite advanced in terms of assessment, mitigation, and safeguarding nearby communities (I24). Overall, assessment approaches and data foundations in the UK stand out in terms of their collection and handling. Approaches in this field are described by both the UK (I24, I34) and other national stakeholders (I32) as being experienced and advanced in terms of certain methodologies.

Another limitation in assessment approaches refers to the lack of integration of land-based socio-economic and social dimensions into marine spatial planning. From a Spanish perspective (I33), potential areas for offshore wind energy identified in marine spatial plans would need to be complemented with more detailed information on the social, socioeconomic, and socioecological conditions of coastal areas. The need for a more holistic approach of coastal zone management has also been mentioned for Denmark (I32). Seen from this perspective, greater understanding is needed regarding the socio-economic conditions of coastal communities and how they depend on different marine resources. It is suggested to investigate such overlaps further, particularly in terms of what types of indicator pools can be used for this kind of analysis (I33). Likewise, there is still room for improvement in considering social impacts by connecting marine impacts with repercussion on land. Hence, a critique has been raised that the industry has acted poorly at closing the loop by following up and surveying the tourism impact for coastal communities and monitoring receptors like hotel occupancy rates, car park receipts from councils, or tourism numbers. Following this perspective, such data could be used as empirical evidence to demonstrate tourism recreation effects caused by the presence of nearshore wind farms are overestimated and not significant (I24, I34).

In accordance with the need for improved methods, some guidance in how to collect and combine different forms of data is required. According to a Danish consultant, having a more unified approach across countries on how to conduct data collection would contribute to both efficiency, comparability and quality of data. Such a guidance could help structure work procedures and remedy the tendency to work from project to project¿»So.having.a.more.unified. approach?saying?this.is.a.guidance.on.how.to.do.this.simplistically?but.if.you.can✗.do.anything? then.at.least.do.it.like.this?so.you.need.to.compile.data.XYZ?and.then.you.can.perhaps.say. something.about.this?then.perhaps.we.could.do.something‹ .(I32)¡ Following this, and views from other consultants, a common framework is lacking, which makes it difficult for consultants to evaluate whether discussions on specific socio-economic impacts are based on facts or assumptions. Such reflections also touch on the tendency to reuse the same methods even though they may not be able to deliver the data needed. Consequently, data is replaced by assumptions, which also represents a lack of credibility. As explained by the same consultant: »I.think.that✗.a.generic.issue.towards.this.as.well?because.rather.than.having.a. discussion.based.on.the.past.96.years".experience.with.this?we✗e.still.having.a.discussion.on. trying.to.use.the.same.methods.that.we.have.used.for.years¡.It"s.not.that.clear_cut?of.course? but.we.are.still.lacking.the.use.of.data.and.saying?we.can.see.from.XYZ.development.that.they. have.gained.an.increase.in.work.rate?or.this.did.XYZ.too¡.We.can✗.really.base.it.on.that?so.it✗. these.assumptions.that.we.have¡.That.makes.it.both.difficult.to.explain.to.the.public?and.also. something.that.the.politicians.can✗.really.discuss.on.anything.like.that‹ (I32).

Also, one does not have the necessary tools to assess social impacts in a consistent and coherent way. The approach has traditionally been based on ad-hoc practices, where sporadic attempts are made to describe the consequences for coastal communities. As described by the same Danish consultant: »I.think.we.don"t.have.any.really.good.methods.for.that¡.That✗. when.I.started.initially.saying?I.think.it✗.very.much.case_to_case.how.that✗.approached¡.When. we.were.looking.into.the.Energy.Island.in.the.North.Sea?we.also.tried.to.see.what.are.the. developments.in.the.coastal.region?where.are.there.some.initiatives.from.municipalities.trying. to. look. into. tourism? where. there. are. some. initiatives. trying. to. look. into. commercial. development.or.local.development.in.terms.of.jobs?and.then.trying.to.evaluate.on.that?whether. or.not.this.would.support.that?given.the.base.harbour.and• ‹.(I32)¡.Referring to other countries it is made explicit that particularly the UK stands out in terms of methodological competences. On.the.other.hand?there.are.ambitions.to.improve.things.and.the.approach.in.Great.Britain. appears.here.as.an.inspiring.and.more.advanced.model¡.One.approach.has.thus?as.in.the.UK?

