



WENDY aims at unravelling the factors triggering social acceptance of wind farms through an in-depth analysis at three dimensions: social sciences and humanities, environmental sciences and technological engineering.

## **D2.4: Challenges and needs for increasing social acceptance and enhancing participation in wind energy projects**

**WP2, T2.4**

**Task 2.4 partners**

**Leading partner: WR**

**Participants: EGP, NOWC, MEC, Q-PLAN**

## Technical Preferences

---

Project Acronym	WENDY
Project Title	Multicriteria analysis of the technical, environmental and social factors triggering the PIMBY principle for Wind technologies
Project Coordinator	CIRCE FUNDACION CIRCE CENTRO DE INVESTIGACION DE RECURSOS Y CONSUMOS ENERGETICOS <a href="mailto:jperis@fcirce.es">jperis@fcirce.es</a>
Project Duration	Oct. 2022 – Sep. 2025 (36 months)
Deliverable No.	D2.4
Dissemination level*	PU
Work Package	WP2 – Preparatory studies related to turbines’ social acceptance and wind energy citizenship
Task	T2.4 – Definition of challenges for increasing social acceptance and enhancing participation in wind energy projects
Lead beneficiary	2 (WR)
Contributing beneficiary/ies	4 (EGP), 5 (NOWC), 6 (MEC), 9 (Q-PLAN)
Due date of deliverable	30 September 2023
Actual submission date	29 September 2023

- PU – Public, fully open
- SEN – Sensitive, limited under the conditions of the Grant Agreement
- Classified R-UE/EU-R – EU RESTRICTED under the Commission Decision No2015/444
- Classified C-UE/EU-C – EU CONFIDENTIAL under the Commission Decision No2015/444
- Classified S-UE/EU-S – EU SECRET under the Commission Decision No2015/444

## Disclaimer of warranties

---

“This project has received funding from the Horizon Europe Framework Programme (HORIZON) under Grant Agreement No 101084137”.

This document has been prepared by WENDY project partners as an account of work conducted within the framework of the EC-GA contract no 101084137.

Neither Project Coordinator, nor any signatory party of WENDY Project Consortium Agreement, nor any person acting on behalf of any of them:

- (a) makes any warranty or representation whatsoever, expressed, or implied,
  - (i). with respect to the use of any information, apparatus, method, process, or similar item disclosed in this document, including merchantability and fitness for a particular purpose, or
  - (ii). that such use does not infringe on or interfere with privately owned rights, including any party's intellectual property, or
  - (iii). that this document is suitable to any particular user's circumstance; or
- (b) assumes responsibility for any damages or other liability whatsoever (including any consequential damages, even if Project Coordinator or any representative of a signatory party of the WENDY Project Consortium Agreement, has been advised of the possibility of such damages) resulting from your selection or use of this document or any information, apparatus, method, process, or similar item disclosed in this document.



Funded by the  
European Union

*Funded by the European Union. Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.*

© WENDY Consortium, 2022

Reproduction is authorised provided the source is acknowledged.



Funded by the European Union. Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the European Climate, Infrastructure and Environment Executive Agency (CINEA) can be held responsible for them.

## WENDY project's abstract

WENDY aims at unravelling the factors triggering social acceptance of wind farms through an in-depth analysis at three dimensions: social sciences and humanities, environmental sciences and technological engineering. For that, the project will implement a series of local actions promoting the wider adoption of the project solutions, including guidelines, reports and handbooks which will be created to boost the understanding of wind farms decision making processes and enhance energy citizenship. This will be supported by the spatial multi-criteria WENDY toolbox. A tool able to identify the optimal turbines' siting with the minimum environmental impact and highest social acceptance likelihood. All developed models, methods, guidelines and tools will be implemented within 10 wind projects spread across 4 countries. These have been selected considering: geography (north vs. south Europe), maturity stage (viability phase / planning phase / short-term operation phase / long-term operation phase); type of wind energy (onshore / offshore – floating, fixed-); and co-existence with other activities (agriculture, fisheries, energy communities). In these locations, outreach activities tailored to their specificities will be performed, creating the WENDY Knowledge Hubs which will incorporate citizens, local authorities, business owners and value chain actors of wind energy. WENDY Hubs will serve as a baseline for the WENDY Knowledge Exchange Platform, a forum that will be developed to facilitate the exchange of knowledge between decision makers and key stakeholders within wind farms planning processes. For a successful implementation of the project activities, all the value chain and the best-in-class expertise is involved in the project consortium including 9 partners from 6 European countries: 1 Large Company (EGP), 2 SMEs (WR, Q-PLAN), 1 University (CBS), 2 RTO (CIRCE, NINA), 1 Energy Community (MEC), 2 Non-profit organisations and associations (NOWC, APPA).

## List of the WENDY's consortium partners

No	Full name	Short name
1	FUNDACION CIRCE CENTRO DE INVESTIGACION DE RECURSOS Y CONSUMOS ENERGETICOS	CIRCE
2	WHITE RESEARCH SRL	WR
3	STIFTELSEN NORSK INSTITUTT FOR NATURFORSKNING NINA	NINA
4	ENEL GREEN POWER SPA	EGP
5	MARIN ENERGI TESTSENTER AS	NOWC
6	ENERGEIAKI KOINOTITA ANATOLIKIS KRITIS	MEC
7	COPENHAGEN BUSINESS SCHOOL	CBS
8	ASOCIACION DE EMPRESAS DE ENERGIAS RENOVABLES - APPA	APPA
9	Q-PLAN INTERNATIONAL ADVISORS PC	Q-PLAN

## Time-plan of Task 2.4 and its resulting deliverable 2.4

Action	Description	Planned time		Responsible
1	Stakeholder identification	M6	M6	WR, Pilot partners
2	Prepare detailed methodology guidelines	M6	M6	WR
2a	<i>Prepare templates and picklists for Challenges (a) and Needs (b) for regional stakeholders by types/relevance/expertise</i>	M6	M7	WR, Q-PLAN
2b	<i>Feedback on templates from other pilot partners</i>	M6	M7	Pilot partners, Q-PLAN
3	kick-off: explain methodology, present templates, agree on deadlines	M8	M8	WR
3a	<i>Round 1 complete templates of each Pilot region (without consulting D2.1-3)</i>	M8	M9	WR, Pilot partners, Q-PLAN
3b	<i>Round 2 complete templates of each Pilot region (with draft of D2.1-3)</i>	M9	M10	WR, Pilot partners, Q-PLAN
3c	<i>Round 3 each Pilot region validation with local stakeholders</i>	M10	M11	WR, Pilot partners, Q-PLAN
3d	<i>Pilot meetings to define Intervention actions - &gt; preliminary regional action plan</i>	M11	M11	WR, Pilot partners, Q-PLAN
4	Consolidation of information	M11	M12	WR
5	Draft of D2.4 deliverable	M11	M12	WR, Pilot Partners, Q-PLAN
6	Quality review of D2.4	M12	M12	D2.4 Reviewers
7	Finalisation of D2.4	M12	M12	WR

## Authors

First Name	Last Name	Beneficiary*
Michail	Ntovas	WR (Task 2.4 Leader)
Anastasios	Tsakas	WR (Task 2.4 Leader)
Silvia	Masci	EGP
Christopher	Harman	NOWC
Martine	Farstad	NOWC

First Name	Last Name	Beneficiary*
Dimitrios	Katsaprakakis	MEC
Nikolaos	Papadakis	MEC
Eirini	Dakanali	MEC
Evangelos	Genitsaris	Q-PLAN
Kosmas	Vamvalis	Q-PLAN
Prodromos	Gkalimanis	Q-PLAN

*\*The order of the names of partners, excluding the Task leader (WR), follows the order mentioned in the description of Task 2.4 in the DoA: EGP, NOWC, MEC, Q-PLAN.*

*In case you want any additional information, or you want to consult with the authors of this document, please send your inquiries to: [mntovas@white-research.eu](mailto:mntovas@white-research.eu)*

## Acknowledgements

We sincerely express our gratitude and acknowledgement to Ana Talayero Navales (CIRCE) for her voluntary contribution, providing invaluable support to partner EGP in the pilot-level analysis of the WENDY Spain pilot case. Also, we sincerely express our gratitude and acknowledgement to all participants who were involved in the local evaluation process, providing valuable insights and helping us to gain an in-depth understanding of the regional needs and challenges of the pilot cases.

## Quality Reviewers

First Name	Last Name	Beneficiary
Evangelos	Genitsaris	Q-PLAN
Jonatan Peris	Rivas	CIRCE

## List of abbreviations

Abbreviation	Full name
CA	Consortium Agreement
CEC	Citizen Energy Community
DoA	Description of Action
EC	European Commission
EEZ	Exclusive Economic Zones

Abbreviation	Full name
EIA	Environmental Impact Assessment
EU	European Union
GA	Grant Agreement
LCOE	Levelized Cost of Energy
NIMBY	Not In My BackYard
NVE	Norwegian Directorate of Water Resources and Energy
OED	Norwegian Ministry of Petroleum and Energy
PESTLE	Political, Economic, Sociological, Technological, Legal and Environmental
PNIEC	National Energy and Climate Plan
WP2	Work Package 2
WTG	Wind Turbine Generator

## Executive summary

Task 2.4 provides an overall analysis of the wind farms' acceptance and participation challenges and needs at the pilot and EU level through working group sessions and by cross-fertilising the outcomes of T2.1, T2.2 and T2.3. WR, Task 2.4 Leader, with the support of the pilot and project partners, led the development of this consolidated report, which covers three topics:

- a. **Definition of regional challenges:** we provide a set of aspects that hinder wind energy citizenship and challenge the harmonious co-existence of turbines and local communities;
- b. **Definition of needs:** we categorise the needs of regional stakeholders based on their type, relevance and expertise on wind energy initiatives, highlighting – for each pilot case – the type of examined wind farm and geographical specificities.
- c. **Preliminary identification of intervention areas:** The information gathered served as input for a prioritization procedure aimed at addressing specific actions and stakeholders. Consequently, this report identifies initial intervention areas to focus for the pilot areas.

For the final development of this report, an evaluation process applied at local level helped to co-define and co-validate the above with key regional actors. In some pilot areas, specific actions were identified and assigned to different stakeholders, while in other pilots the actions were considered from a regional perspective. In some pilots, there were not the same actions in all intervention areas because there were not the same critical needs or challenges that required this type of intervention.

While numerous interventions are tailored to specific pilot areas, there are certain shared components: *1) Develop robust policy frameworks involving local and national government/authorities and stakeholder cooperation, 2) Promote economic growth, job creation, and investment attraction with support from local government/authorities and wind energy providers, 3) Actively engage communities through transparent dialogue, fair compensation, and equitable benefit sharing, 4) Focus on improving wind turbine efficiency via research and development with the participation of multiple stakeholders, 5) Establish, communicate, and enforce clear legal guidelines and standards for wind energy projects with collaboration from legal experts and stakeholders and 6) Ensure environmental protection through comprehensive assessments, stakeholder involvement, eco-friendly practices, and effective coordination throughout the project lifecycle.*

In the framework of revisiting and distilling the outputs of the previous Tasks of WP2, we conducted, among others, a second round of evaluation of the analysed lighthouse wind farm cases. In this report, we have included the final ranking of the best identified

wind farm cases in D2.1, which was given as an assignment to the T2.1 partners. The final ranking of wind farm cases can be found in Section 1.3 of this report. Finally, we conducted a triangulation of the D2.3 results from different sources, e.g. pilot-level surveys, semi-structured interviews with key stakeholders and an EU-level survey via a crowdsourcing platform conducted in Task 2.3. Through the triangulation of data, common themes and overlaps were found in relation to wind farm acceptance and participation, such as: *1) economic benefits as a key driver, 2) environmental concerns and public perception, 3) negative public perception and NIMBY opposition, 4) importance of transparent communication, 5) local authority involvement, 6) regulatory challenges, 7) health and aesthetic concerns, 8) institutional trust and 9) community involvement.*

## Table of contents

<b>1. Introduction</b>	<b>12</b>
1.1. Objective of Task 2.4	12
1.2. Background information	12
1.3. Ranking of best wind farm cases identified in D2.1	23
1.4. Triangulation of D2.3 results	28
1.5. Task overview and methodology	31
1.5.1. Indicative clustering of intervention areas	32
<b>2. Pilot-level analysis</b>	<b>35</b>
2.1. Spain pilot case	35
2.1.1. Regional needs and challenges	35
2.1.2. Definition of intervention areas	40
2.2. Italy pilot case	41
2.2.1. Regional needs and challenges	42
2.2.2. Definition of intervention areas	47
2.3. Norway pilot case	49
2.3.1. Regional needs and challenges	50
2.3.2. Definition of intervention areas	55
2.4. Greece pilot case	57
2.4.1. Regional needs and challenges	57
2.4.2. Definition of intervention areas	63
<b>3. EU-level analysis</b>	<b>66</b>
3.1. Identified needs	66
3.2. Identified challenges	69
3.3. Intervention areas	72
<b>4. Conclusions</b>	<b>74</b>
<b>5. References</b>	<b>76</b>
<b>6. Annex</b>	<b>77</b>
6.1. Picklist for needs and challenges	77
6.2. Stakeholder groups used for the analysis	79
6.3. Example – notes from the needs/challenges assessment of the working group in the Norwegian pilot case	80

**6.4. Wind farm rating based on four key criteria .....83**  
**6.5. Exploitation potential of D2.4 results and findings .....86**

### List of Tables

Table 1: Key aspects of consideration identified per pre-defined dimension (theme).  
 ..... 15  
 Table 2: Drivers and barriers of public acceptance and participation in wind turbines development based on the desk research findings. ....22  
 Table 3: Wind farm ranking (2nd evaluation round).....24  
 Table 4: Summary of the needs identifies in the Spanish pilot case .....37  
 Table 5: Summary of the challenges identified in the Spanish pilot case.....39  
 Table 6: Summary of the needs identified in the Italian pilot case .....43  
 Table 7: Summary of the challenges identified in the Italian pilot case .....47  
 Table 8: Summary of the needs identified in the Norwegian pilot case.....51  
 Table 9: Summary of the challenges identified in the Norwegian pilot case .....54  
 Table 10: Summary of the needs identified in the Greek pilot case.....59  
 Table 11: Summary of the challenges identified in the Greek pilot case .....62  
 Table 12: Summary of the needs identified at EU level .....68  
 Table 13: Summary of the challenges identified at EU level..... 71  
 Table 14: Spider graphs (quadrant plots) depicting the rating of wind farms based on four key criteria. ....83

### List of Figures

Figure 1: Map of the analysed 25 best wind farm cases across the EU in Task 2.1, numbered in alphabetical sequence..... 14  
 Figure 2: Integrated evaluation methodology approach applied throughout Task 2.1 & Task 2.4.....15  
 Figure 3: Methodology followed for Task 2.3 which includes desk research, pilot and EU level survey, semi-structured interviews and cross-fertilisation analysis. ....23  
 Figure 4: Spider graphs based on the ownership model depicting the average rating scores for the four evaluation criteria. ....26  
 Figure 5: Wind farm cases’ total average score for the 1<sup>st</sup> and 2<sup>nd</sup> evaluation round. 27  
 Figure 6: Schematic of the methodology followed in Task 2.4. ....31

# 1. Introduction

---

## 1.1. Objective of Task 2.4

T2.4 will provide an overall analysis of challenges and needs regarding wind farms' acceptance and participation at the WENDY pilot cases and EU level, by cross-fertilising outcomes of T2.1, T2.2 and T2.3.

This assessment allowed each pilot partner to identify preliminary intervention areas to be covered by specific actions. In this way, this consolidated report helps prioritizing which aspects need to be improved or strengthened and which approach should be taken.

## 1.2. Background information

Several previous deliverables have been used into this one, that are the following:

### ***D2.1: Lighthouse wind farms across Europe: impact and best practices***

The deliverable D2.1 was developed in the frame of Task 2.1, within the first technical Work Package 2 (WP2) of the WENDY project. The aim of Task 2.1 was to identify and retrieve lessons learnt from lighthouse wind farms that harmoniously coexist with- and encourage the participation of local communities. For this purpose, a comprehensive mapping exercise of both onshore and offshore lighthouse wind energy projects across the EU was conducted. The key insights from the report (D2.1) resulted from Task 2.1 contributed to establishing the basis of the key conditions towards wind energy acceptance at the European level.

To begin with, an initial exploration of the basic and fundamental concepts regarding the social acceptance of wind energy was conducted with the aim of establishing a shared understanding and a solid foundation upon which we could build our work. This included the provision of definitions of specific terms used throughout our research process. In line with the DoA and based on the literature, a wind farm can be considered as “good” (“lighthouse”) when it fosters sustainable development (society, economy, environment), while ensuring fair and equitable distribution of its benefits. These four (4) key criteria were chosen to serve as the fundamental principles for the identification of exemplary wind farm cases. Furthermore, these four criteria were further broken down and analysed across 13 dimensions (sub-criteria) that provide more specific details and context regarding their content and significance: *well-being aspects, local opposition, co-existence, employment, financial gains and benefits, local*

*value enhancement, distributional justice, social ownership models, information level, local participation, transparency, ecosystem and wildlife, climate neutrality, land diversion.*

The impact and best practice analysis of the best wind farm cases followed a structured approach and consisted of four main stages: identification, evaluation, selection, in-depth analysis, and cross-fertilisation synthesis. Firstly, through preliminary identification and brief reporting, the involved partners identified 44 good practice examples of wind farm cases. Afterwards, an evaluation process was adopted and followed for the rating, ranking, and final shortlisting of the wind farm cases that have been initially identified by the partners. Based on the evaluation outcome, and by additionally taking into consideration other important parameters, the final selection/shortlisting of the best 25 wind farm cases to be analysed, was decided in the framework of a dedicated interactive workshop among the involved partners.

The best wind farm cases were analysed in-depth by conducting desk research, as well as field research in the form of targeted interviews with key stakeholders, whenever necessary. The desk research comprised the basic component of our research process that involved gathering data and obtaining information from various existing, available, and accessible sources. Whenever necessary, partners were encouraged to reach out individuals representing a key stakeholder of a wind farm case. The targeted interviews covered knowledge gaps, or supplemented and verified our findings and the already existing knowledge. They were conducted following a semi-structured approach, based on a recommended questionnaire structure that included predetermined thematic questions.

The retrieved information established the knowledge baseline for the WENDY project in a story-board format with insights and lessons learnt. The analysis of the best wind farm cases included information regarding their background context and their impact on the local community and was organised in the four (4) main aspects/criteria defined: i) environment, ii) society, iii) economy, and iv) procedures and justice. Based on this in-depth analysis, a summary of each best wind farm case was created, capturing key information. The summary was presented in the form of a graphic-style template (identity card), which included basic details, challenges and barriers, enablers, impact, a timeline, and a spider graph representing the evaluation ratings provided by the partners.

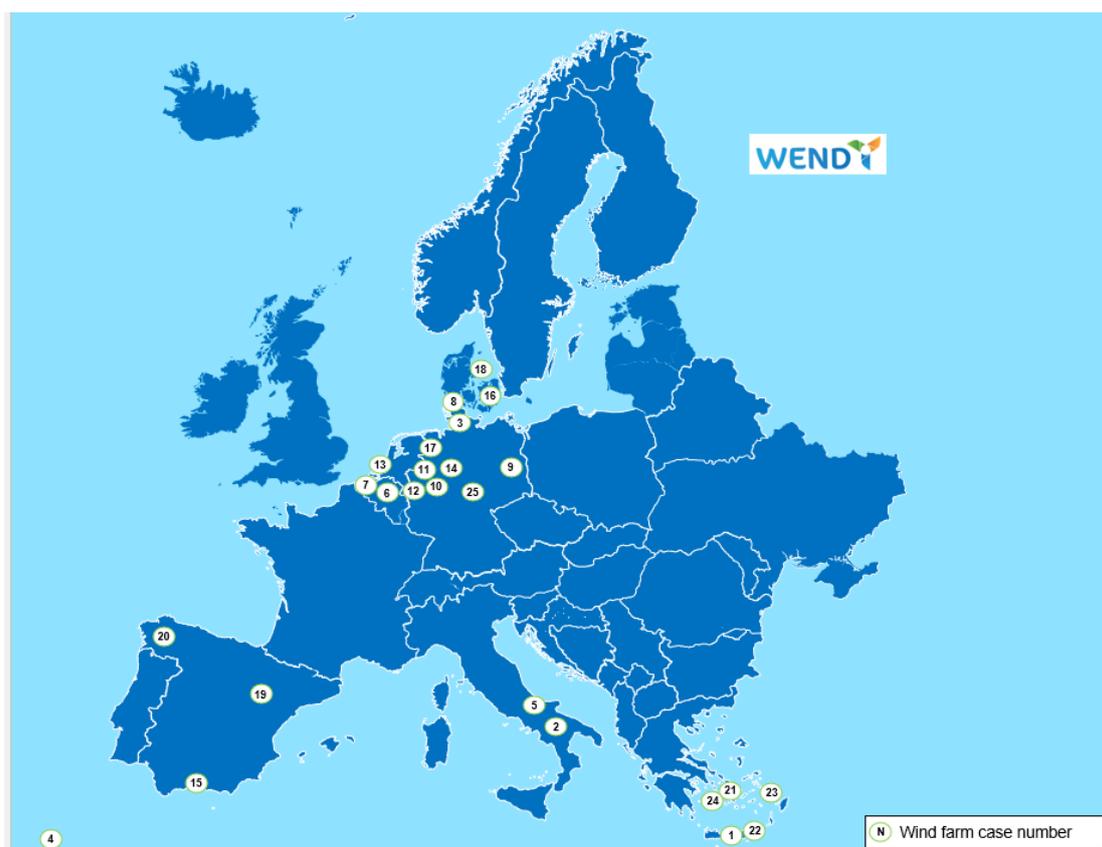


Figure 1: Map of the analysed 25 best wind farm cases across the EU in Task 2.1, numbered in alphabetical sequence.

Within Task 2.4, partners thoroughly examined the comprehensive analysis reports of the 25 wind farms. Subsequently, they proceeded with a second round of evaluation by rating these in-depth analysed 25 cases that were shortlisted during the dedicated interactive workshop-meeting of Task 2.1. At least one representative from each partner involved in the 1<sup>st</sup> round of the evaluation (Task 2.1 partners), participated in this assessment. Employing a rationale akin (though not identical) to the Delphi technique, during this assessment phase, evaluators could observe the average total scores of all 25 cases in the assessment template. These scores were established in the initial evaluation round and were assigned based on the four criteria. The objective of sharing the initial scores with evaluators in this iterative and structured approach was to facilitate conditions for consensus-building in rating. The partners were allowed to change their initial evaluation rating for each case by taking into account the “collective” opinion of all partners in the first round. This process allowed participants to rethink and reconsider their initial decision.

The figure below illustrates the integrated methodology approach used in Tasks 2.1 and 2.4 regarding the identification, analysis and evaluation of the 25 lighthouse wind farm cases.

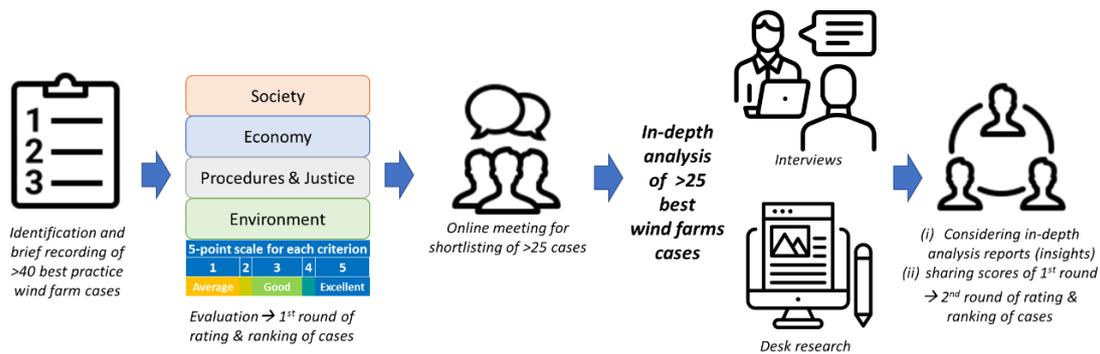


Figure 2: Integrated evaluation methodology approach applied throughout Task 2.1 & Task 2.4.

In addition, within Task 2.1, a cross-fertilisation synthesis was conducted to distil key insights and consolidate main findings from the comprehensive analysis of the selected best wind farm cases. This synthesis process informed the analysis of the main themes, which were defined as six key dimensions of analysis in the DoA. By thoroughly and systematically reviewing and revisiting the gathered data and information material for the wind farms cases, we identified meaningful patterns within each dimension/theme. As a result, specific “aspects of consideration” (sub-themes) emerged associated with each dimension.

The findings were analysed and presented in textual form, capturing the key insights and observations from the analysis of the 25 best wind farm cases. In order to facilitate a comprehensive overview of the compliance and alignment of these cases with the identified indicative “aspects of consideration,” tabular forms were utilised. These tables serve as filters to categorize and organise the information, enabling a structured overview of how each wind farm case aligned with these specific aspects of consideration. This approach enabled a systematic evaluation and comparison of the cases based on the identified criteria.

Table 1: Key aspects of consideration identified per pre-defined dimension (theme).

Pre-defined Dimensions (“themes”)	Aspects of consideration
Socio-economic impact	<ul style="list-style-type: none"> <li>Engagement and involvement</li> <li>Community benefits</li> <li>Local economic benefits</li> <li>Co-existence with other projects</li> <li>Health &amp; social well-being</li> </ul>
Environmental impact	<ul style="list-style-type: none"> <li>Site selection</li> <li>Environmental compensation</li> <li>Climate change</li> <li>Wildlife protection</li> <li>Noise mitigation measures</li> </ul>

Pre-defined Dimensions (“themes”)	Aspects of consideration
Business models and participatory processes established	<ul style="list-style-type: none"> <li>▪ Social ownership model</li> <li>▪ Hybrid ownership model</li> <li>▪ Corporate ownership model</li> </ul>
Co- benefits and financial gains at the community level	<ul style="list-style-type: none"> <li>▪ Local economy impact</li> <li>▪ Employment rate</li> <li>▪ Social welfare</li> </ul>
Employed practices used to increase community acceptance	<ul style="list-style-type: none"> <li>▪ Local engagement and mobilisation</li> <li>▪ Citizen ownership and participation</li> <li>▪ Environmental protection measures</li> <li>▪ Financial benefits to the municipality</li> <li>▪ Supportive policies and legislation</li> </ul>
Main challenges faced	<ul style="list-style-type: none"> <li>▪ Social acceptance and opposition</li> <li>▪ Regulatory and authorisation</li> <li>▪ Environmental and health impacts</li> <li>▪ Financing and investment</li> </ul>

Deliverable 2.1 encompasses various aspects that should be considered for fostering the social acceptance of wind energy projects. The best wind farm cases selected have not only taken proactive measures to address potential challenges during the planning phase but have also effectively resolved issues that may have arisen after the project was implemented.

Through our research activity, several essential concluding remarks have been outlined, summarizing the key findings generated from the analysis of wind farm cases.

- The storytelling of our research shed light on the challenges we encountered throughout our research process.
- Considering various types of ownership models enabled us to gain valuable insights for social acceptance in wind farm projects.
- The analysed wind farm cases exhibit significant differentiation from one another and in relation to the social acceptance practices they prioritise.
- The true strength of our research process lied in generating an informed “systemization” of the existing knowledge and understanding.
- Another unique point of our research was the active involvement of two wind farm developers in the implementation of the Task 2.1.
- Addressing at least one field of intervention is crucial for achieving social acceptance in a wind farm project.

- Multi-dimensionality of wind farm cases highlights the complexity of our research and its limitations.
- Proactively considering multiple factors and employing a bouquet of practices to foster social acceptance is important.
- A tailored approach based on a pool of alternative approaches is needed to meet the local needs of any unique wind farm case.
- Ongoing and long-term efforts to build and maintain social acceptance are essential from the very beginning.
- Various areas for potential future research related to and extending beyond our analysis can be suggested.
- Contrary to the inherent limitations of our research, the transferability potential of the identified good practices of social acceptance is unlimited.

These concluding remarks provide interesting insights and reflections on the research conducted and contribute to the broader understanding of social acceptance in the context of wind farm projects.

### ***D2.2: Regional and EU framework conditions affecting turbines' social acceptance***

D2.2 outlines the framework for assessing the social acceptance of wind energy projects within the WENDY project. It falls under Work Package 2, focusing on the social acceptance of wind turbines and wind energy among citizens. Task 2.2 specifically involves mapping the regional and EU conditions that influence the acceptance of wind turbines. The primary goals are to identify the factors that drive social acceptance and the barriers to wind energy acceptance at regional, national, and European levels. The study analyses European directives and their implementation in EU Member States, while also considering recommendations for promoting public participation. Additionally, it aims to examine the implementation of European directives and recommendations in four pilot regions and assess regional regulations impacting wind farm development, with a focus on citizen participation throughout the various phases of wind farm projects, from planning to licensing and development.

#### **EU level**

Directive 2018/2001 has established a solid framework to promote the implementation of renewable energy in the European Union. This directive guides Member States in the implementation of policies and practices related to renewable energies in their respective territories. However, despite the progress made, challenges are still to be overcome. To ensure effective and significant involvement of

local communities and stakeholders at all stages of the process, it is necessary to address those barriers faced by wind projects such as simplifying administrative procedures, improving transparency, and enhancing communication. In addition, there is a requirement to address existing preconceptions, encourage collaboration, and provide more opportunities for stakeholder participation. These actions will help to increase social support for wind energy projects and ensure their acceptability.

In addition, other agreements and initiatives promote public participation, such as the EU 2020 Guidance Document on Wind Energy Projects and Nature Protection Legislation. Another example in this field is the Aarhus Convention, an international protocol that establishes three fundamental pillars for access to information, public participation and access to justice in environmental matters. This convention has been ratified by all members of the European Union and transposed by Directive 2003/35/EC.

Public participation and stakeholder involvement is also regulated by the Environmental Impact Assessment Directive (2014/52/EU). This directive establishes the obligation for developers to involve and provide clear and transparent information on the project and its impacts. This directive has been transposed by each of the member states into their legislation.

The European Union is committed to the dissemination of the fundamental role of renewable energy both now and in the future. This factor supports the social acceptance of projects in the early stages, such as the planning process. In addition to disseminating information to the community, implementing pilot projects is encouraged with the aim of promoting dissemination at the local level and providing tangible examples to promoters, so that their experience can be taken as a reference.

#### **Regional level: Greece**

Directive (EU) 2018/2001 was recently introduced into Greek law. Also, Law 5037/2023, which introduces special provisions, came into force. Local communities are highly supported and promoted by different entities and institutions. Law 4513/2018 recognizes and regulates energy communities.

In Greece, there is a need to increase public participation, review the legal framework, disseminate information, ensure transparency, and implement reward systems in the planning phases of wind energy projects. This is based on the promotion of public dialogue, the establishment of preparatory plans for the management of renewable energy sources and the involvement of local governmental organizations in the process. As well as a possible improvement in terms of transparency and information during the project design phase.

It highlights the regulatory framework for CECs, including wind farms, in which the participation of the local community is ensured. Local community representatives are involved in the licensing process, initial contacts are made with the licensing authorities, who consider objections, allegations, and possible modifications. Emphasizes the importance of improving public participation, establishing an information organization, providing guidance to stakeholders, and considering reward systems.

Citizen participation in CECs is high, however, in the development phase, there is insufficient regulatory framework for other types of projects. While there are positive drivers for public participation, such as cultural background, information agencies and engagement strategies, there are also notable barriers to participation, such as lack of trust, inadequate information and communication, and the need for clearer legislation. A more transparent planning process is required, and the importance of stakeholder education is stressed. This is supported by clear legislation, wide dissemination of information, public dialogue, involvement of independent third parties and the implementation of reward systems.

#### **Regional level: Italy**

Public participation in wind projects is mainly focused on the permitting and environmental impact assessment, although there is a clear tendency to involve citizens from the earliest stages. In addition, different forms of financial participation of local communities and citizens have been identified.

Italy has designated wind energy zones through national or regional territorial plans, but there is a lack of harmonisation between national and regional policies. Therefore, a comprehensive policy framework is needed to enhance public participation, establish spaces for debate and engagement, improve participation mechanisms and increase awareness and knowledge about the projects. It is crucial to listen to stakeholders' concerns and opinions and to introduce regulations that facilitate public participation and investment through financial initiatives.

The licensing and authorisation process for wind energy projects in Italy is governed by Legislative Decree 387/2003. Public participation is mainly collected during the Environmental Impact Assessment (EIA) process, and some regions have their own forms of public consultation. Although improvements have been made, there is opportunity for further progress, especially in simplifying authorisation procedures that hinder public participation. Collaboration, openness, and transparency are evident in the planning process, but there is a need to promote community dialogue and address public participation, comments and input. As for reward systems, these

are not entrenched, but recommendations for non-financial/monetary compensatory measures are pursued.

Italy has recently established a regulatory framework for CECs that emphasises community ownership. However, the framework does not address public participation in company-driven wind energy projects, so there is a need for a regulatory framework aligned at national and regional level for all phases of wind projects and provides specific guidelines and regulations. Public participation in the development phase is still considered insufficient, despite some improvements. There is a desire for greater local involvement, including financial participation (there are currently no community reward schemes) and information campaigns to improve public engagement during the development phase.

#### **Regional level: Norway**

Based on the Norwegian Energy Act of 1991, policies are established for the installation of wind turbines and for zoning based on the division of the country into grid cooperation zones. There is planning for the installation of wind turbines as part of an overall plan for the development of wind energy. There is a comprehensive framework of guidelines which, although not legally binding, contains precise guidelines and specific prerequisites, leaving less discretion to the administrative authorities.

Norway has a system where national policy plays an important role in the planning process. There are three levels of planning for wind farms: national, regional, and municipal. The Norwegian Directorate of Water Resources and Energy (NVE) actively promotes guidelines for the installation of wind farms that provide details on potential conflicts and ways to resolve them.

Planning and permitting are closely linked processes. To obtain a permit, developers must have comprehensive plans on technical, commercial, and environmental aspects. Local communities and stakeholders are involved in the process. The use of reward systems for participation is met with mixed views, with some advocating dialogue-based engagement rather than economic incentives.

The licensing process for wind energy projects is under the control of the NVE and the Norwegian Ministry of Petroleum and Energy (OED). Participation is encouraged through local consultations with the host municipality and stakeholders. Public hearings are held where stakeholders comment on concerns and proposals and any formal objections are dealt with according to NVE procedures.

There are fewer opportunities for public participation in the development phase compared to the planning and permitting phases. There is also insufficient information to determine if there is a collaborative, open and transparent planning process during the development phase. To improve public participation, the following suggestions can be considered: extend the length of public consultation periods to allow for more meaningful participation; increase clarity on implementation in all phases of the project; strengthen the involvement of municipalities and ensure their active participation by encouraging communication, dialogue, and consideration of stakeholder perspectives.

### **Regional level: Spain**

The guidelines and lines of action established in the European Directive 2018/2001 for the promotion of renewable energies have defined the ideas and concepts included in the National Energy and Climate Plan (PNIEC).

Although Spain does not have specific regulations on public participation during the planning phase, the PNIEC has incorporated and adapted European recommendations. The importance of maintaining an open dialogue with regional and local administrations, as well as with the community, during the early stages of a wind project should be emphasized. Although existing formats and procedures are in place, there is a demand for more meaningful participation, transparency, and comprehensive planning. Stakeholders' interest in participating is evident and noticeable, with a desire for involvement and influence over aspects of the project.

For the licensing of wind projects, Spanish legislation has transferred the ideas set out in the European Directive 2014/52/EU from Europe through Law 21/2013. This environmental assessment law establishes the obligation of developers to provide clear, transparent, and accessible information on the project and its impacts, as well as to inform and consult the local community. Public participation is promoted through electronic channels and the opportunity to submit relevant allegations is provided during the public consultation period. However, there is a perception of an interested public that demands more opportunities for involvement and participation.

In Spain, there are no specific legal requirements for public participation at this stage, the aim is to ensure a collaborative, transparent and open process. The importance of taking stakeholder perceptions into account and adopting approaches that improve the social acceptability of wind projects is evident.

Spanish legislation does not directly provide for community reward schemes for wind projects and such schemes are not considered essential as a mechanism to improve the social acceptability of wind energy.

**D2.3: Stakeholders’ perceptions, awareness levels and willingness to accept and participate in wind farms**

Deliverable 2.3 is part of Task 2.3 of Work Package 2 (WP2), which focuses on preparatory studies to assess the social acceptance and energy citizenship of wind turbines. This assessment is intended to provide insights for the subsequent phases of the WENDY project. WP2 lays the foundation for understanding social acceptance and energy citizenship within the context of the WENDY project. Task 2.3 aims to identify and analyse existing perceptions of wind energy projects. The results of this deliverable help to fine-tune pilot actions and address concerns.

Surveys and interviews were conducted at both pilot and EU level to assess wind farm social acceptance and related factors. Factors affecting social acceptance identified from desk research include knowledge and awareness about wind energy, support for wind farms, attitudes towards them, economic impacts, aesthetics, health impacts, environmental awareness, trust, personal values and personality traits. Barriers and drivers to public acceptance were also identified that can be found in Table 2.

Table 2: Drivers and barriers of public acceptance and participation in wind turbines development based on the desk research findings.

Drivers	Barriers
Positive impact of wind farms on the local economy	Limited access to information
Transparent communication	Limited or ineffective engagement methods
Effective formal mechanisms of participation	Environmental-related factors
Effective informal mechanisms of participation	Technical characteristics
Environmental concerns and climate change awareness	Societal impacts of wind farms
Bio-diversity impacts	Individual-level sociodemographic characteristics
	Economic impacts of wind farms

A survey was designed based on desk research findings and circulated at the WENDY pilot cases in Greece, Spain, Italy, and Norway, as well as at EU level. Descriptive

statistics were used to analyse trends and preferences. Semi-structured interviews were conducted with key stakeholders to identify further barriers and drivers.