been.to.start.working.more.purposefully.with.the.Coastal.Protection.Schemes.from.the.Coastal. Directorate. along. the. western. coast. of. Denmark¡. Here. they. started. with. a. coastal. zone. approach?where.you.look.at.the.whole.from.the.marine.environment.to.the.near.shore.and.to. the.urban.developments?thereby.trying.to.get.the.coastal.zone.in.a.holistic.approach.(I32).

Fisheries

The potential impact on fishing and fisheries was the most highlighted socio-economic impact, which was named by 17 interviewees. Strategic planning processes usually try to avoid placing wind farm areas in heavily used fishing areas, effectively acting as a form of pre-screening (I7).

Ambiguities in the assessment of impacts on commercial fishing have gained the greatest attention during interviews. For fisheries, it is difficult to quantify and compare the information provided (I6). Assessments of impacts on fisheries are typically qualitative and descriptive, as there is limited data on economic losses for fishermen caused by restricted access to fishing areas. While the baseline can be defined relatively well due to GPS and AIS data tracking vessel movements and the number of landings and amount of catch, data on the actual economic consequences can effectively only be gathered once the impact has occurred. Thus, some countries rely primarily on statistics (e.g. Portugal. I18), which are not always up to date and can cause contentions. Others make use of dialogue involving fishermen but fail to communicate with the fishing community in a productive way. Whereas dialogues take place early in the process as part of a screening process (to get an overview of where the economically important fishing areas are), consultants are also accused of not using the right data and manipulating the evidence (I17). In addition, three interviewees consider fisheries difficult to engage and provide unreliable information (I6, I18, I24).

However, ambiguities have been mentioned regarding fisheries data. While one interviewee (I9) refers to reliable and good data about fisheries, others acknowledge imprecise and unreliable data (I6, I7) for income effects for fisheries and issues about being accused of using wrong data (I7) and the need for gathering independent data to ‘really’ understand impacts (I18). Hence, across countries the need to collect reliable data and make better analysis about fisheries is emphasized, as described by a Portuguese researcher (I18): “We.have.also.to.make.better. analysis.about.fisheries.because.they.are.many.times.based.on.statistics.that.are.not.good. enough.and.about.interviews.with.fishermen.that.not.always.give.very.nice.information¡.So.we. have.to.get.independent.data.about.the.fisheries.to.really.understand.the.impacts.that.are. happening.with.that.component¡.That.is.one.of.the.most.important.ones?of.course?in.social. terms‹ (I18).

In contrast to limited information on income data, information on the geographical location of fishing areas is better documented. As explained by a Danish consultant: »Assessing.impacts. on.fisheries.is.actually.easier?because.we.have.really.good.fisheries.data¡.In.Denmark?we.know. exactly.where.fishing.takes.place?what.is.being.caught?and.in.what.quantities?so.fisheries. assessments.are.among.the.easier.assessments.to.carry.out‹ (I9).

In a Danish context there is a tendency towards an avoidance of dealing with fisheries concerns in EIARs. Even though fishing is an important sector in Denmark, fisheries are rarely examined in depth in environmental impact assessments. This is mainly due to mandatory compensations for fisheries when they are affected by the siting OWFs. As a result, a thorough consideration impacts on fisheries are often avoided in assessments, with compensation used as a solution instead. However, this avoidance does not solve the underlying issues but bypasses them. Hence, there is significant institutional pressure and sensitivity around critically assessing this sector, which complicates efforts to evaluate their true environmental and socio-economic impacts (I7). In addition, an interview has raised the issues that compensation should go to individual fishermen and businesses, but are sometimes made to fishing organisations, which then distribute compensations locally, but this is not always monitored by developers (I6). Furthermore, another consultant from Denmark questioned whether compensatory practices can be maintained in the future when more fishing activities are displaced (I7).