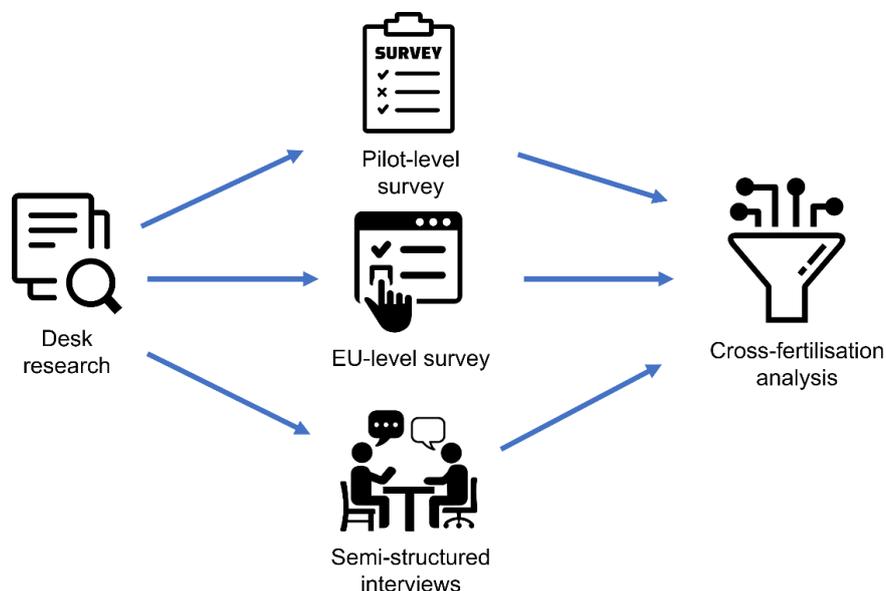


Figure 3: Methodology followed for Task 2.3 which includes desk research, pilot and EU level survey, semi-structured interviews and cross-fertilisation analysis.

A cross-analysis was carried out between the pilot and the EU survey data and interview responses. Statistical analysis was conducted to determine the impact of various factors on social acceptance and participation. Specific findings were obtained for each pilot case. EU-level survey analysis identified egoistic and altruistic values, income, and biospheric values as drivers of wind energy uptake. Perceived health impact, economic impact, aesthetic concerns, and hedonic value were identified as barriers. Common drivers and barriers across pilot cases were categorized into areas of wind farm development, establishment and continuation, and public participation. Key findings include higher support for wind farms in Spain, Italy and Greece compared to Norway, generally higher acceptance of offshore wind farms compared to onshore wind farms, and the importance of tailored strategies to promote social acceptance. The deliverable's outcomes highlight the need for targeted communication, addressing concerns and engaging local communities to effectively promote the transition to wind energy across Europe.

### 1.3. Ranking of best wind farm cases identified in D2.1

In this section, the key outcomes of the 2<sup>nd</sup> evaluation round are presented in a graphical format. Additionally, noteworthy observations and conclusions are highlighted based on the final ranking scores of the wind farm cases.

The decision to implement the second round of evaluation served multiple purposes. Firstly, it prompted partners to revisit and thoroughly review the content of D2.1, as recommended in the process applied in Task 2.4, which involved several workshops among involved partners to distill various needs and challenges derived from the previous Tasks of WP2. Secondly, it was believed that by considering the full in-depth analysis reports of wind farm cases, as well as the average scores from the first round of evaluation, partners would assign ratings that were not only closer to each other, leading to higher consensus, but also more aligned with the actual and accurate conditions of the cases. Thirdly, by generating new scores for the wind farms, the spider graphs in the summarising tables could be updated for potential future use in future project activities, such as a potential atlas of wind farm cases to be included in the WENDY's Knowledge Exchange Platform. Finally, by conducting this final phase of the integrated evaluation methodology approach applied in Task 2.1 and Task 2.4, we establish a structured procedure for assessing wind farm cases that could be adopted and used in other contexts and situations. Comparative evaluation of wind farm cases based on various criteria related to social acceptance could prove valuable in numerous instances. For example, this kind of benchmarking could be used to map and understand the current situation across a territory under examination (e.g., the EU); study and monitor changes over time at both individual wind farm case and collective (aggregated) territorial levels; and identify, acknowledge, and recognise “champions” in this field—those who pioneer and serve as exemplary models for others to imitate and draw inspiration from. The latter application could form an integral part of a special EU contest that could be established as a periodic institution, perhaps on a biannual basis.

The following table presents the list of the best wind farm cases ranked based on the second evaluation in Task 2.4. Additionally, certain information is provided including the country where the wind farm case is located, the year of the wind farm’s launch, the ownership model applied, the overall rate of the 1<sup>st</sup> round, the overall rate of the 2<sup>nd</sup> round, and the change in ranking position (1<sup>st</sup> column). It’s important to note that the first evaluation was applied to 44 cases. Thus, the position change is calculated after removing the 19 cases that were not shortlisted from the ranking of the first round.

Table 3: Wind farm ranking (2nd evaluation round)

Pos.	No	Best Wind Farm Cases	Location	Year	Ownership Model	1 <sup>st</sup> round	2 <sup>nd</sup> round
+7	1	Lichtenau	Germany	2014	Social	4.2	4.4
-	2	Sifnos hybrid power plant	Greece	Planning	Social	4.6	4.4
+7	3	Feldheim	Germany	1995	Hybrid	4.2	4.3
-1	4	KrammerWind	Netherlands	2019	Hybrid	4.3	4.3

Pos.	No	Best Wind Farm Cases	Location	Year	Ownership Model	1 <sup>st</sup> round	2 <sup>nd</sup> round
-	5	Eeklo	Belgium	2002	Hybrid	4.3	4.2
+4	6	Middelgrunden	Denmark	2000	Hybrid	4.2	4.2
+4	7	Samsø	Denmark	2003	Hybrid	4.2	4.2
-4	8	Duikeldam	Belgium	2012	Social	4.3	4.1
+9	9	Uthleben	Germany	2011	Social	3.9	4.1
+4	10	Brebek	Germany	2009	Social	4.1	4.1
-9	11	Asterousia	Greece	Planning	Social	4.3	4.0
-6	12	Hilchenbach	Germany	2008	Social	4.3	4.0
-5	13	Neuenkirchen	Germany	2017	Social	4.2	4.0
+2	14	Sitia	Greece	1993 & 2021	Hybrid	4.1	4.0
-3	15	Tilos	Greece	2018	Corporate	4.2	4.0
-8	16	Tragoudistis	Greece	2019	Corporate	4.3	4.0
+5	17	Castelmauro	Italy	2022	Corporate	3.5	3.8
-2	18	Ellhöft	Germany	2000	Social	4.0	3.7
+1	19	Königshovener Höhe	Germany	2016	Hybrid	3.8	3.7
-1	20	Hollich	Germany	2001	Hybrid	3.9	3.7
+3	21	Santo Domingo de Luna	Spain	2020	Corporate	3.4	3.7
-5	22	Carretera Arinaga	Spain	2014	Hybrid	4.0	3.6
+1	23	Barile Venosa	Italy	2016	Corporate	3.3	3.6
+1	24	Los Arcos	Spain	2020	Corporate	3.3	3.5
-4	25	Serra das Penas	Spain	2018	Corporate	3.5	3.4

### General observations

It can be observed that the range gap between the wind farm ratings is shorter than the 1<sup>st</sup> round (in the 1<sup>st</sup> round, the gap varies from 3.3 to 4.6, while in the 2<sup>nd</sup> round the gap varies from 3.4 to 4.4). In addition, the wind farms with the lowest scores in the 1<sup>st</sup> round have improved their ratings after the 2<sup>nd</sup> evaluation, whereas most of the cases that were highly ranked in the 1<sup>st</sup> round showed a decline in their rating scores (Table 2). As previously mentioned, the second round of evaluation yielded a more unified rating thanks to both (i) consulting the collective opinion of all evaluators, and (ii) considering the enhanced and in-depth analysis reports of the wind farms. In particular, in the frame of Task 2.1, we exchanged and consolidated information and knowledge through desk research and interviews with stakeholders from the wind industry. Additionally, we became more experienced and familiar with the selected wind farm cases, forming a more thorough assessment description of each wind farm case, identifying and distilling the “Key Insights and Lessons Learnt” for each wind farm case in D2.1. Based on this shared experience and deeper understanding of the cases, we assume that the second evaluation rating could be considered as more accurate and reliable than the rating from the first round of evaluation.

It is revealed that the rating performance of the wind farm cases is influenced by their ownership model. Wind farms (in total 9) based on a social ownership model scheme have an overall average rating of 4.06, whereas hybrid models (in total 9) have an overall average rating of 3.99. Wind farms owned by corporations (in total 7), where locals do not hold shares, have the lowest overall average rating (3.68). This ownership model is prevalent in the wind farm cases of Southern European countries such as Italy, Spain, and Greece. In contrast, the best wind farm cases examined in Northern and Central Europe usually adopt a social or hybrid ownership approach (Table 2).

Figure 3 illustrates the variation in average ratings of wind farms belonging to different ownership models.

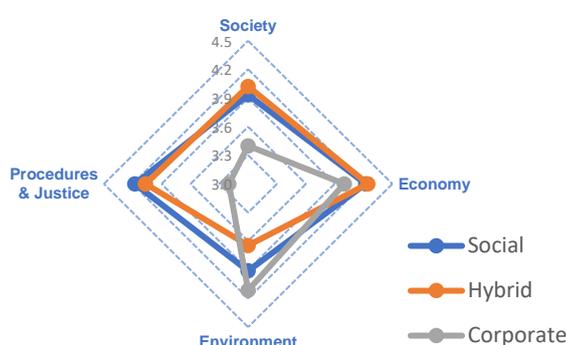


Figure 4: Spider graphs based on the ownership model depicting the average rating scores for the four evaluation criteria.

Social and hybrid ownership models exhibit similar ratings with slight variations regarding “procedures & justice”, “society” and the “economy”. Notably, corporate wind farm models receive the lowest ratings in all aspects, except for the environmental criterion. It seems that since local population does not enjoy direct economic benefits from the wind farm development, it becomes necessary for these farms to shift their focus towards implementing environmental protection plans, measures, and techniques to gain social acceptance.

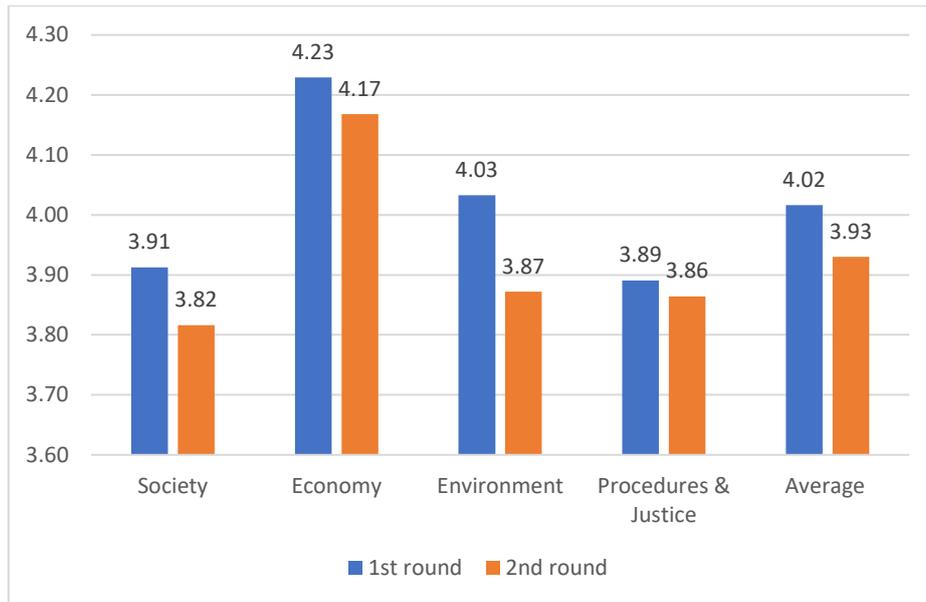


Figure 5: Wind farm cases' total average score for the 1<sup>st</sup> and 2<sup>nd</sup> evaluation round.

In general, the economy receives the highest average score among the four criteria considered (Figure 4). This can be attributed to the fact that all of the selected wind farm cases provided significant economic benefits to their region, community, or local residents. The other three criteria (dimensions) exhibit higher variations among the wind farm cases, depending on numerous contextual factors such as wind farm type, ownership model, technological aspects, and specific needs of each location.

In addition, it is noticeable that the average scores for all four criteria were reduced after the 2<sup>nd</sup> evaluation (Figure 4). This could be possibly explained by the fact that the in-depth analysis of the wind farm cases revealed certain drawbacks that were not acknowledged during the initial evaluation. Moreover, partners may have become stricter at judging in their evaluations throughout the process, as they reviewed the entire pool of top wind farm cases and encountered truly exceptional wind farms. The greatest decrease from the 1<sup>st</sup> to the 2<sup>nd</sup> evaluation round is evident in the environmental aspect. The in-depth research of the wind farm cases uncovered certain ecological issues and technological remedies that many cases didn't adequately considered in their project planning or implementation.

In summary, the following observations were made after the 2<sup>nd</sup> evaluation round:

- The individual average scores of the wind farms exhibit a narrower range of variation than in the 1<sup>st</sup> evaluation round, due to a collective effort towards higher consensus.
- The ranking is influenced by the ownership model of the wind farm: whereby social ownership models receive the highest average rating, hybrid models fall in the middle, and corporate-owned farms receive the lowest average rating.

- All average scores of the four evaluation criteria were reduced, as the evaluators developed a deeper understanding about the wind farms.
- The economy receives the highest average score among the four evaluation criteria both in the first and second round of evaluation.
- Corporate owned wind farms aim to prioritise environmental protection towards gaining social acceptance, given the limited provision of direct economic benefits for communities.
- The in-depth analysis revealed some environmental concerns and social issues that were not considered in the initial evaluation of the cases that was based on the brief reporting of the cases. In this context, it's not surprising that the environment criterion shows the highest decrease from the first to the second evaluation round among the four criteria.
- The criteria of society and procedures & justice exhibit closely aligned scores in both the first and second evaluation round. However, a slight shift in average ratings resulted in a change of ranking of the four criteria. Society moved from the third place to the fourth, while procedures & justice shifted from the last position to the third place.

## 1.4. Triangulation of D2.3 results

Triangulation of data (Heale & Forbes, 2013) is a research methodology commonly used in various fields, including the social sciences and qualitative research (Carter et al., 2014), to increase the credibility and validity of findings by using multiple sources or methods to study a particular phenomenon. For example, interviews, surveys and observations can be combined to study a particular social issue.

In D2.3 “Stakeholders’ perceptions, awareness levels and willingness to accept and participate in wind farms” of the WENDY project, a number of research methods were used to study wind farms’ social acceptance and participation. In particular, a wind farms’ social acceptance assessment survey prepared by WR was circulated at the WENDY pilot case level to capture perceptions, NIMBY phenomena and acceptance rates taking into account geographical and socio-cultural differences. In addition, semi-structured consultation interviews were held with key stakeholders of the wind farm value chain to further investigate the captured insights from the pilot level survey. Finally, an EU-level survey was conducted to complement the study and indicate whether factors assumed significant at the regional level are indeed important in driving public’s preferences across Europe.

In this section, we conduct a triangulation of D2.3 results that have emerged from the pilot surveys and the EU-level survey, as well as from the semi-structured consultation

interviews. In this way, the D2.3 results triangulation will enhance the overall analysis of the challenges and needs related to the wind farms' acceptance and participation at pilot and EU level, reported in the following sub-sections of Deliverable 2.4.

#### **Support and attitudes towards wind farms:**

- **Pilot-level survey:** The Norwegian pilot had lower public support and more negative attitudes towards wind farms than the pilot cases of Spain, Italy, and Greece.
- **EU-level survey:** Economic development and job creation were key drivers for wind farm acceptance across all pilot cases, aligning with the economic benefits of wind farms.
- **Interviews:** Concerns about social opposition (NIMBY) and negative public perception were consistent barriers to wind farm development and establishment.

#### **Environmental and economic factors:**

- **Pilot-level survey:** The pilot case in Norway showed positive perceptions of the environmental impact of wind turbines, even though it had less support and more negative attitudes toward wind farms overall.
- **EU-level survey:** Environmental concerns and negative perceptions of wind farms were barriers across all pilot cases.
- **Interviews:** Both surveys and interviews highlighted the importance of transparent communication and accurate information dissemination to address these concerns.

#### **Social acceptance and public participation:**

- **Pilot-level survey:** Social acceptance varied across pilot cases, with the Greek pilot having higher willingness to pay for accommodations using wind energy.
- **EU-level survey:** Social acceptance was influenced by altruistic and egoistic values, community involvement, and public awareness.
- **Interviews:** NIMBY opposition, negative attitudes, and misinformation were barriers to social acceptance, while financial support, local authority involvement, and transparent communication were drivers of public participation.

#### **Perceived health and aesthetic impacts:**

- **Pilot-level survey:** Health and aesthetic impacts were concerns in the pilot cases of Spain, Greece, and Italy, influencing public attitudes.

- **EU-level survey:** Perceived health impacts were barriers to wind farm acceptance, while aesthetic impacts were barriers to establishment and continuation.
- **Interviews:** Health concerns and aesthetic perceptions were consistent barriers to both wind farm development and public participation.

#### **Regulatory and informational factors:**

- **Pilot-level survey:** Regulatory conditions and lack of information were barriers in various pilot cases.
- **EU-level survey:** Slow regulatory procedures and lack of public information were barriers in all pilot cases.
- **Interviews:** Regulatory challenges, slow bureaucratic systems, and lack of public information were common barriers identified.

#### **Economic benefits and community involvement:**

- **Pilot-level survey:** The pilot cases of Greece and Spain showed economic benefits and community involvement as drivers for wind farm establishment.
- **EU-level survey:** Economic benefits and coordination of entities were drivers in all pilot cases.
- **Interviews:** Economic benefits for local communities and well-executed planning were identified as drivers.

#### **Institutional trust and communication:**

- **Pilot-level survey:** The Greek pilot had lower trust in government, impacting social acceptance.
- **EU-level survey:** Transparent communication, legal frameworks, and local authority involvement were drivers of public participation.
- **Interviews:** Transparent communication and involvement of local authorities were identified as drivers.

Overall, the data triangulation reveals consistent themes and intersections such as: 1) *economic benefits as a key driver*, 2) *environmental concerns and public perception*, 3) *negative public perception and NIMBY opposition*, 4) *importance of transparent communication*, 5) *local authority involvement*, 6) *regulatory challenges*, 7) *health and aesthetic concerns*, 8) *institutional trust* and 9) *community involvement*. While certain factors may vary based on context and region, the collective insights from the pilot level survey, EU level survey, and interview results provide a comprehensive view of wind farm acceptance and participation, enabling a deeper understanding of the

complexities involved. These insights can inform targeted strategies to enhance wind farm acceptance and promote sustainable energy practices.