Assessments in the UK are also meant to struggle with socio-economic cumulative impacts on fisheries and necessary methods, other than calling for mapping and dialogue tools due to a lack of sufficient data. As explained by a British organization (I 24): »Realistically.speaking?what. you've.got.to.do.is.accurately.map.the.fishing.activity.in.your.zone?which.is.actually.quite.hard. because.of.lack.of.data.and.people.lying¡.You've.basically.got.to.try.and.work.out.who.is.actually. genuinely.impacted¡.Can.they.coexist?.If.they.can't.coexist?why.can't.they.coexist?.Because.it's. rarely.that.you.can't.fish.at.all‹ .(I24). Hence, due to gaps in cumulative assessments, impacts on fisheries and cumulative impacts related to a large-scale displacement of fisheries need to be studied with the aim of gathering more evidence (I24).

Landscape and visual impact

Another important issue raised in 10 interviews relates to landscape and visual impacts. Across countries, the usefulness of the visualisation method is questioned. The common recognition is that visual effects from OWF are subjective (I7, I15, I21, I23) and that visualisations do not change that. Whether or not wind turbines can be seen from land, people may be against them (I21). In some countries, this reluctance is reinforced by the lack of legal rules for distance of OWF to land (as mentioned for Ireland and Denmark).

In the UK, the assessment of visual impacts usually draws on the same approach including the assessment of ZTV, which is considered a well-established and advanced method (I24). Yet, in a Danish context visualisations appear as highly conflicted. People are often seen as questioning why and how visual impacts are being assessed at all as there are no actual rules or thresholds for how much visual impact is allowed. As explained by a Danish consultant: »One.of.the.things.that.has.been.brought.up.almost.at.all.public.meetings.is.that.people.have.a. very.hard.time.understanding.that.in.Denmark.we.do.not.have.any.limits.for.the.visual.impacts. offshore¡.We.have.spatial.planning.laws.and.landscape.protection.on.land?but.as.soon.as.we. go.offshore?you.can.put.a.turbine.very.close.to.shore?whereas.on.land.you.would.never.get.a. permit.for.that.because.there.are.multiple.rules.preventing.that‹ (I7). This hints at a discrepancy between standardised approaches and subjective judgements and perceptions. Consequently, people have difficulties understanding why visual impacts should be assessed if there are no actual rules, limits or threshold for the acceptable magnitude of visual impacts (I4, I7).

However, it has also been mentioned that visual impacts become only relevant for nearshore wind farms and that most wind farms are nowadays placed far offshore so that they are out eyesight and no longer visually intrusive (I24, I7).

Tourism

Impacts on tourism were mentioned by seven interviewees. Tourism impacts were causally connected to landscape and visual impacts (I1, I19, I23) as visible offshore wind turbines are feared to spoil the view resulting in economic losses for touristic areas. However, several people (I24, I32, I34) also hinted at the fact that there is no proven evidence for OWF having detrimental effects on tourism, while this evidence is at the same time poorly documented and there is a need for more follow-up assessments (I24, I32, I34). Thus, there is a general perception that the fear of OWF affecting tourism is not in line with reality. However, this perception appears more as subjective observations than actual fact-based surveys which are not included in EIAs in some of the countries concerned, thus confirming the lack of valid data in socio-economic impacts assessment. The same applies to more positive considerations about the potential that OWF may have for tourism - including sightseeing and the opportunity to have a picnic in the wind farm on a boat. Interviewees also hint at OWFs as a factor that attracts tourists (I22, I24).