## 1.5. Task overview and methodology

Task 2.4 presents a summary of the outcomes from the entire *WP2 - Preparatory studies related to turbines' social acceptance and wind energy citizenship*. The activities related to this task were divided and organized in three rounds:

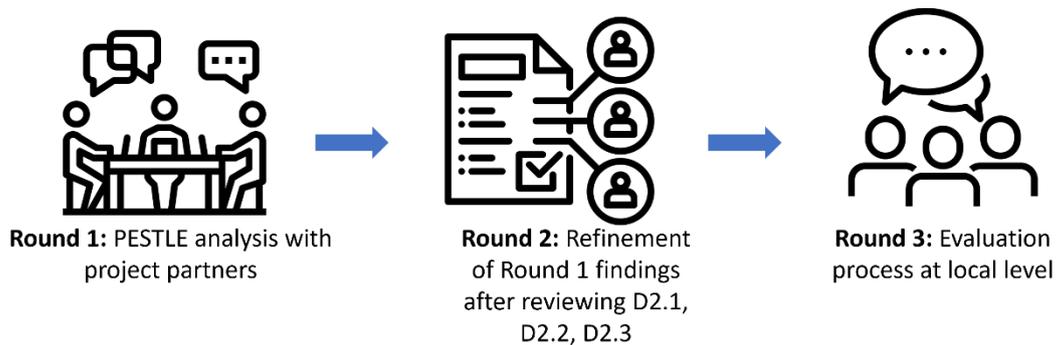


Figure 6: Schematic of the methodology followed in Task 2.4.

**In Round 1**, the project partners conducted a PESTLE analysis (Perera, 2017; Zalengera et al., 2014) to evaluate regional needs and challenges related to wind farms' acceptance and participation. This analysis was based on input from WENDY partners, with four (4) regional working groups and one (1) at EU level. To facilitate the analysis, regional experts were asked to consider the perspectives of 12 different stakeholder types. Specific aspects were provided as guidance for the PESTLE analysis, and the experts rated the importance of each aspect using categories such as *not important*, *low importance*, *high importance*, or *critical importance*. The specific aspects for analysis can be found in Annex I, and additional aspects applicable to a pilot area were included as necessary. A list of stakeholders to be considered is provided in Annex II.

**In Round 2**, the project partners reviewed and refined the findings of Round 1 in relation to the draft deliverables from Tasks 2.1, 2.2, and 2.3. Feedback from interviews, surveys and workshops influenced this process of review and adjustment. Specific actions were developed to address the needs and challenges that were identified as 'critically important'. Given the extensive list, some regional pilot partners chose to focus on the critical needs and challenges that directly affected them and excluded the inclusion of other stakeholders' needs and challenges in the Round 3 analysis.

**In Round 3**, selected regional stakeholders were invited to give their feedback on the analysis of needs and challenges and the corresponding actions. Taking this valuable

input into account, the project organised and consolidated the individual actions for each pilot area. These actions were then grouped into preliminary intervention areas that were standardised across all pilot cases to allow for effective comparison. However, it is important to note that the actual content and scope of the proposed actions varied according to unique regional needs and challenges, as expected and intended.

### 1.5.1. Indicative clustering of intervention areas

In addition to the analysis of needs and challenges, all pilot cases were able to identify a number of interventions at the end of all rounds (1 to 3) that could be broadly categorised into the following intervention areas:

#### **1. Robust policy framework for effective wind energy initiatives**

To effectively address the challenges associated with wind farms, it is critical to develop and implement robust policy frameworks. This requires proactive outreach and dialogue at local and international levels to promote cooperation and mutual understanding. Representatives of inhabitants near wind farms and local government/authorities should actively participate in these discussions. In addition, national government/authorities play a key role in creating a favourable policy environment. Representatives of wind energy producers and wind energy cooperatives can contribute their expertise to policy-making. Energy distributors and wind energy providers are important actors to ensure the smooth implementation of the policy. Cooperation between these actors, farmers/fishermen, regional policy makers, wind turbine companies and wind farm developers is essential for diplomatic engagement and international cooperation.

#### **2. Driving economic growth and investment in wind energy projects**

To ensure the success of wind energy projects, we must prioritise actions that promote economic growth and attract investment. These include job creation and attracting investment in related industries. Farmers/fishermen in local communities can benefit from job creation and economic growth. Local governments/authorities play an important role in establishing financial mechanisms and support programmes. National government/authorities play a role in facilitating the necessary financial models. Wind energy providers and wind cooperatives can invest in local communities and support socio-economic change. Energy distributors are important for flexible pricing mechanisms. Cooperation between these actors and the companies building wind farms and wind farm developers is crucial for the implementation of robust financing mechanisms.

### **3. Community engagement and empowerment**

Engaging with local communities is fundamental to gaining support for wind energy projects. To achieve this, it is essential to actively inform and involve these communities. Representatives of inhabitants near wind farms and local government/authorities should take a leading role in community engagement. Wind energy providers and wind energy cooperatives can actively participate in an open and transparent dialogue and ensure fair compensation practices. Cooperation between these stakeholders, regional policy makers and wind farm installation companies, is important to strengthen the community through measures that ensure equitable sharing of economic benefits.

### **4. Technological advancements and innovation for wind turbines**

To improve the efficiency and reliability of wind turbines, technological advances are key. This requires interdisciplinary expertise, comprehensive data collection and advanced modelling techniques. Wind farm developers, in cooperation with wind farm installation companies, should invest in research and development programmes that focus on wind turbine technology. Representatives of wind energy producers and energy distributors should also participate in joint efforts to drive innovation. The involvement of experts from different scientific fields such as engineering and environmental sciences is essential for technological advancements. Farmers/fishermen and local governments/authorities can provide insights into local needs and challenges and are thus important stakeholders in these efforts.

### **5. Establishing supportive legal framework for wind energy development**

In order to create a stable and supportive environment for the development of wind farms, it is important to establish clear legal guidelines and framework conditions. To achieve this, it is essential to develop and communicate these regulations effectively. National government/authorities should take the lead in creating common standards and guidelines for wind energy projects. Local government/authorities play a crucial role in implementing and enforcing these regulations at the local level. Wind farm developers and wind farm installation companies should collaborate with legal experts and participate in the process. Representatives of wind energy producers and wind energy cooperatives can participate in policy formulation and compliance. Cooperation between these stakeholders and regional policy makers is essential for streamlined management and coordination.

### **6. Preserving the environment in wind farm projects**

The protection of the environment during the development and operation of wind farms is of utmost importance. Therefore, comprehensive Environmental Impact Assessments (EIAs) must be carried out, following sustainability guidelines.

Farmers/fishermen, local government/authorities and national government/authorities should actively participate in the environmental impact assessment and regulatory processes. Wind farm developers, wind farm installation companies, and representative of wind energy producers must adhere to environmentally friendly construction materials and recycling technologies. Energy distributors should ensure that decommissioning and disposal of wind turbines comply with the relevant regulations. Transparent communication channels involving all these stakeholders are essential to address environmental concerns throughout the project life cycle. Regional policy makers can facilitate coordination between these actors and ensure that environmental protection measures are effectively enforced.

## 2. Pilot-level analysis

---

This section presents the results of the analysis of needs and challenges after the completion of all rounds (1 to 3), while giving the preliminary identification of intervention areas.

### 2.1. Spain pilot case

**Lead pilot partner:** EGP, a WENDY pilot partner, owns four onshore areas in the city of Zaragoza in Spain that have been operational since 2019. In short, four Spanish wind farms have been operational since 2019, each with different characteristics: Primoral in Zaragoza started operations in 2019, with 11 turbines and a wind power generation capacity of 39.6MW; Campoliva I and Campoliva II, also in Zaragoza, started operations in 2019, with a total of 17 and 15 turbines and power outputs of 36MW and 39MW respectively; Motilla, in Cuenca, started operations in 2020, with 17 turbines and a wind power generation capacity of 51MW; and El Campo, in Zaragoza, started operations in 2019, with 6 turbines and a wind power generation capacity of 20MW. These wind farms face significant environmental concerns, such as impacts on birds, loss and fragmentation of natural habitats, impacts on vegetation and landscape, and conversion of agricultural land for cereal crops. In response, the Environmental Administration has ordered the implementation of bird prevention, surveillance, stopping and deterrent systems at all these sites.

In addition, the technologies validated in these wind farms have the potential for replication in other onshore wind farms during their operational phase. These technologies allow real-time detection of birds and can also be used in the pre-construction phase to minimise mortality, leading to more informed wind farm siting decisions and habitat management strategy planning.

#### 2.1.1. Regional needs and challenges

##### **Needs identified in the Spanish pilot case**

In the context of the Spanish wind farm pilot case, various needs in different dimensions – political, economic, socio-cultural, technological, legal and environmental – have been identified that need to be taken into account to ensure the successful establishment and operation of wind energy projects.

**Policy frameworks** play a pivotal role in streamlining wind energy project approvals. By creating clear and efficient regulatory pathways, policymakers can expedite the process of obtaining necessary permits for wind farms. Additionally, fostering ongoing dialogue through stakeholder engagement platforms ensures that the concerns and

insights of local communities, environmental groups, and other stakeholders are heard and taken into account. One condition for obtaining permits could involve the dissemination of accurate and comprehensible information about the project, enabling stakeholders to make informed decisions.

Wind energy projects hold *significant potential for economic development* within local communities. ***Establishing incentives and support mechanisms*** encourages these communities to actively participate in wind energy initiatives. Moreover, ***allowing citizens to have a financial stake in the projects*** through various investment models can lead to increased public support and shared benefits. ***Benefit-sharing mechanisms***, which allocate a portion of the project's profits to the surrounding communities, can further enhance local buy-in and cooperation.

***Transparent and effective communication strategies*** are vital for building trust and maintaining open channels of information flow between project developers and local communities. Ensuring that community members are engaged and involved in decision-making processes fosters a sense of ownership and inclusion. Enhancing citizens' awareness for wind energy involves comprehensive education campaigns that communicate the advantages and benefits of this renewable energy source, dispelling misconceptions and building a positive perception.

***Identifying suitable locations*** with strong and consistent wind conditions is fundamental for the success of wind farms. ***Integrating innovative noise reduction technologies and adhering to best practices*** for minimizing turbine noise addresses potential concerns of noise pollution in nearby areas. The ***availability of grid connections and accessible infrastructure*** is crucial for efficient energy distribution. ***A clear understanding of legal frameworks and compliance measures*** is essential to navigate the complex legal landscape surrounding wind energy projects. Collaboration with legal experts can ensure that all regulatory requirements are met and potential legal challenges are anticipated and mitigated effectively.

***Environmental impact assessments*** remain a cornerstone in the development of wind farms. By identifying potential ecological risks and adopting sustainable practices, the environmental footprint can be minimized. Special measures can be introduced to ensure the safe operation of wind farms while safeguarding local wildlife and ecosystems. Conducting research, such as bird migration studies, contributes to understanding the impact of wind farms on local wildlife and supports the development of targeted mitigation strategies. ***Innovations aimed at reducing visual impact, eliminating shadows, and mitigating other visual disturbances*** contribute to more harmonious integration within the natural landscape.

Table 4: Summary of the needs identifies in the Spanish pilot case

Domain	Needs
Political	<ul style="list-style-type: none"> <li>• Clear and efficient policy frameworks for regulatory approvals</li> <li>• Stakeholder engagement and information dissemination</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Incentives and support for local community participation</li> <li>• Benefit-sharing mechanisms</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>• Transparent and effective communication strategies</li> <li>• Community engagement and education campaigns</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Identifying suitable wind farm locations</li> <li>• Noise reduction technologies and minimizing turbine noise</li> <li>• Grid connections and infrastructure availability</li> <li>• Legal compliance and mitigation of legal challenges</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Environmental impact assessments and minimizing ecological risks</li> <li>• Safeguarding wildlife and ecosystems</li> <li>• Research and innovations for reduced visual impact and disturbances</li> </ul>

### Challenges identified in the Spanish pilot case

In the wind farm pilot case in Spain, a number of challenges have been identified across various domains, each posing unique hurdles that need to be carefully navigated for successful implementation. These challenges span political, economic, sociocultural, technological, legal, and environmental aspects, underscoring the complexity of introducing and integrating wind energy projects.

**At the political level**, the wind farm pilot case faces **regulatory and policy barriers** both regionally and nationally. Overcoming these barriers necessitates strategic engagement with administrative bodies that are closely tied to the geographical context and the project itself. Optimizing the wind farm's development timeline while facilitating an expedited permitting process requires delicate negotiation and clear communication with relevant authorities. **Opposition from local stakeholders and the community** adds an additional layer of complexity, demanding efforts to mitigate conflicts and foster harmony. Implementing stringent monitoring and supervision during the construction phase is crucial to ensure compliance and alleviate concerns. Addressing the **lack of objective and transparent information dissemination**

**procedures** and facilitating wind energy international trades further contribute to the political challenges.

Economically, the wind farm case faces concerns such as **potential property devaluation and negative impacts on local businesses**. Effective communication is essential to convey that a wind farm is more than a mere activity – it represents an opportunity to harness a valuable energy resource. This potential energy can be pivotal in addressing diverse challenges and goals. Enhancing local value, increasing financial participation of citizens, and ensuring equitable distribution of funds require careful economic planning. Exploring alternatives that balance **economic viability and community needs**, addressing **issues of accessible quotas and lack of supportive policy frameworks**, and ensuring proper **allocation of economic benefits** are all vital components of overcoming these economic challenges.

**Sociocultural challenges** encompass **public perception and misconceptions about wind energy**. Integrating the wind farm as a seamless part of society necessitates robust community engagement programs and active citizen participation throughout the project lifecycle. Elevating the community's environmental awareness level is essential for fostering a positive perception of wind energy as a valuable asset, rather than a disruption.

On the technological front, **decommissioning outdated wind farms** and elaborating on the factors that determine favorable and unfavorable locations are vital considerations. Addressing **noise and vibration generated by current wind turbine technology** is a pressing concern, demanding innovative solutions to reduce such disturbances. **Strategic turbine placement** – particularly in proximity to urban areas – can help bridge the gap between wind farms and urban life, fostering a closer relationship between the two. Additionally, streamlining **time-consuming procedures**, embracing **technological solutions for environmental protection**, and tackling wind energy development in **areas with limited grid infrastructure** are all critical technological challenges.

Navigating the legal landscape presents challenges of **regulatory compliance** and **adherence to legal requirements** associated with wind energy projects. Given the **diversity of legal rules** for renewable energy communities, harmonizing these regulations becomes pivotal for the successful establishment of wind farm projects.

**Environmental challenges** encompass potential **impacts on local wildlife and ecosystems**. Accommodating these changes within ecosystems while complying with administrative environmental specifications requires careful planning and collaboration with environmental associations. Recognizing the wind farm's role as an integral part of the ecosystem and sustaining life through dynamic changes is crucial. Pre-visioning to understand impacts, installing barriers to avoid shadows and flickers, and selecting turbine models that consider ecological factors are all critical steps.

Advancing turbine technology also contributes to minimizing the environmental footprint of wind energy projects.

In summary, the wind farm pilot case in Spain demands a holistic and multidisciplinary approach to address the array of challenges spanning political, economic, sociocultural, technological, legal, and environmental domains. Effective solutions will require collaboration, innovation, clear communication, and a deep understanding of the interconnectedness of these challenges within the broader context of sustainable energy development.

Table 5: Summary of the challenges identified in the Spanish pilot case

Domain	Challenges
Political	<ul style="list-style-type: none"> <li>• Regulatory and policy barriers at regional and national levels</li> <li>• Opposition from local stakeholders and community</li> <li>• Lack of objective and transparent information dissemination procedures</li> <li>• Facilitating wind energy international trades</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Potential property devaluation and negative impacts on local businesses</li> <li>• Balancing economic viability and community needs</li> <li>• Lack of supportive policy frameworks</li> <li>• No proper allocation of economic benefits</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>• Public perception and misconceptions about wind energy</li> <li>• Robust community engagement programs</li> <li>• Elevating environmental awareness</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Decommissioning outdated wind farms</li> <li>• Addressing noise and vibration from wind turbine technology</li> <li>• Strategic turbine placement near urban areas</li> <li>• Limited grid infrastructure in some areas</li> </ul>
Legal	<ul style="list-style-type: none"> <li>• Regulatory compliance and adherence to legal requirements for wind energy projects</li> <li>• Harmonizing diverse legal rules for renewable energy communities</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Potential impacts on local wildlife and ecosystems</li> <li>• Collaboration with environmental associations</li> </ul>

- Minimizing environmental footprint through technology advancement

### 2.1.2. Definition of intervention areas

#### 1. Policy development and implementation

In the area of policy development and implementation, it is crucial to draw inspiration from successful regions and adopt their best practices. This includes creating clear and efficient regulatory pathways to speed up the permitting process for wind farms. To ensure that policies are in line with the geographical context and project objectives, active cooperation with local authorities is essential. In addition, stakeholder input should be incorporated into policy development to promote community acceptance. Regular site visits and structured monitoring during the construction phase help to ensure compliance, while guidelines and the sharing of information as part of the approval process increase transparency. Finally, improving interconnection capacity between neighbouring countries can harmonise policies and facilitate cross-border cooperation.

#### 2. Economic development and investment

To promote economic development and investment, the wind farm project should focus on job creation and investment opportunities in local communities. Active participation in public forums, school presentations and community activities can help communicate the importance of the wind farm beyond energy production. Investments in local infrastructure and social projects that are aligned with community needs can strengthen the relationship between the project and the community. Cooperative models and benefit-sharing mechanisms can ensure an equitable distribution of economic benefits, while awareness campaigns can inform the public about the economic benefits of the project.

#### 3. Community Engagement and Communication

Effective community engagement and communication are critical to the success of the project. Developing a communication plan with clear and concise messages disseminated through various channels will help build trust and understanding. Engaging local schools and communities through visits and educational activities can foster a sense of inclusion. The project should define the purpose and scope of the engagement programmes to facilitate dialogue and cooperation. Cultural events and village landmarks should be respected during construction and a sense of community should be fostered during the park's operation. Environmental education initiatives can improve public awareness and promote the project as a valuable asset.

#### 4. Technological advancement

Technological advancement plays a crucial role in the success of the project. Training on technical parameters ensures that staff are well equipped to manage and maintain the technology. Continuous improvement of wind turbine technology with a focus on noise reduction is important to address concerns about noise pollution. Good preliminary technical studies form the basis for sound technical decisions. Investment in advanced monitoring technologies improves efficiency and environmental monitoring. In addition, research into off-grid Wind Turbine Generators (WTGs) and the development of local grid infrastructure can improve energy distribution and availability.

#### 5. Legal framework development

The development of a robust legal framework is essential to navigate the complex regulatory landscape. Clear guidelines should be established and training provided to ensure compliance with legal requirements related to wind energy projects. A holistic legal framework should be established to harmonise regulations and facilitate the successful establishment of wind farm projects.