Likewise, the possibility that coastal communities could economically benefit from OWF developments has not been proven, so it is also difficult to include this as a potential cumulative effect. As described by a Danish Consultant: »People.also.tend.to.want.to.describe?. saying?.oh?.we''re.gonna.have.these.thousands.new.jobs.on.the.port?.like.maintenance.and. whatever¡.And.I''m.also.not.really.sure.that''s.something.that.is.being.well_documented¡.More. often.than.not?.I.think?.it''s.simply.some.numbers.being.written.in.the.project.description.initially. by.the.developer?.more.than.it''s.something.that.is.practice_based" (I32). There is a strong call for more studies on correlations between things like hotel occupancy rates, car park receipts from councils, tourism numbers, which could be used as empirical evidence to demonstrate tourism recreation effects from nearshore wind farms are overestimated and not significant (I 24).

Shipping/Navigation

Shipping was mentioned by 6 interviewees (I3, I7, I14, I15, I24) but unlike fisheries, it was merely listed as a socio-economic issue that is considered in SEA and EIARs. Also, newcomer countries do not assume conflicts with shipping routes to become a big issue (I15). Rather, navigation conflicts were indicated by interviewees as avoidable through marine spatial planning and project design, where major shipping routes are considered when identifying suitable areas for OWF (I24). An Estonian stakeholder noted that »the.main.shipping.roads.

should.be.free.of.wind.farms?but.local.boats.definitely.will.have.to.sail.differently‹ (I15). Hence, interviewees did not discuss navigation and shipping in terms of livelihood compensation, conflicts, or social acceptance, but as a statutory consideration that authorities need to consider before operation. For example, an Irish state agency worker noted that under the Marine Area Planning Act, authorities must consider "the rights of navigation" as part of the project assessment (I3).

Cultural heritage

Cultural Heritage has received comparatively little attention during the interviews, being discussed in detail by only one UK consultant from the UK. According to the interviewee, heritage assessments rely on a well-designed scheme of investigations, scanning, and survey sampling. Essentially, this approach identifies anomalies, and exclusion zones are placed around them. Investigations are very expensive, so the normal approach is avoidance in the first instance, and investigation only if necessary. If there is something that cannot be avoided, divers can be sent down to investigate underwater sites of interest because, as described by a consultant: »when.looking.at.radar.data.alone?it.is.impossible.to.know.whether.something.is. just.dropped.fishing.tackle.or.a.rare.wreck‹ (I24).

The interviewee also suggested that OWF may generate positive outcomes for cultural heritage, as heritage survey work has contributed to the discovery of previously unknown heritage, which is deemed to have affected the public opinion positively. Surveys undertaken for offshore wind projects have identified artefacts and unlocked knowledge that would otherwise have remained undiscovered, and since protected wrecks and similar features can be identified through radar and avoided, damage is generally limited (I24).

Benefits

There is a consensus that there are very few economic benefits for local communities in the start-up phase. The turbines are often produced in other geographical locations and not many locals are needed to maintain them, so direct job creation is deemed minimal and not well-documented (I32). Among the more experienced OWF countries, the importance of the capital infrastructure provided by OWF development is instead pointed out, as it can be used to invest in local infrastructure, including smaller ports (I24), and is perceived as one of the most significant socio-economic benefits of OWF »It.was.the.capital.infrastructure.that.went.in.to. upgrade. the. little. port? which. then. everyone. benefits. from? the. fishermen? the. tourists? recreational.users?because.once.you.repair.the.quay?it's.repaired.for.everyone?not.just.for.you¡‹ . (I23). There is a perception that there is far too little focus on this long-term potential in EIAs, which instead focuses on the immediate effect in terms of job creation. As described by a British consultant: "The. first. big. socio_economic. benefits. I. saw. was. the. regeneration. and. improvement.of.capital.infrastructure.in.small.ports¡.You.see.that.even.more.with.the.bigger. ports.where.they've.developed.wind.clusters?like.on.the.East.Coast.– –where.they.really.had.a. deteriorating.infrastructure.from.historically.collapsed.fishery.or.shipbuilding.or.whatever.the. local.industry.is¡.Then.this.gives.them.a.new.lease.of.life" (I24).