#### 6. Environmental conservation and impact mitigation

Comprehensive environmental impact assessments (EIAs) are crucial to assess and mitigate environmental risks. To offset these risks and reduce negative impacts, public education on ecosystem changes and past land uses is essential. The project should implement systems to protect local wildlife, with a focus on bird conservation. Cooperation with environmental associations can lead to more inclusive EIAs. Research and monitoring programmes for bird protection should be carried out, and innovative technologies to temporarily stop turbines or move blades can protect wildlife. In addition, evolutionary studies and preliminary engineering studies can address environmental aspects, while exploring repowering options can lead to fewer turbines being installed, reducing the overall environmental footprint of the project.

## 2.2. Italy pilot case

**Lead pilot partner:** EGP currently operates two onshore wind farms in the Calabria region of Italy. These Italian wind farms are the oldest in the portfolio and are currently in the process of adopting migratory species protection measures. The first wind farm, Bagaladi, in Calabria CZ, was established in 2012 and comprises 33 turbines generating 28 MW of wind power. The second site, Maida/San Florio, in Calabria RC, was commissioned in 2010 and consists of 28 and 4 turbines generating 56MW and 8MW

of wind power respectively. Both wind farms are located in areas of importance for birdlife in spring and autumn. The areas serve a dual purpose: Bagaladi comprises mountainous agricultural regions with natural vegetation, while Maida/San Florio combines agricultural activities with natural vegetation.

Addressing the challenges of dual use of agricultural and natural land in these wind farms, as well as mitigating impacts on migratory birds during critical seasons, remains a priority. The validated technologies used in these wind farms can also be used in onshore wind farms to provide real-time avifauna detection. These technologies can also be used in the pre-construction phase to improve wind farm siting decisions and plan habitat management strategies to reduce bird mortality.

### 2.2.1. Regional needs and challenges

#### Needs identified in the Italian pilot case

The WENDY Italian pilot case envisions a comprehensive approach that addresses various needs of the project, fostering its success while respecting the environment, community interests, and legal parameters.

In order to expedite the development of wind energy projects, it is crucial to **streamline the approval process**. This can be achieved by implementing policies that **simplify bureaucratic procedures** while maintaining stringent environmental and safety standards. **Engaging stakeholders through dedicated platforms** ensures ongoing dialogue, where concerns and suggestions can be voiced, fostering a sense of community involvement. Requiring **project information dissemination** as a prerequisite for obtaining permits guarantees that local residents are well-informed about the potential impacts and benefits, promoting transparency.

**To address project delays**, allocating additional staff resources to oversee various stages of the project's lifecycle becomes imperative. Building upon the successful legacy of cooperatives ensures that lessons learned from previous projects are integrated, enabling smoother implementation and greater community collaboration for future wind energy endeavors.

The wind farm project presents an **opportunity for economic growth in local communities**. By prioritizing the hiring of local labor and sourcing materials from nearby suppliers, the project can stimulate job creation and support local businesses. **Establishing benefit-sharing mechanisms** through supportive policy frameworks guarantees that the economic advantages are equitably distributed among the community members. **Clear and well-defined policy guidelines** for eligibility and access to public funding facilitate the acquisition of financial resources necessary for the project's realization.

**Effective communication strategies** play a pivotal role in addressing concerns and disseminating information. Transparent and consistent communication about the project's goals, benefits, and potential challenges fosters community trust.

**Implementing community engagement programs**, such as public workshops and informational sessions, ensures that local residents are actively involved in decision-making processes. Encouraging citizen participation in energy communities and wind projects empowers individuals to take an active role in shaping their energy future, enhancing their sense of ownership.

Given the potential environmental impacts of wind farms, conducting thorough **environmental impact assessments** is vital. These assessments should not only identify potential negative effects but also propose innovative solutions to mitigate them. Advanced noise reduction technologies can be employed to minimize turbine noise, respecting the tranquility of the surroundings. Embracing best practices for minimizing other environmental impacts, such as bird and bat collisions, ensures the project's sustainability. Additionally, by planning for the reuse of materials from turbines at the end of their lifecycle, the project contributes to circular economy principles.

Navigating the legal complexities of wind energy projects requires **collaboration with legal experts well-versed in energy and environmental law**. A well-structured legal framework ensures compliance with regulations while providing the flexibility needed to accommodate the unique circumstances of each project. Facilitating community wind farm projects within the legal framework promotes a decentralized and participatory approach to energy generation, aligning with broader sustainable development goals.

**Minimizing the environmental footprint of the wind farm** is a paramount objective. This involves using low environmental impact materials during construction to reduce the carbon footprint of the project. Implementing a comprehensive siting plan at the regional level ensures that the project is harmoniously integrated into the existing landscape. Additionally, having a **robust framework for decommissioning and landscape restoration** guarantees that the land is returned to its natural state once the project reaches the end of its operational life.

Table 6: Summary of the needs identified in the Italian pilot case

Domain	Needs
Political	<ul style="list-style-type: none"> <li>• Streamlining approval processes with policies to simplify bureaucracy while maintaining environmental standards.</li> <li>• Engaging stakeholders for ongoing dialogue and transparency.</li> <li>• Establishing clear policy guidelines for eligibility and access to public funding.</li> <li>• Collaboration with legal experts for compliance with regulations.</li> </ul>

	<ul style="list-style-type: none"> <li>• Promoting decentralized and participatory energy generation.</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Prioritizing local labour and suppliers for job creation and support to local businesses.</li> <li>• Implementing benefit-sharing mechanisms to distribute economic advantages equitably.</li> <li>• Accessing financial resources through policy frameworks.</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>• Fostering community involvement through ongoing communication, workshops, and citizen participation.</li> <li>• Empowering individuals in energy communities and wind projects.</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Using advanced noise reduction technologies to minimize turbine noise.</li> <li>• Embracing best practices for minimizing environmental impacts.</li> <li>• Planning for material reuse to support circular economy principles.</li> </ul>
Legal	<ul style="list-style-type: none"> <li>• Collaborating with legal experts to navigate legal complexities.</li> <li>• Establishing a well-structured legal framework for compliance and flexibility.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Conducting thorough environmental impact assessments to identify and mitigate negative effects.</li> <li>• Using low environmental impact materials during construction.</li> <li>• Implementing a comprehensive siting plan for harmonious integration.</li> <li>• Having a robust framework for decommissioning and landscape restoration.</li> </ul>

### Challenges identified in the Italian pilot case

The WENDY Italian pilot case confronts a series of challenges that span political, economic, sociocultural, technological, legal, and environmental dimensions. Each challenge presents unique hurdles that require strategic solutions for the successful implementation of the wind energy project.

**Regulatory and policy barriers at the regional or national level** can impede the progress of the wind farm project. Overcoming these barriers necessitates a concerted effort to revise and streamline regulations that hinder renewable energy development.

**The lack of alignment between different Ministries** can cause confusion and delays in decision-making processes. To overcome this, establishing cross-ministerial coordination and communication channels is crucial.

**Local stakeholder opposition and community resistance** to participate can hinder project advancement. Addressing this challenge requires proactive engagement with local communities, understanding their concerns, and integrating their feedback into project planning. Transparent and objective information dissemination channels should be established to counter misinformation and build trust.

**Bureaucracy and time-consuming processes** can lead to project delays. Simplifying bureaucratic procedures while maintaining environmental standards can help expedite project approvals. However, navigating the varied political landscape and managing opposition towards wind cooperatives necessitates tailored communication strategies and community outreach initiatives.

**Economic concerns**, including potential property devaluation and negative impacts on businesses, highlight the importance of integrating the renewable energy plan with broader economic and tourism development strategies. Clear communication regarding the benefits and potential mitigations is essential. Lack of clear financial information for citizens can be addressed through accessible information campaigns that outline the economic advantages for individuals and communities.

**Active cooperation between developers and local government** is often lacking. Establishing mechanisms for collaboration, such as joint planning committees, ensures that both parties align their objectives and work together harmoniously. Additionally, facilitating access to public funding for technology development projects in municipalities can be achieved by creating dedicated support structures and promoting partnerships.

**Public perception and misconceptions about wind energy** can result in opposition. Educating the public about the benefits of wind energy, dispelling myths, and showcasing successful case studies can reshape these perceptions. **Lack of community engagement and involvement in decision-making processes** can be mitigated through inclusive participatory forums that empower local residents to voice their opinions and influence project outcomes.

Increasing awareness of the importance of wind turbine maintenance and highlighting the positive impact of proper maintenance practices can address concerns and build public confidence. Similarly, identifying facilitating factors and potential barriers before initiating a new project can help avoid conflicts within the community and devise strategies to overcome them.

**Policy gaps and regulations concerning new technologies** need to be addressed to ensure a supportive environment for innovation. Building trust in new offshore technology involves transparent communication, collaboration with experts, and showcasing successful offshore projects from other regions. **Noise and vibration generated by wind turbine technology** can be mitigated through continuous research and development of quieter turbine designs.

**The potential impact on local wildlife and ecosystems** necessitates thorough environmental impact assessments and the implementation of mitigation measures. Strategies to minimize the **environmental impact during construction**, such as using low-impact construction techniques and habitat preservation, are essential. The **lack of recycling and reuse options for decommissioned wind turbines** highlights the need for sustainable end-of-life solutions.

The **lack of clear understanding of legal frameworks and compliance measures** can create uncertainty. Providing comprehensive guidance and training on legal aspects related to renewable energy projects can assist stakeholders in navigating the complex legal landscape. Addressing the **fragmentation of legal rules for renewable energy communities** requires harmonization and standardization efforts.

**High-capacity thresholds for energy community development** can limit participation. Evaluating and adjusting these thresholds to accommodate smaller-scale projects enables broader community involvement in renewable energy initiatives.

**No clear guidelines on sustainable practices** can lead to inconsistent environmental practices. Developing comprehensive guidelines for sustainable construction, operation, and decommissioning ensures responsible project management. Minimizing **degradation during operation** can be achieved through regular monitoring, maintenance, and proactive measures to prevent equipment wear.

Minimizing **visual impact** is important for maintaining the aesthetics of the surrounding landscape. Incorporating architectural and landscaping design elements that blend with the environment can help mitigate **visual disruptions caused by the wind farm**.

In summary, the Italian pilot case should embrace a holistic approach that not only emphasizes on the technical and economic aspects of wind energy but also acknowledges the importance of social engagement, environmental stewardship, legal compliance, and sustainable practices. Through the convergence of these elements, the wind farm project can serve as a model for responsible and impactful renewable energy development.

Table 7: Summary of the challenges identified in the Italian pilot case

Domain	Challenges
Political	<ul style="list-style-type: none"> <li>• Regulatory and policy barriers at the regional/national level.</li> <li>• Tailored communication strategies to navigate the political landscape and manage opposition.</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Economic concerns including property devaluation and negative impacts on businesses.</li> <li>• Integration with broader economic and tourism development strategies.</li> <li>• Accessible financial information campaigns to inform citizens about economic advantages.</li> <li>• Cooperation mechanisms between developers and local government.</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>• Local stakeholder opposition and community resistance.</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Policy gaps and regulations for new technologies.</li> <li>• There is no trust in offshore.</li> <li>• No research and development efforts.</li> </ul>
Legal	<ul style="list-style-type: none"> <li>• Lack of understanding of legal frameworks and compliance measures.</li> <li>• Lack of comprehensive guidance and training on legal aspects.</li> <li>• Lack of harmonization and standardization for legal rules concerning renewable energy communities.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Lack of comprehensive environmental impact assessments and mitigation measures.</li> <li>• Lack of strategies for minimizing environmental impact during construction, including low-impact techniques and habitat preservation.</li> <li>• No sustainable end-of-life solutions for decommissioned wind turbines.</li> </ul>

### 2.2.2. Definition of intervention areas

#### 1. Effective policy development and implementation

Actors such as national government/authorities can play a crucial role in developing and implementing effective policy frameworks, while local government/authorities



can facilitate proactive outreach and dialogue with communities. Representatives of wind energy producers and wind farm developers should actively participate in policy development, and regional policy makers can advocate for policies that promote wind farm projects at the community level. Actions in this area include developing and implementing these policy frameworks, promoting inclusive engagement, establishing information dissemination requirements, streamlining regulatory processes and communicating the benefits of collaboration.

## **2. Job creation and investment promotion**

National government/authorities play a key role in promoting job creation and investment in the relevant industries, while local government/authorities establish standard compensation procedures. Representatives of wind energy producers and wind farm developers support transparent financial reporting systems. Actions include promoting job creation and investment, introducing transparent financial reporting, setting compensation standards and streamlining processes with dedicated financing channels.

## **3. Community engagement and communication**

Local government/authorities create transparent communication channels and national government/authorities advocate for a legal framework that supports community wind farm projects. Representatives of Wind Energy Cooperatives develop tailored community engagement strategies, and farmers/fishermen participate in pre-installation surveys. Actions include establishing effective communication channels, effectively engaging communities, providing public information via digital screens, encouraging citizen participation.

## **4. Technological advancement**

National government/authorities advocate for a legal framework that promotes cooperation with experts, while representatives of wind energy producers and wind farm installation companies focus on the development and implementation of innovative technologies. Wind energy providers invest in research and development for recycling and reuse. Actions in this area include addressing regulatory gaps in Environmental Impact Assessments, introducing innovative technologies with a low environmental footprint, investing in research for sustainability and sharing data on existing offshore installations.

## **5. Legal framework development**

National government/authorities play a central role in developing clear legal guidelines and providing training on the legal framework, and local government/authorities advocate for a legal framework that supports community

wind farm projects. Actions include developing guidelines, providing legal training, improving cooperation with experts and advocating for legal frameworks that support community projects.

## 6. Sustainable practices and impact mitigation

Local government/authorities can establish strong frameworks for decommissioning and restoring the landscape, while representatives of wind energy producers and companies constructing wind farms can focus on the use of low environmental impact materials in construction. Measures include comprehensive Environmental Impact Assessments with sustainable guidelines, environmentally friendly construction materials and robust frameworks for decommissioning and restoration.

## 2.3. Norway pilot case

**Lead pilot partner:** NOWC is the WENDY pilot representative for three different wind farm areas in Norway, carefully selected for their significant offshore wind potential, two of which are currently in the planning phase and one of which is scheduled for construction later this year. The first area, Hywind Tampen, is scheduled for construction in 2022 and will be the largest floating offshore wind farm in the world. It consists of 11 turbines with a capacity of 8 megawatts each. Its main goal is to supply electricity to the Snorre and Gullfaks offshore oil and gas platforms in the Norwegian North Sea. The second and third areas, Utsira Nord (floating, approx. 1500 MW) and Sørilige Nordsjø II (bottom-fixed, 3000 MW), have been made available for allocation and licensing in 2020 and mark important developments in offshore renewable energy production.

These three projects are located in the southern to southwestern regions of Norway and provide a unique opportunity to evaluate the licensing process and the consideration of social and environmental factors, both retrospectively and prospectively, as well as in terms of bottom-fixed versus floating technologies. However, the challenges associated with these projects are considerable, as their remote offshore locations mean that there is no comprehensive data on critical ecosystem components such as the impact of noise on marine life such as fish and whales, and potential collisions with seabirds and migratory birds. The methodology for conducting effective Environmental Impact Assessments (EIAs) to adequately address environmental risks remains unclear, and this uncertainty can potentially lead to social conflict in the future.

### 2.3.1. Regional needs and challenges

#### Needs identified in the Norwegian pilot case

In the context of the WENDY Norwegian pilot case, a comprehensive and integrated approach is essential to address its multifaceted needs. The successful establishment and operation of a wind farm necessitate attention to various dimensions, each of which plays a crucial role in ensuring the project's viability, sustainability, and positive impact on the region.

**Political framework conditions** are the basis for efficient approvals of wind energy projects. By streamlining these frameworks, the regulatory process becomes smoother, reducing delays and uncertainties. Moreover, **engaging stakeholders through dialogue mechanisms** fosters a sense of community ownership. **Building on the legacy of cooperatives** ensures that local communities remain integral to future project developments. This also aligns with the facilitation of new energy communities, empowering regions to actively participate in clean energy generation. The wind farm project brings forth **economic opportunities for local communities**. In particular, there is a **need to review compensation rules and practices for those affected**, especially fishermen whose livelihoods may be affected. **Clear policy frameworks** regarding public funding eligibility and access for municipalities create transparency and equal access. **Public investment strategies related to electricity prices** can stabilize the economic landscape. Moreover, **determining a minimum guaranteed electricity** selling price for community-initiated wind farms safeguards their financial feasibility.

**Effective communication strategies**, characterized by transparency and clarity, are essential for gaining public support. **Community engagement programs** foster a sense of involvement and awareness. **Promoting the positive impact of wind energy farms** counteracts misinformation. **Respecting ethical cultural practices and traditions** ensures that the project integrates harmoniously with the region's identity. **Transparent communication** about the benefits of wind farms further strengthens community trust.

Conducting thorough **environmental impact assessments** safeguards the local ecosystem. **Innovations in noise reduction technology** and adherence to best practices minimize disturbances from turbine noise. Reducing the **visual impact** through lower intensity light markings maintains the landscape's aesthetic appeal. Ongoing research to **lower the levelized cost of energy (LCOE)** enhances economic feasibility. Prioritizing a lower carbon footprint during construction and installation aligns with broader environmental goals. Investigating circularity and decommissioning methods ensures responsible end-of-life strategies.

**A clear understanding of legal frameworks and compliance measures** is essential to prevent legal conflicts. Establishing a responsible regulatory body for licensing and

supervision ensures adherence to regulations. Developing a **long-term politically independent strategy** prevents policy fluctuations that can hinder progress. Crafting **marine plans in coordination with legal frameworks** ensures sustainable spatial allocation. **Adapting tax regulations to offshore wind** supports project viability and incentivizes investment.

Implementing sustainable practices **minimizes the environmental footprint** of the wind farm. Special measures for safe operation enhance the project's safety profile. Research into emissions from turbine blade wear addresses potential concerns. Conducting bird migration studies and fish research and monitoring programs mitigate ecological impacts. Establishing a **comprehensive system for decommissioning** ensures responsible closure and site rehabilitation.

Table 8: Summary of the needs identified in the Norwegian pilot case

Domain	Needs
Political	<ul style="list-style-type: none"> <li>• Streamlining political framework conditions for wind energy project approvals.</li> <li>• Engaging stakeholders through dialogue mechanisms.</li> <li>• Building on cooperative legacies for community involvement.</li> <li>• Facilitating new energy communities.</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Reviewing compensation rules for affected parties, especially fishermen.</li> <li>• Clear policy frameworks for public funding eligibility.</li> <li>• Public investment strategies for stable economic landscapes.</li> <li>• Guaranteed electricity selling price for community-initiated wind farms.</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>• Effective communication strategies for gaining public support and awareness.</li> <li>• Community engagement programs and promoting the positive impact of wind energy.</li> <li>• Respecting cultural practices and traditions.</li> <li>• Transparent communication about wind farm benefits.</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Conducting environmental impact assessments and innovations in noise reduction technology. - Lowering visual impact with reduced light markings.</li> <li>• Research to lower the levelized cost of energy (LCOE).</li> </ul>

	<ul style="list-style-type: none"> <li>• Prioritizing a lower carbon footprint during construction.</li> <li>• Investigating circularity and decommissioning methods.</li> </ul>
Legal	<ul style="list-style-type: none"> <li>• Understanding legal frameworks and compliance measures.</li> <li>• Establishing a responsible regulatory body for licensing and supervision.</li> <li>• Developing a long-term politically independent strategy.</li> <li>• Crafting marine plans in coordination with legal frameworks.</li> <li>• Adapting tax regulations to support offshore wind projects.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Implementing sustainable practices to minimize the environmental footprint.</li> <li>• Special measures for safe operation.</li> <li>• Research on emissions from turbine blade wear.</li> <li>• Bird migration and fish research, along with monitoring programs.</li> <li>• Comprehensive system for decommissioning and site rehabilitation.</li> </ul>

### Challenges identified in the Norwegian pilot case

In the WENDY Norwegian pilot case, an analysis of the multiple challenges faced is essential to develop effective strategies that promote the successful development, operation and integration of offshore wind farms. These challenges span several areas and underline the complexity of sustainable energy projects.

The wind farm project faces **regulatory and policy barriers at regional and national levels**, necessitating an alignment of objectives and coordinated efforts. **Assigning roles to stakeholders** is complicated by different regulatory frameworks, highlighting the need for clarity. Harmonizing with emerging EU regulations ensures compliance and cross-border collaboration. The **time-consuming commissioning process** underscores the urgency for streamlined procedures. Overcoming **opposition from local stakeholders, community groups, and even industry entities** demands inclusive and transparent communication. Addressing **national resistance to offshore wind** requires advocacy and evidence-based discussions. Bridging the **lack of offshore wind experience in Norway** requires knowledge exchange and capacity-building. The development of innovative cooperation models that are oriented towards market trends and societal changes is of utmost importance in the rapidly developing sector of wind energy.

**Economic concerns** include devaluation of property and negative impacts on local businesses, requiring comprehensive compensation schemes. To compensate for

**perceived economic inequalities**, it is important to achieve fair outcomes. The **potential impacts on fisheries and the associated loss of income** require joint mitigation efforts. The **coexistence of wind farms with existing industries** requires strategic planning. Establishing **eligibility criteria and simplified access mechanisms** ensures equitable participation. **High electricity prices for floating offshore wind projects** require price stabilisation strategies to encourage investment. Establishing a balanced guaranteed minimum electricity selling price aligns economic viability with consumer interests.

**Engaging diverse stakeholders** with varying levels of knowledge and communication preferences requires tailored outreach strategies. **Addressing the different interests of stakeholders** requires active listening and cooperation. Combating misinformation and false facts through transparent communication is crucial. Demonstrating the positive climate impact of the project encourages public support. Integrating wind farms into the local landscape and cultural fabric should be **in line with the community's identity**. Transparency and accountability are needed to build public trust in the wind industry.

**Mitigating cumulative effects, wildlife habitat degradation and ecological sensitivities** requires careful project planning. The credibility of environmental impact assessments (EIAs) supports informed decision-making. Dealing **with noise and vibration caused by wind turbines** requires innovative noise reduction measures. Investigating **potential impacts of electromagnetism on marine life** highlights the importance of comprehensive impact assessments. Minimising **disturbance to wildlife and visual aesthetics** requires thoughtful planning and siting of wind turbines. Moving to cost-effective technology for floating offshore wind turbines improves **project feasibility**. Reducing the **carbon footprint of materials and technologies** is in line with Norway's sustainability goals. Exploring circular economy and end-of-life management is crucial to reduce waste of wind energy projects.

Dealing with **complex and evolving legal frameworks, regulations and compliance** measures requires legal expertise and adaptable strategies. Centralised coordination is needed to reduce **regulatory fragmentation**. Resolving **conflicts between aviation safety and bird safety regulations** underscores the need for differentiated solutions. Ensuring continuity and consistency of policy across political cycles is critical to avoid disruption. Developing holistic marine spatial planning ensures **sustainable use of marine resources**. Addressing the **complexity of tax regulations** requires interdisciplinary collaboration. Overcoming **industry resistance to taxes** on resource use requires convincing arguments supported by evidence.

**Impacts on the marine ecosystem, noise pollution and material sustainability** are important environmental issues. Studying the impact on local wildlife, ecosystems and fish populations is an essential part of responsible project development. In particular, strict regulatory oversight is needed to mitigate the potential impacts of chemicals and

substances on marine ecosystems. Challenges posed by **extreme weather conditions, remote locations and offshore logistics** require robust engineering solutions. Comprehensive studies on **turbine wear and their ecological impact** are essential. By addressing these challenges in a holistic and collaborative manner, the Norwegian pilot case can serve as a model for offshore wind energy projects while paving the way for sustainable development, economic growth and environmental protection.

Table 9: Summary of the challenges identified in the Norwegian pilot case

Domain	Challenges
Political	<ul style="list-style-type: none"> <li>Regulatory and policy barriers at regional and national levels require alignment and coordination.</li> <li>Clear assignment of stakeholder roles is needed.</li> <li>Harmonization with EU regulations and streamlined procedures are essential.</li> <li>Advocacy to overcome national resistance to offshore wind is necessary.</li> <li>Development of innovative cooperation models is important.</li> </ul>
Economic	<ul style="list-style-type: none"> <li>Devaluation of property and impacts on local businesses necessitate comprehensive compensation schemes.</li> <li>Fair outcomes and mitigation of impacts on fisheries are vital.</li> <li>Strategic planning for coexistence with existing industries is required.</li> <li>Equitable participation through eligibility criteria and access mechanisms is important.</li> <li>Price stabilisation strategies and a guaranteed minimum electricity selling price are needed.</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>Tailored outreach strategies for diverse stakeholders are required.</li> <li>Active listening and cooperation to address different interests.</li> <li>Combating misinformation and demonstrating positive climate impact are crucial.</li> <li>Integration into the local landscape and cultural fabric should align with the community's identity.</li> </ul>

- Transparency and accountability are essential for building public trust.

Technological	<ul style="list-style-type: none"> <li>• Careful project planning to mitigate cumulative effects and ecological sensitivities is necessary.</li> <li>• Credible environmental impact assessments (EIAs) support informed decision-making.</li> <li>• Innovative noise reduction measures and impact assessments for electromagnetism are important.</li> <li>• Thoughtful planning and siting of wind turbines for minimal disturbance.</li> <li>• Transition to cost-effective technology and reducing the carbon footprint are aligned with sustainability goals.</li> </ul>
---------------	--

- |       |   |
|-------|---|
| Legal | <ul style="list-style-type: none"> <li>• Dealing with complex and evolving legal frameworks requires legal expertise and adaptable strategies.</li> <li>• Centralized coordination to reduce regulatory fragmentation is needed.</li> <li>• Resolution of conflicts between aviation safety and bird safety regulations is important.</li> <li>• Consistency of policy across political cycles is critical.</li> <li>• Holistic marine spatial planning and addressing tax regulations complexity are essential.</li> </ul> |
|-------|---|

Environmental	<ul style="list-style-type: none"> <li>• Studying impacts on local wildlife, ecosystems, and fish populations is essential.</li> <li>• Strict regulatory oversight for potential impacts of chemicals and substances on marine ecosystems is needed.</li> <li>• Robust engineering solutions for extreme weather conditions and remote locations are required.</li> <li>• Comprehensive studies on turbine wear and ecological impact are essential for sustainability.</li> </ul>
---------------	--

### 2.3.2. Definition of intervention areas

#### 1. Policy development and implementation

National government/authorities play a crucial role in developing and implementing streamlined policy frameworks, harmonising decision-making processes and accelerating Environmental Impact Assessments (EIAs). Local government/authorities facilitate dual consultation processes for nearshore/offshore scenarios and create transparent administrative procedures. Representatives of wind energy producers and

wind farm developers should implement stakeholder engagement strategies, and Wind Energy Cooperatives can promote continuous education and knowledge sharing among members. Measures include developing streamlined policy frameworks, facilitating dual consultations, accelerating EIAs, implementing stakeholder engagement strategies and promoting continuous education and training.

## **2. Job Creation, Investment, and Compensation**

National government/authorities can promote job creation, evaluate alternative compensation methods and improve access to financial participation quotas, while local government/authorities can implement standard compensation procedures for municipalities. Representatives of wind energy producers and wind farm developers conduct surveys on economic impacts and conduct independent research on wind farm impacts. Farmers/fishermen can assess possible changes in fishing practices. Energy distributors can play a role in conducting independent research on the impacts of wind farms.

## **3. Community Engagement and Communication**

Local government/authorities craft communication strategies that effectively convey complex information transparently and engage local communities. National government/authorities ensure fact-checking mechanisms and open communication, while wind energy providers calculate and present climate factors. Wind farm developers engage cultural experts and landscape architects, and Academia and NGOs ensure transparent information dissemination.

## **4. Environmental Impact Assessment and Innovation**

National government/authorities can engage multidisciplinary environmental teams, invest in research and support R&D efforts. Representatives of wind energy producers and wind farm installation companies can develop innovative technologies, conduct visibility studies and assessments, and invest in research. Academia and NGOs can contribute to R&D efforts.

## **5. Legal Framework Development**

National government/authorities develop clear legal guidelines, collaborate with stakeholders and advocate for industry-specific operating frameworks, while local government/authorities advocate for such frameworks. Wind energy cooperatives engage in dialogue with government and industry, and NGOs contribute to regulations for decommissioning. Actions include developing legal guidelines, advocating for sector-specific frameworks, dialogue and contributing to decommissioning regulations.

## 6. Environmental Impact Mitigation and Sustainability

National government/authorities conduct comprehensive environmental impact assessments, while representatives of wind energy producers and wind farm installation companies implement nature-friendly solutions and sustainable practices, and explore co-production opportunities with farmers/fishermen. Academia and NGOs support research on environmental impacts.

### 2.4. Greece pilot case

**Lead pilot partner:** MINOAN manages a dynamic energy community, the Minoan Energy Community (MEC), which was established in Arkalochori in 2019. In just 25 months of existence, MEC has become the largest energy community in Greece, with over 300 individual members, the active participation of three Municipalities, and the Regional Authority of Crete as official stakeholders, jointly holding the majority of capital shares. MEC hosts solar energy projects already in operation, including a photovoltaic park generating 405 kW of power. The energy community in Crete is ready to expand its horizons by venturing into wind farm development. Three commercial wind farms with a total capacity of 33 MW are already in the planning and licensing phase. There are also plans for an extensive hybrid power plant with a pumped storage system and wind farms with an estimated total capacity of over 90 MW.

Nevertheless, MEC acknowledges that there are likely to be challenges, as despite strong local engagement and familiarity with the concept of social ownership in renewable energy projects, there may still be reactions and social opposition to the establishment of wind farms, especially from organised groups. Looking to the future, MEC envisions the potential replication of its successful model and to apply the lessons learned from the WENDY project to one or two additional islands beyond Crete. Sifnos, one of the six pilot islands of the "Clean Energy for EU Islands" initiative, is one such potential case where concerns about the natural environment and the aesthetics of the island need to be taken into account to ensure social acceptance.

#### 2.4.1. Regional needs and challenges

##### Needs identified in the Greek pilot case

The success of the WENDY Greek pilot case relies on a comprehensive approach that addresses various key aspects, including political, economic, sociocultural, technological, legal, and environmental factors. Each of these dimensions plays a pivotal role in ensuring the smooth development and operation of wind energy projects while maximizing benefits for local communities and the environment.

In order to foster the growth of wind energy in Greece, **a set of well-defined policy frameworks** must be established. These frameworks should streamline the approvals process for wind energy projects, reducing bureaucratic hurdles and expediting the implementation timeline. Additionally, the **creation of stakeholder engagement platforms and ongoing dialogue mechanisms** will facilitate open communication between project developers, local communities, and regulatory bodies. This inclusive approach ensures that concerns are addressed and local perspectives are incorporated into project planning. The **formulation of a general siting plan**, complete with priority sites for wind farm installation, provides a roadmap for efficient utilization of available resources. Moreover, the **definition of distinction criteria for energy communities** is essential to ensure that the benefits of wind energy are equitably distributed. A **cooperative legal framework designed specifically for energy communities** further promotes collaboration and participation in wind energy initiatives.

Wind energy projects offer significant **economic development opportunities** for local communities. By participating in these projects, communities can benefit from direct and indirect job creation, increased local spending, and potential revenue sharing agreements. To encourage local involvement, **incentives and support mechanisms** should be established, enabling communities to actively participate in wind energy initiatives. Community-initiated wind farm projects should receive **eligibility and priority status in subsidies and funding calls**, incentivizing their establishment. In addition, **regulatory measures to address grid disconnections** caused by new wind farm projects will ensure the smooth integration of wind energy into the existing electrical infrastructure. Reviewing **compensation rules** for affected parties, such as fishermen, ensures fairness and just compensation. Determining a **minimum guaranteed electricity selling price for community wind farms** provides financial stability and predictability.

**Transparent and effective communication strategies** are crucial for building public awareness and support for wind energy projects. **Community engagement programs** should be designed to involve local residents in the decision-making process, giving them a sense of ownership. **Capacity building campaigns** will educate citizens about the benefits of wind energy and dispel any myths or misconceptions. **Citizen participation in energy communities and wind projects** fosters community pride and engagement, and thus the overall success of the initiatives.

**Environmental impact assessments** are essential for assessing the potential ecological impact of wind farms. Innovations aimed at mitigating these impacts should be researched and included in project planning. In particular, the use of noise reduction technologies is essential to minimise the acoustic impact of turbines on surrounding areas. Research and development efforts should focus on increasing turbine efficiency and overcoming technical challenges to **improve overall energy production and project sustainability**. The presence of a robust electrical grid and adequate general

infrastructure is crucial for the **effective transmission of generated energy to consumers**.

A **clear understanding of the legal framework and compliance measures** is essential to navigate the regulatory landscape. Collaborating with legal experts ensures that all complex legal issues are clarified to reduce legal risks and uncertainties. Creating a legal framework that promotes and facilitates community wind farm projects gives municipalities the opportunity to actively participate in the energy transition.

Sustainable practices should be adopted to **minimise the environmental footprint of wind energy projects** and ensure that the benefits of wind energy are not outweighed by negative environmental impacts. The introduction of specific measures for the **safe operation of wind farms** raises safety standards. Research into the impacts of wind farms on wildlife and ecosystems is used to develop measures to **mitigate negative impacts**. The regional siting plan takes into account the potential impacts on the natural environment, enabling informed decisions to be made. In addition, the **exploitation of recycling potential** contributes to an environmentally friendly life cycle management of the wind energy infrastructure.

In summary, the Greek wind farm pilot case requires a holistic approach that takes into account political, economic, socio-cultural, technological, legal and environmental aspects. If each of these aspects is addressed systematically, wind energy projects in the Greek pilot area can benefit both local communities and the environment while contributing to the transition to renewable energy sources.

Table 10: Summary of the needs identified in the Greek pilot case

Domain	Needs
Political	<ul style="list-style-type: none"> <li>• Establish well-defined policy frameworks to streamline approvals for wind energy projects.</li> <li>• Create stakeholder engagement platforms and ongoing dialogue mechanisms.</li> <li>• Formulate a general siting plan for efficient resource utilization.</li> <li>• Define criteria for energy communities.</li> <li>• Develop a cooperative legal framework for energy communities.</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Local economic development opportunities through job creation and increased spending.</li> <li>• Incentives and support mechanisms for local community involvement.</li> <li>• Eligibility and priority status for subsidies and funding calls.</li> </ul>

	<ul style="list-style-type: none"> <li>• Regulatory measures to address grid disconnections.</li> <li>• Review compensation rules for affected parties.</li> <li>• Determine a minimum guaranteed electricity selling price.</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>• Transparent and effective communication strategies.</li> <li>• Community engagement programs and capacity building campaigns.</li> <li>• Citizen participation in energy communities and wind projects.</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Environmental impact assessments and innovations to mitigate ecological impacts.</li> <li>• Use of noise reduction technologies to minimize acoustic impact.</li> <li>• Research and development for turbine efficiency and sustainability.</li> <li>• Adequate electrical grid and general infrastructure.</li> </ul>
Legal	<ul style="list-style-type: none"> <li>• Collaborate with legal experts to navigate the regulatory landscape.</li> <li>• Create a legal framework for community wind farm projects.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Adopt sustainable practices to minimize the environmental footprint.</li> <li>• Specific measures for safe wind farm operation.</li> <li>• Research on impacts on wildlife and ecosystems.</li> <li>• Consideration of potential environmental impacts in regional siting plans.</li> <li>• Exploitation of recycling potential for wind energy infrastructure.</li> </ul>

### Challenges identified in the Greek pilot case

The WENDY Greek wind farm pilot case have identified several challenges that span various dimensions, including political, economic, socio-cultural, technological, legal and environmental factors. Overcoming these challenges is crucial for the successful development and operation of wind energy projects while safeguarding the interests of local communities and the environment.

Overcoming **regulatory and policy barriers at both regional and national levels** is a major hurdle. Although policy frameworks exist, their implementation and

effectiveness have proven to be insufficient, often leading to blockages. **Resistance from local stakeholders and community associations**, who feel marginalised and not heard in project decisions, also contributes to resistance. The **lack of transparent information channels** makes it difficult for citizens to access project-related details. **Existing ties between politicians and investors** can hinder the approval of projects at the local level, while rigid administrative laws and the lack of clear and uniform criteria contribute to regulatory complexity. In addition, the **lack of political will** to involve the public in wind energy projects is a major challenge.

**Economic concerns**, such as devaluation of land and negative impacts on businesses, play a major role. **Synergies between renewable energy plans and local economic development**, including tourism, need to be explored. The economic benefits of wind energy projects are often unclear, making it difficult to demonstrate their positive impacts. To increase citizens' financial participation in projects, **information gaps and financing difficulties** need to be addressed. The **high capital costs of wind energy projects** are a significant obstacle, and the **lack of clear eligibility criteria and priority in competition** with other renewable energy projects further complicates matters. There is also a **lack of economic incentives for energy communities** to participate and produce, which inhibits their engagement. The **large increase in new connections** puts a strain on the grid and the erratic nature of wind energy poses reliability challenges. **Potential impacts on fisheries and loss of income** also need to be carefully weighed, especially in coastal communities.

**Public perception and misconceptions** about wind energy hinder acceptance. There is **a lack of understanding of the benefits** of wind energy and a **lack of effective communication strategies** to reach diverse stakeholders. Dealing with energy poverty and its solutions is not well understood by communities. The **low level of public interest and engagement** in wind farm technologies highlights the need for awareness-raising activities. The importance of community practices and processes is underestimated, leading to disengagement. Communities lack motivation to actively participate in wind farm development, often remaining uninvolved.