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Apart from the infrastructure development, other interviewees highlight the potentials of co-existence of fisheries and OWF »There.is.a.lot.of.discussion.regarding.impacts.on.fisheries.but.depending.on.the.gear.and.depending.on.the.size.of.the.ship?there.are.already.examples.of.coexistence.and.fishing.ships.that.can.operate.in.a.more.or.less.limited.way.inside.the.wind.farm¡.It's.not.necessarily.a.full.exclusion.or.a.full.exclusion.for.just.going.through¡.The.surface.of.the.area.is.so.small.compared.to.the.rest.of.the.sea‹ .(I20). However, the main potential positive impact for the fishing communities still revolves around employment opportunities for fishing communities in terms of monitoring the OWF: "Who.better.to.monitor.that.than.people.who.know.the.environment.very.well?.So?you.can.use.the.fishing.community¡.Their.vessels.can.be.used. for. monitoring. and. so. consider. that. as. a. social. gain¡. There. will. be. employment.opportunities.as.well.within.the.wind.park.itself‹ .(I5).

Similarly, there is a demand for greater insight, including more research, into the potential benefits that offshore wind infrastructure may provide, both from a socio-economic perspective and potentially from an ecological perspective. This area is by three interviewees claimed to be missing a substantial amount of research, which constrains OWF developments to operate advantageously in terms of supporting both environmental and community benefits (I6; I23; I33).

The lack of documentation of effects also questions the more positive cumulative effects of OWF on coastal communities. As the possibility that coastal communities could economically benefit from OWF development cannot be scientifically proven, it is difficult to include this as a potential cumulative effect. As described by a Danish Consultant: "People.also.tend.to.want.to. describe? saying? oh? we're. gonna. have. these. thousands. new. jobs. on. the. port? like. maintenance.and.whatever¡.And.I'm.also.not.really.sure.that's.something.that.is.being.well_documented¡.More.often.than.not?I.think?it's.simply.some.numbers.being.written.in.the.project.description.initially.by.the.developer?more.than.it's.something.that.is.practice_based" (I32).

An example of a possible alternative to compensation models highlighted across countries is the use of community funds. In general, there is recognition of the need to better understand specific needs of local communities and strengthen their democratic influence. Experiences from onshore wind are being looked at and it is pointed out that a growing use of such funds is also gaining ground in offshore wind.

Annex 3. Overview of interviewees and affiliations

The overview below lists those interviewees, who addressed socio-economic impacts.

Code	Affiliation	Country
I1	Consultancy	Ireland
I2	State agency/research/advisory	Ireland
I3	State agency	Ireland
I4	Planning Authority, consenting	Ireland
I5	Government body	Ireland
I6	Developer	Denmark
I7	Consultant	Denmark
I8	State agency	Denmark
I9	Consultant	Denmark
I14	Government body	Estonia
I15	Government body	Estonia
I18	Research centre	Portugal
I19	Government body	Portugal
I20	Advisory organisation	Spain
I21	Research centre	Spain
I23	Developer	UK
I24	Consultant	UK
I32	Consultancy	Denmark
I33	Research centre	Spain
I34	Researcher/consultant	UK
I35	Local Authority	Estonia

Annex 4. Overview of SEA and EIA reports

Code	Country	Project/Plan
DK1	Denmark	Hesselø OWF
DK2	Denmark	Aflandshage OWF
DK3	Denmark	Thor OWF
SC1	Scotland	Berwick Bank OWF
SC2	Scotland	Inch Cape OWF
SC3	Scotland	Sectoral Marine OW Plan - Social & Economic Assessment
ES1	Spain	Tramuntana OWF
ES2	Spain	GREGAL OWF
DE1	Germany	NC 1 project site
DE2	Germany	NC 3 project site
DE3	Germany	Spatial Plan North Sea
IE1	Ireland	Dublin Array OWF
IE2	Ireland	Oriel OWF
EE1	Estonia	Saare Wind Energy OWF
EE2	Estonia	Saare-Liivi OWF

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