**Time-consuming environmental impact assessment (EIA)** procedures delay project progress. The **erratic nature of wind energy** poses a challenge to grid stability and energy supply. **Noise and vibration generated by current wind turbine technology** can lead to public opposition and discomfort. The **availability of smaller wind turbine models with lower nominal power** further limits project options. In addition, the existing **electrical grid is not able to support new wind farms**, leading to technical limitations.

**Outdated or unclear information about the regulatory framework** creates confusion and uncertainty. Potential delays and conflicts arise from **legal ambiguities**. **High capacity thresholds for energy community development** are a barrier to market entry. The **rigidity of the legal framework**, often imposed by central government, limits the

flexibility of regional authorities to adapt to local challenges. In addition, the existing legal framework does not provide an easy way for small investors and local community-based initiatives to participate in wind farm projects, making their engagement difficult.

The ***potential impact of wind farms on local wildlife and ecosystems*** raises environmental concerns. Compliance with specific environmental requirements imposed by the authorities makes project planning even more complex. Collaboration with environmental associations is essential to balance energy goals with conservation efforts. Wind farm development can **negatively impact existing human activities**, requiring ***careful site selection and mitigation strategies***. The ***lack of guidelines and best practices for decommissioning*** poses challenges for responsible project closure and site restoration.

In summary, the Greek wind farm pilot case have identified political, economic, socio-cultural, technological, legal and environmental challenges. Overcoming these challenges through well-coordinated efforts, innovative solutions and the involvement of all stakeholders is crucial for the successful and sustainable development of wind energy projects in the Greek pilot area.

Table 11: Summary of the challenges identified in the Greek pilot case

Domain	Challenges
Political	<ul style="list-style-type: none"> <li>• Overcoming regulatory and policy barriers at regional and national levels.</li> <li>• Resistance from local stakeholders and community associations.</li> <li>• Lack of transparent information channels.</li> <li>• Ties between politicians and investors.</li> <li>• Regulatory complexity due to rigid laws and unclear criteria.</li> <li>• Lack of political will to involve the public.</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Economic concerns, including land devaluation and negative impacts on businesses.</li> <li>• Exploring synergies between renewable energy and local economic development.</li> <li>• Unclear economic benefits of wind energy projects.</li> <li>• Addressing information gaps and financing difficulties.</li> <li>• High capital costs and unclear eligibility criteria.</li> <li>• Lack of economic incentives for energy communities.</li> <li>• Strain on the grid and potential impacts on fisheries.</li> </ul>

Sociocultural	<ul style="list-style-type: none"> <li>• Public perception and misconceptions about wind energy.</li> <li>• Lack of understanding and effective communication strategies.</li> <li>• Energy poverty and its solutions not well understood.</li> <li>• Low public interest and engagement in wind farm technologies.</li> <li>• Underestimation of community practices and processes.</li> <li>• Lack of motivation for community participation.</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Time-consuming environmental impact assessment (EIA) procedures.</li> <li>• Challenges to grid stability and energy supply.</li> <li>• Noise and vibration generated by wind turbine technology.</li> <li>• Limited options due to smaller wind turbine models.</li> <li>• Inadequate electrical grid support for new wind farms.</li> </ul>
Legal	<ul style="list-style-type: none"> <li>• Outdated or unclear information about the regulatory framework.</li> <li>• Potential delays and conflicts arising from legal ambiguities.</li> <li>• High capacity thresholds for energy community development.</li> <li>• Rigidity of the legal framework imposed by central government.</li> <li>• Lack of avenues for small investors and local initiatives to participate.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Potential impact of wind farms on local wildlife and ecosystems.</li> <li>• Compliance with specific environmental requirements.</li> <li>• Collaboration with environmental associations.</li> <li>• Careful site selection and mitigation strategies.</li> <li>• Lack of guidelines and best practices for decommissioning.</li> </ul>

### 2.4.2. Definition of intervention areas

#### 1. Policy development and implementation

In policy intervention area for the Greek pilot case, the focus is on developing and implementing streamlined policy frameworks, assessing the effectiveness of policies, establishing stakeholder engagement platforms and encouraging greater participation in the development. In addition, it is important to improve consultation mechanisms, provide public documents and develop inclusive site plans and criteria through joint

efforts. Stakeholders such as national and local governments, wind energy producers, cooperatives and experts are jointly responsible for ensuring that these policy initiatives are successful.

## **2. Job Creation, Investment, and Compensation**

Economic interventions aim to promote job creation, increase financial accessibility and ensure equitable distribution of benefits. These include mechanisms such as crowdfunding, community investment programmes and support for smaller energy wind turbine models. Stakeholders, including wind energy producers, cooperatives, developers and national and local governments, have an important role to play in facilitating these economic initiatives. They also need to advocate for effective regulations, grid management and technology integration, while promoting community participation and access to public funding for technology development projects.

## **3. Community Engagement and Communication**

Socio-cultural interventions include creating effective communication channels, educating communities about the benefits of wind energy, capacity building programmes and community engagement strategies. Stakeholders such as wind energy producers, cooperatives, developers and local governments are responsible for these actions, as well as for addressing energy poverty, organising outreach, awareness raising and economic participation of local people. Financing mechanisms for community-based projects also fall within their remit.

## **4. Technological advancement**

In the technological field, the simplification of processes through cooperation with local authorities and the integration of energy storage solutions are crucial. Stakeholders, including wind energy providers, developers and local authorities, also need to focus on innovation, research and development, grid strengthening and collaboration with electricity storage technologies.

## **5. Legal framework development**

Legal interventions necessitate the development of clear guidelines, training on the legal framework and the introduction of licensing criteria in cooperation with authorities. Effective collaboration and communication between project teams and legal experts, and advocacy for legal frameworks that support community wind farm projects and flexibility at the regional level, requires the involvement of multiple stakeholders, including national and local governments, wind energy producers, cooperatives and developers. Licensing priorities for energy communities also require their combined efforts.

## **6. Environmental Impact Mitigation and Sustainability**

Environmental measures involve public education, proper implementation of regional siting plans, site selection, comprehensive EIAs, research into environmental impacts and the development of recycling guidelines and regulations. Cooperation between local authorities, wind energy developers, providers and cooperatives is essential for these measures to minimise environmental impacts and ensure responsible decommissioning and recycling of wind farms through pilot programmes.

## 3. EU-level analysis

---

This section provides an overview of the results of the expert assessments and discussions focusing on the main needs and challenges of stakeholders in the wind farm sector at EU level. Several joint working group sessions were held involving WENDY partners, namely White Research, Q-PLAN and T2.4 partners. The results of these working group sessions are categorised according to their thematic relevance. Furthermore, intervention areas are presented based on the analysis of the identified needs and challenges.

### 3.1. Identified needs

Several political needs for the wind power sector have been identified at EU level. The wind energy sector requires a **streamlined approval process** for projects at the EU level. This involves reducing bureaucratic hurdles and ensuring that projects can move forward efficiently. Establishing robust **stakeholder engagement platforms** and ongoing dialogue mechanisms is crucial. These platforms should facilitate communication and collaboration between various stakeholders, including industry representatives, environmental organizations, and local communities. There is a need for strong **political willingness, support, and leadership** at all levels - local, regional, national, and EU - to drive wind energy policies and projects. This ensures that renewable energy initiatives receive the necessary backing for successful implementation. **Clear and straightforward policies and regulations** are essential for the development of wind energy projects. This clarity helps investors and developers navigate the regulatory landscape and make informed decisions. Suitable **communication and public engagement strategies** are needed at all levels of governance. These strategies should inform and engage the public in understanding the benefits of wind energy while addressing any concerns. EU Member States need strong solidarity and **political support** to implement EU energy and maritime policies and regulations, ensuring compliance with EU and international law, including the Law of the Sea (Johansen et al., 2020).

At the economic front, wind energy projects should provide **economic development opportunities for local communities**. This includes job creation and the potential for revenue generation. **Incentives and support mechanisms** are needed to encourage active participation from local communities in wind energy initiatives. These mechanisms should also help address the economic challenges associated with the energy transition. **Financial incentives**, such as subsidies and low-interest loans, are essential to attract investors to wind energy projects. These incentives mitigate economic risks tied to fluctuating energy prices.

The sociocultural needs of the wind farm sector at EU level include **transparent and effective communication** and public awareness strategies that are necessary to address public concerns and educate the public about the benefits of wind energy. Transparent and meaningful **community engagement programs** should involve local residents in the planning, licensing, and development of wind energy projects. This promotes acceptance in the community. Incentive schemes should be developed to distribute **economic benefits to local communities in a fair manner**, possibly by using social ownership models to ensure equitable sharing of project benefits. Vulnerable or disadvantaged groups should be protected and actively engaged in all stages of a wind farm project to ensure that the **benefits reach everyone**. The development of good practices including **sustainability frameworks** should be encouraged in order to promote responsible wind energy projects.

From a technological perspective, robust **environmental impact assessments** are required to identify and mitigate potential risks to wildlife and ecosystems associated with wind energy projects. Innovation in **noise reduction technologies** and best practices is crucial to minimize the impact of turbine noise on local communities and wildlife. Investment in **research and development efforts** is necessary to improve turbine efficiency and address technical challenges in wind power generation. Advancements in **energy storage technology** are needed to ensure a stable electricity supply from wind energy, especially during periods of low wind. Developments in turbine design and siting are necessary to **mitigate the visual impact of wind farms** on the landscape and surrounding areas.

At a legal level, a clear understanding of **legal frameworks and compliance measures** is essential for developers to operate within the law. **Collaboration with legal experts** is required to navigate legal complexities associated with wind energy projects. **Harmonizing legal requirements** and establishing enabling regulatory frameworks across EU Member States is crucial. This includes addressing administrative burdens and time constraints. Promoting policies and regulations that enable **cross-border cooperation** in wind power generation and supply fosters a more integrated and efficient European energy market.

Comprehensive **environmental impact assessments** at EU level are essential to identify and mitigate potential risks to wildlife and ecosystems associated with wind energy projects. Adoption of **sustainable planning and technology practices** is necessary to minimize and monitor the environmental impact of wind energy projects in real operational conditions. Development of technology and strategies for the **sustainable end-of-life management** of wind energy projects, including the disposal of wind turbine components and rare earth metals, is critical for environmental sustainability.

**Consulting with environmental organizations and local communities** during the planning and installation phases of wind farms helps address environmental concerns.

The **integration of wind energy projects** into special protected areas, taking into account ecological sensitivities, is essential for preserving biodiversity and ecosystems.

Table 12: Summary of the needs identified at EU level

Domain	Needs
Political	<ul style="list-style-type: none"> <li>• Streamlined approval process for EU-level wind energy projects.</li> <li>• Robust stakeholder engagement platforms and dialogue mechanisms.</li> <li>• Strong political willingness, support, and leadership at all levels.</li> <li>• Clear and straightforward policies and regulations.</li> <li>• Suitable communication and public engagement strategies.</li> <li>• Solidarity and political support among EU Member States.</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Economic development opportunities for local communities.</li> <li>• Incentives and support mechanisms for community participation.</li> <li>• Financial incentives, such as subsidies and low-interest loans.</li> <li>• Mitigating economic risks tied to fluctuating energy prices.</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>• Transparent and effective communication and public awareness strategies.</li> <li>• Meaningful community engagement programs.</li> <li>• Incentive schemes for fair distribution of project benefits.</li> <li>• Protection and engagement of vulnerable or disadvantaged groups.</li> <li>• Promotion of responsible wind energy projects.</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Robust environmental impact assessments to identify and mitigate risks to wildlife and ecosystems.</li> <li>• Innovation in noise reduction technologies and best practices.</li> <li>• Research and development for turbine efficiency and addressing technical challenges.</li> <li>• Advancements in energy storage technology.</li> </ul>

	<ul style="list-style-type: none"> <li>• Developments in turbine design and siting to mitigate visual impact.</li> </ul>
Legal	<ul style="list-style-type: none"> <li>• Clear understanding of legal frameworks and compliance measures.</li> <li>• Collaboration with legal experts to navigate complexities.</li> <li>• Harmonizing legal requirements and enabling regulatory frameworks.</li> <li>• Promotion of cross-border cooperation in wind power generation.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Comprehensive environmental impact assessments at EU level.</li> <li>• Adoption of sustainable planning and technology practices.</li> <li>• Development of strategies for sustainable end-of-life management.</li> <li>• Consultation with environmental organizations and local communities.</li> <li>• Integration of wind energy projects into special protected areas.</li> </ul>

### 3.2. Identified challenges

Several challenges for the wind energy sector have also been identified at EU level. One of the primary political challenges facing the wind farm sector at the EU level is the **presence of regulatory and policy barriers** at the regional or national level. These barriers can hinder the smooth development and operation of wind energy projects. **Opposition from local stakeholders** and community groups can pose significant challenges. Resistance from these groups may be based on concerns about environmental impact, land use or aesthetic aspects. Balancing **conflicting energy and political interests**, priorities, and needs among EU Member States is a complex challenge. Different countries may have varying approaches to energy generation and may prioritize different energy sources. **Differentiated policy and regulatory frameworks** across EU Member States add complexity to the wind energy landscape. Harmonizing these frameworks and ensuring consistency is an ongoing challenge. **Opposition from anti-wind energy groups** can create hurdles for the sector's growth, leading to public debates and potential delays in project approvals. The revisionist and provocative behaviors of non-EU Member States that reject the Law of the Sea as a basis for reaching mutually acceptable agreements on Exclusive Economic Zones (EEZ)

where floating wind farms can be established can complicate international cooperation and territorial disputes.

Concerns about **property devaluation** and negative impacts on businesses in areas with wind farms can be a challenge. Some residents fear that the presence of wind turbines may decrease property values. Investors may face potential **financial risks** associated with wind energy projects. These risks could deter investment and impact project viability. Addressing the **negative economic effects of transitioning from conventional to wind energy sources** at the local community level can be challenging. Communities may rely on traditional industries that wind energy could replace. **High uncertainty and variation related to energy prices** and wider market conditions can affect the economic viability of wind energy projects, making them susceptible to market fluctuations.

**Public perception and misconceptions** about wind energy can lead to opposition and resistance. Effective communication is crucial to address these challenges. **Insufficient community engagement** and involvement in decision-making processes can hinder project's acceptance. Communities should be included in planning and development discussions. **Resistance from local communities** due to concerns about the environmental impact, cultural heritage preservation, economic activities, and quality of life disruptions poses a significant challenge. Ensuring an **equitable distribution of benefits and costs** between local communities and developers can be challenging. Fairness and transparency are essential. Fostering broad **voluntary adoption of wind energy practices** among communities and individuals requires effective education and awareness campaigns.

Understanding and mitigating the **complexity of ecological interactions**, such as the impact of wind turbines on local wildlife and ecosystems, presents a technological challenge. **Noise and vibration** generated by current wind turbine technology can lead to conflicts with local communities and potentially harm nearby wildlife. Addressing the **environmental impact**, including noise and visual disturbances caused by wind energy farms, is essential to maintain harmony with surrounding ecosystems and local communities. Wind energy projects require **substantial initial investments** in infrastructure and technology, which can be a barrier to entry. The **intermittent generation of electricity** by wind turbines poses challenges to grid stability and capacity. Integration into the existing infrastructure and potential conflicts between users need to be addressed. **Striking a balance between aesthetics and energy production efficiency** is a technological challenge. Designing turbines and siting them in ways that minimize visual impact while maximizing energy output requires innovation.

**Ensuring compliance with diverse regulatory and legal requirements** related to wind energy projects can be complex, especially when navigating different legal contexts across EU Member States. Demanding and time-consuming **permitting procedures** can

cause delays and add to project costs, affecting the attractiveness of wind energy investments. The presence of ***differentiated regulatory contexts and framework conditions*** both across EU member states and within individual countries can create legal complexities and potential conflicts between different levels of administration. ***Potential impacts on local wildlife and ecosystems***, including bird and bat populations, need to be carefully managed to mitigate adverse effects. The potential ***environmental impact on biodiversity***, especially in sensitive areas, requires thorough assessment and mitigation strategies. The wind energy sector faces challenges related to the availability of ***innovative, sustainable, and environmentally friendly materials*** for turbine construction and maintenance. Managing ***potential conflicts and mistrust*** between developers, environmental organizations, and local communities over environmental concerns is vital for project success.

Table 13: Summary of the challenges identified at EU level

Domain	Challenges
Political	<ul style="list-style-type: none"> <li>• Regulatory and policy barriers at regional or national levels.</li> <li>• Opposition from local stakeholders and community groups.</li> <li>• Conflicting energy and political interests among EU Member States.</li> <li>• Differentiated policy and regulatory frameworks across EU Member States.</li> <li>• Opposition from anti-wind energy groups.</li> <li>• Disputes related to Exclusive Economic Zones (EEZ).</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Concerns about property devaluation and negative impacts on businesses.</li> <li>• Financial risks and investment deterrence.</li> <li>• Economic effects of transitioning from conventional to wind energy.</li> <li>• Uncertainty and variation in energy prices and market conditions.</li> </ul>
Sociocultural	<ul style="list-style-type: none"> <li>• Public perception and misconceptions about wind energy.</li> <li>• Insufficient community engagement and involvement.</li> <li>• Resistance from local communities due to various concerns.</li> <li>• Equitable distribution of benefits and costs.</li> <li>• Fostering voluntary adoption of wind energy practices.</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Complexity of ecological interactions and impact on local wildlife and ecosystems.</li> <li>• Noise and vibration generated by wind turbines.</li> </ul>

	<ul style="list-style-type: none"> <li>• Environmental impact, including noise and visual disturbances.</li> <li>• Initial investments in infrastructure and technology.</li> <li>• Intermittent generation of electricity and grid stability.</li> <li>• Balancing aesthetics and energy production efficiency.</li> </ul>
Legal	<ul style="list-style-type: none"> <li>• Compliance with diverse regulatory and legal requirements.</li> <li>• Demanding and time-consuming permitting procedures.</li> <li>• Differentiated regulatory contexts and framework conditions.</li> <li>• Potential conflicts between different levels of administration.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Management of potential impacts on local wildlife and ecosystems.</li> <li>• Assessment and mitigation of environmental impact on biodiversity.</li> <li>• Availability of innovative, sustainable materials for turbine construction and maintenance.</li> <li>• Managing conflicts and mistrust related to environmental concerns.</li> </ul>

### 3.3. Intervention areas

#### 1. Political:

At the EU level, the focus should be on developing and implementing effective policy frameworks, fostering inclusive engagement through outreach and dialogue with stakeholders, promoting skillful negotiation and diplomatic mediation for cross-border cooperation, supporting harmonization efforts and knowledge-sharing platforms, necessitating strategic advocacy and coalition-building, and engaging in diplomatic cooperation and constructive dialogue to create a conducive environment for wind energy development.

#### 2. Economic:

EU economic interventions should aim to promote job creation and attract investment in wind-related industries, establish robust financing mechanisms, including a risk-sharing framework and innovative financing models, while implementing targeted socio-economic support programmes, and promote the use of flexible pricing

mechanisms, advanced forecasting models, diversified energy portfolios and adaptive market strategies for economic sustainability.

### **3. Sociocultural:**

To promote social acceptance and engagement, it is important to implement targeted education and community engagement programmes; promote participatory approaches such as public consultations and stakeholder engagement initiatives; ensure open and transparent dialogue with thorough impact assessments, fair compensation and local community participation; and implement policies and mechanisms for equitable sharing of economic benefits, including community ownership models and revenue sharing agreements.

### **4. Technological:**

The EU should focus on improving research and development in wind turbine technology, interdisciplinary expertise, data collection and monitoring, with an emphasis on improving performance, maximising energy capture and increasing grid flexibility through smart grid technologies, while promoting extensive research and collaboration between architects, engineers and environmental experts.

### **5. Legal:**

The EU should work to develop clear guidelines, provide training and create a cooperative framework for legal aspects related to wind energy projects by emphasising cooperation with experts and promoting the development of common standards and guidelines. It should also establish a multi-level governance framework to facilitate coordination and engagement between governmental, regional and municipal authorities.

### **6. Environmental:**

Environmental aspects should include comprehensive Environmental Impact Assessments (EIAs) with sustainability guidelines, promotion of low impact materials and technologies, research into the recycling of wind turbines and the establishment of an effective legal framework for decommissioning and disposal.

To ensure meaningful participation, EU interventions should involve representatives of wind farm residents, work with local, regional and national government authorities, cooperate with industry and cooperative representatives, involve local economic actors such as farmers and fishermen, and promote compliance with environmental and social standards by wind farm installation and development companies to ensure responsible project implementation.

## 4. Conclusions

---

A set of actions were identified by all pilot areas that broadly belonged to the following 6 intervention areas:

- Robust policy framework for effective wind energy initiatives
- Driving economic growth and investment in wind energy projects
- Community engagement and empowerment
- Technological advancements and innovation for wind turbines
- Establishing supportive legal framework for wind energy development
- Preserving the environment in wind farm projects

In some pilot areas, specific actions were identified and assigned to different stakeholders, while in other pilots the actions were considered from a regional perspective. In some pilots, there were not the same actions in all intervention areas because there were not the same critical needs or challenges that required this type of intervention.

The commonalities in the intervention areas are:

- Involvement of various stakeholders, including representatives of local communities, government authorities, wind energy producers, wind energy cooperatives, wind farm developers, and energy distributors, is emphasized throughout the text.
- Cooperation and collaboration between different stakeholders are consistently highlighted as crucial for the success of wind energy initiatives.
- The importance of clear and effective communication is stressed in multiple sections.

The main points of these interventions are:

- The *“Robust policy framework for effective wind energy initiatives”* intervention focuses on the need for a robust policy framework, while the *“Establishing supportive legal framework for wind energy development”* intervention emphasizes the importance of establishing a supportive legal framework.
- The *“Driving economic growth and investment in wind energy projects”* intervention discusses driving economic growth and investment, while the *“Preserving the environment in wind farm projects”* intervention emphasizes the importance of preserving the environment in wind farm projects.
- The *“Community engagement and empowerment”* intervention talks about community engagement and empowerment, whereas the *“Technological advancements and innovation for wind turbines”* intervention emphasizes technological advancements and innovation for wind turbines.

- The *“Robust policy framework for effective wind energy initiatives”*, *“Establishing supportive legal framework for wind energy development”*, and *“Preserving the environment in wind farm projects”* interventions mention the roles of national government/authorities, while the *“Community engagement and empowerment”* and *“Technological advancements and innovation for wind turbines”* interventions focus more on cooperation with regional policy makers.
- The *“Driving economic growth and investment in wind energy projects”* intervention highlights job creation, while the *“Preserving the environment in wind farm projects”* intervention discusses the importance of conducting Environmental Impact Assessments (EIAs) and preserving the environment.
- The *“Driving economic growth and investment in wind energy projects”* intervention mentions the establishment of financial mechanisms, whereas the *“Community engagement and empowerment”* intervention talks about flexible pricing mechanisms in cooperation with energy distributors.

These points reflect the multifaceted nature of wind energy initiatives, which require a holistic approach involving various stakeholders and addressing a range of issues from policy and finance to environmental and community concerns.

## 5. References

---

- Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum*, 41(5), 545–547. <https://doi.org/10.1188/14.ONF.545-547>
- Heale, R., & Forbes, D. (2013). Understanding triangulation in research. *Evidence-Based Nursing*, 16. <https://doi.org/10.1136/eb-2013-101494>
- Johansen, E., Busch, S. V., & Jakobsen, I. U. (2020). *The Law of the Sea and Climate Change: Solutions and Constraints*. Cambridge University Press.
- Perera, R. (2017). *The PESTLE Analysis*. Nerdynaut.
- Zalengera, C., Blanchard, R. E., Eames, P. C., Juma, A. M., Chitawo, M. L., & Gondwe, K. T. (2014). Overview of the Malawi energy situation and A PESTLE analysis for sustainable development of renewable energy. *Renewable and Sustainable Energy Reviews*, 38, 335–347. <https://doi.org/10.1016/j.rser.2014.05.050>

## 6. Annex

---

### 6.1. Picklist for needs and challenges

To support all partners in conducting their initial PESTLE analysis and ensure consistency across the various pilot cases, a panel of project experts compiled a list of suggested needs and challenges. This list served as the foundation for the Round 1 analysis, as described in section 1.3, which outlines the methodology of this study.

#### Suggested needs and challenges

##### Political needs

- Policy frameworks that streamline and facilitate wind energy project approvals and grid integration.
- Stakeholder engagement platforms and mechanisms for ongoing dialogue and feedback.

##### Political challenges

- Regulatory and policy barriers at the regional or national level.
- Opposition from local stakeholders and community groups.

##### Economic needs

- Economic development opportunities for local communities through job creation and investment in related industries.
- Incentives and support mechanisms for local communities to actively participate in wind energy initiatives and address the impact of energy transition challenges.

##### Economic challenges

- Economic concerns, such as property devaluation or negative impacts on local businesses.

##### Sociocultural needs

- Transparent and effective communication and public awareness and educational strategies to address concerns and educate the public about wind energy benefits.
- Transparent, proper and meaningful community engagement programs to involve local residents in the planning, licensing and development of wind energy projects.

### Sociocultural challenges

- Public perception and misconceptions about wind energy.
- Lack of community engagement and involvement in decision-making processes.

### Technological needs

- Environmental impact assessments to identify and mitigate potential risks to wildlife and ecosystems.
- Innovative noise reduction technologies and best practices for minimizing the impact of turbine noise.
- Research and development efforts to improve turbine efficiency and address technical challenges.

### Technological challenges

- Visual impact and aesthetics of wind turbines.
- Noise and vibration generated by wind turbines.
- Potential impact on local wildlife and ecosystems.

### Legal needs

- Clear understanding of legal frameworks and compliance measures.
- Collaboration with legal experts to navigate legal complexities.

### Legal challenges

- Regulatory compliance and legal requirements related to wind energy projects.

### Environmental needs

- Environmental impact assessments to identify and mitigate potential risks to wildlife and ecosystems.
- Adoption of sustainable planning and technology practices to minimize and monitor in real operational conditions the environmental impact of wind energy projects.

### Environmental challenges

- Potential impact on local wildlife and ecosystems.

## 6.2. Stakeholder groups used for the analysis

For the initial picklist of needs and challenges, the targeted stakeholders for the WENDY project based on the GA “regional and national key actors of the wind farm value chain” were used for the analysis. The pilot partners were instructed to assess the needs and challenges from the perspective of each of these stakeholders, as explained in section 1.3.

These key actors are listed below:

- Representative of inhabitants near wind farms
- Local government/authorities
- National government/authorities
- Representative of wind energy producer
- Representative of Wind Energy Cooperative
- Energy distributors
- Wind Energy providers
- Farmers / fishermen
- Regional policy Makers
- Wind farm installation companies
- Wind farm developers

### 6.3. Example – notes from the needs/challenges assessment of the working group in the Norwegian pilot case

#### Political aspect

Norwegian pilot needs	Challenges
Policy frameworks that streamline wind energy project approvals	Regulatory and policy barriers at the regional or national level
	Assigning the correct role to each stakeholder (different regulatory frameworks)
	Harmonization with emerging EU regulations
	Time-consuming commissioning process
Stakeholder engagement platforms and ongoing dialogue mechanisms	Opposition from local stakeholders and community groups to engage
	Resistance from the industry
	National opposition to offshore wind
	Lack of experience in offshore wind in Norway
Build on cooperatives' legacy for future projects	No innovating cooperative models to meet evolving market demands and changing societal needs
	Rapid offshore wind farm development
Facilitate the creation of new energy communities	Regulatory frameworks and administrative processes to facilitate the smooth and timely creation of new energy communities
	How to finance such energy communities (much more expensive for offshore), also hybrid
	Lack of knowledge of energy community
Models for foreign ownership – concern about profits leaving Norway, based on use of “public resource”	Regulatory control

#### Economic aspect

NEEDS	CHALLENGES
Economic development opportunities for local communities	Economic concerns, , and negative impacts on businesses
	Feeling of “unfair” economic outcome
	Compensation for giving up land (local authority sea area in this case)
Review of compensation rules and practices for affected parties, including fishermen	Potential impact on fisheries and loss of income
	Non-economic impact on fisheries
	Potential impact on fisheries and loss of income II
	Coexistence with existing industries/activities
Clear policy frameworks for eligibility and access to public funding for municipalities	No eligibility criteria and streamline access
Public investment related to electricity prices	High electricity prices for floating offshore wind
	High electricity prices for floating offshore wind

Determination of a minimum guaranteed electricity selling price for community-based parks	No balance between setting a minimum guaranteed electricity selling price that provides fair returns for community-based parks ensuring cost-effectiveness for consumers
---	--

### Sociocultural aspect

NEEDS	CHALLENGES
Transparent and effective communication strategies	Diverse stakeholders, with varying levels of knowledge and communication preferences
Community engagement programs	diverse stakeholder interests
Promotion of true impact of wind energy farms	Misinformation and incorrect facts
	Demonstrate the project's positive climate impact
Respectful of ethical cultural practices/traditions	Integration of wind farms to the local landscape and cultural needs
Transparent communication of wind farm benefits	No public trust in the wind industry

### Technological aspect

NEEDS	CHALLENGES
Environmental impact assessments	cumulative effects, wildlife habitat, and ecological sensitivities in the project area
	Credibility of the EIAs performed
Innovative noise reduction technologies, Best practices for minimizing turbine noise	Noise and vibration generated by current wind turbine technology
	Effects of electromagnetism on marine life are unknown
Lower potential impact from light marking of turbines	wildlife disturbance, visual aesthetics etc.
Research on lowering the levelized cost of energy (LCOE)	Technology not yet cost effective (floating offshore wind)
Lower carbon footprint of construction and installation	Currently high-carbon footprint materials and technologies for wind farm installations
Research on circularity and decommissioning	Materials not reusable at the end of the turbine's lifetime

### Legal aspect

NEEDS	CHALLENGES
Clear understanding of legal frameworks and compliance measures	complex and evolving legal frameworks, regulations, and compliance measures
Clear pathway for responsible regulatory bodies for licensing and supervision of wind farms	Fragmentation of regulatory bodies
	Conflicting rules aviation safety vs. bird safety

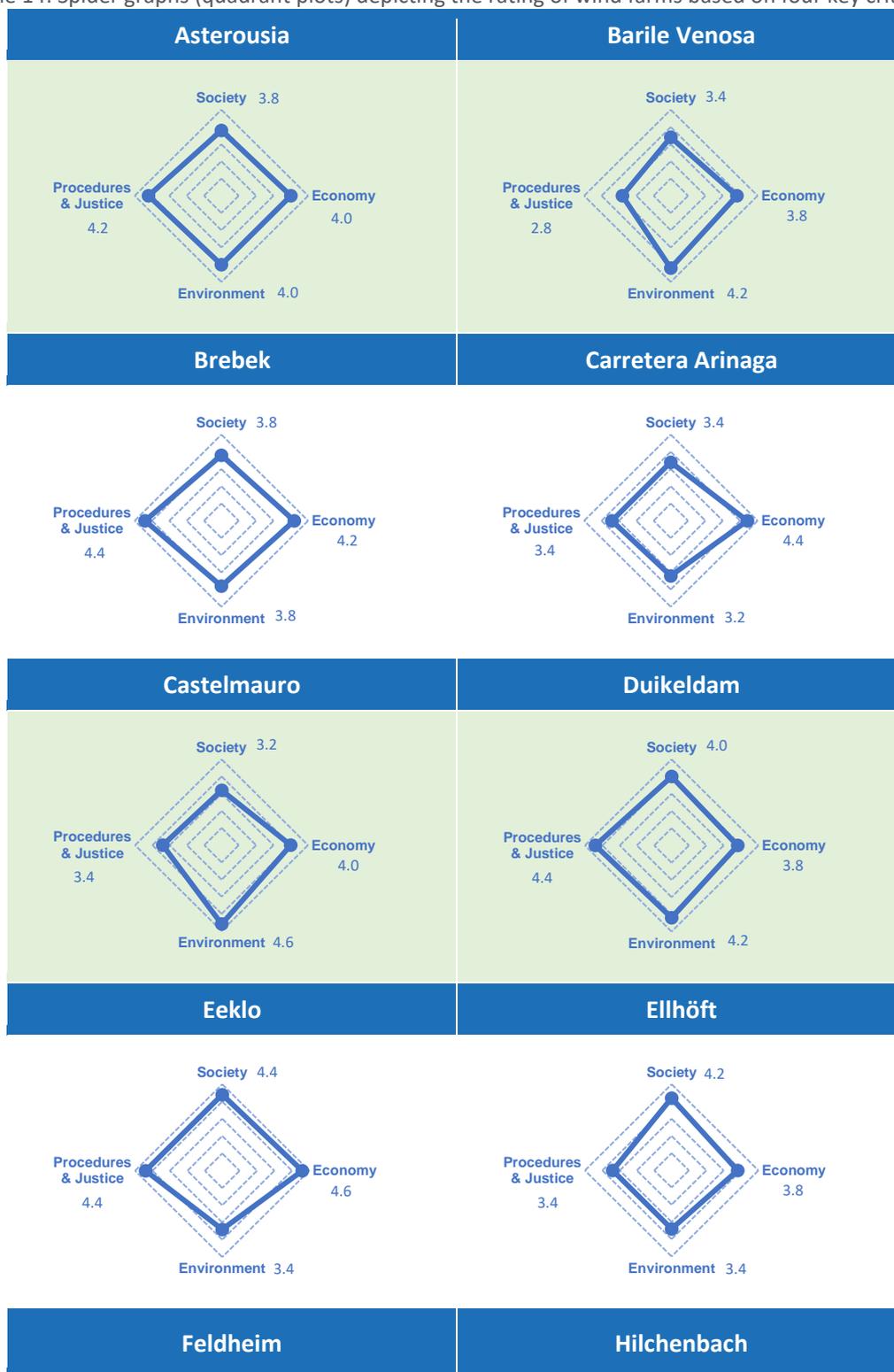
Long-term politically independent strategy	No continuity and consistency across political cycles and the risk of policy shifts and regulatory uncertainty
Development of marine plans	Lack of holistic marine spatial planning
tax regulation to offshore wind	complexity and evolving nature of tax regulations
	Resistance from industry (“public resource use tax”)

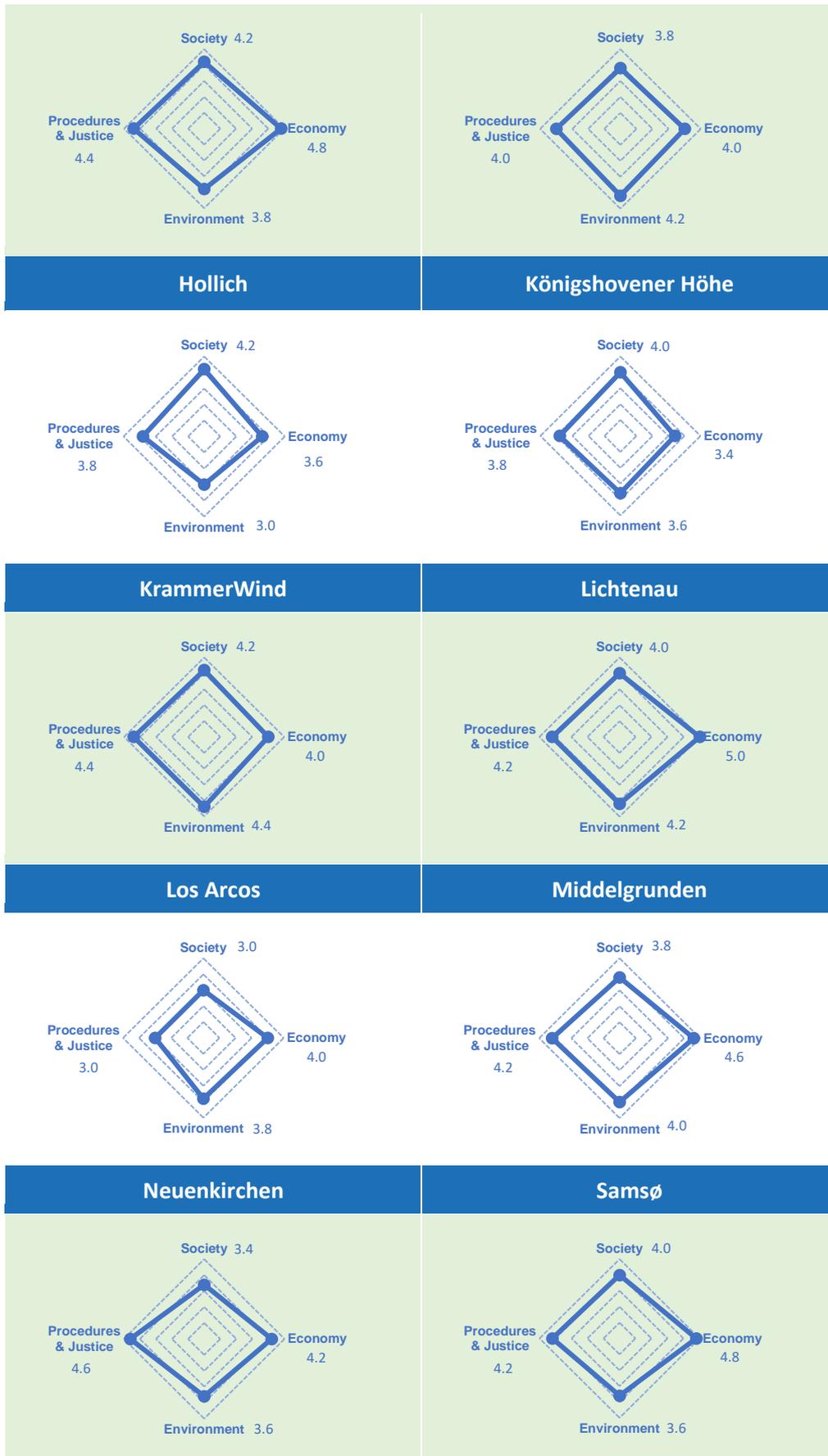
### Environmental aspect

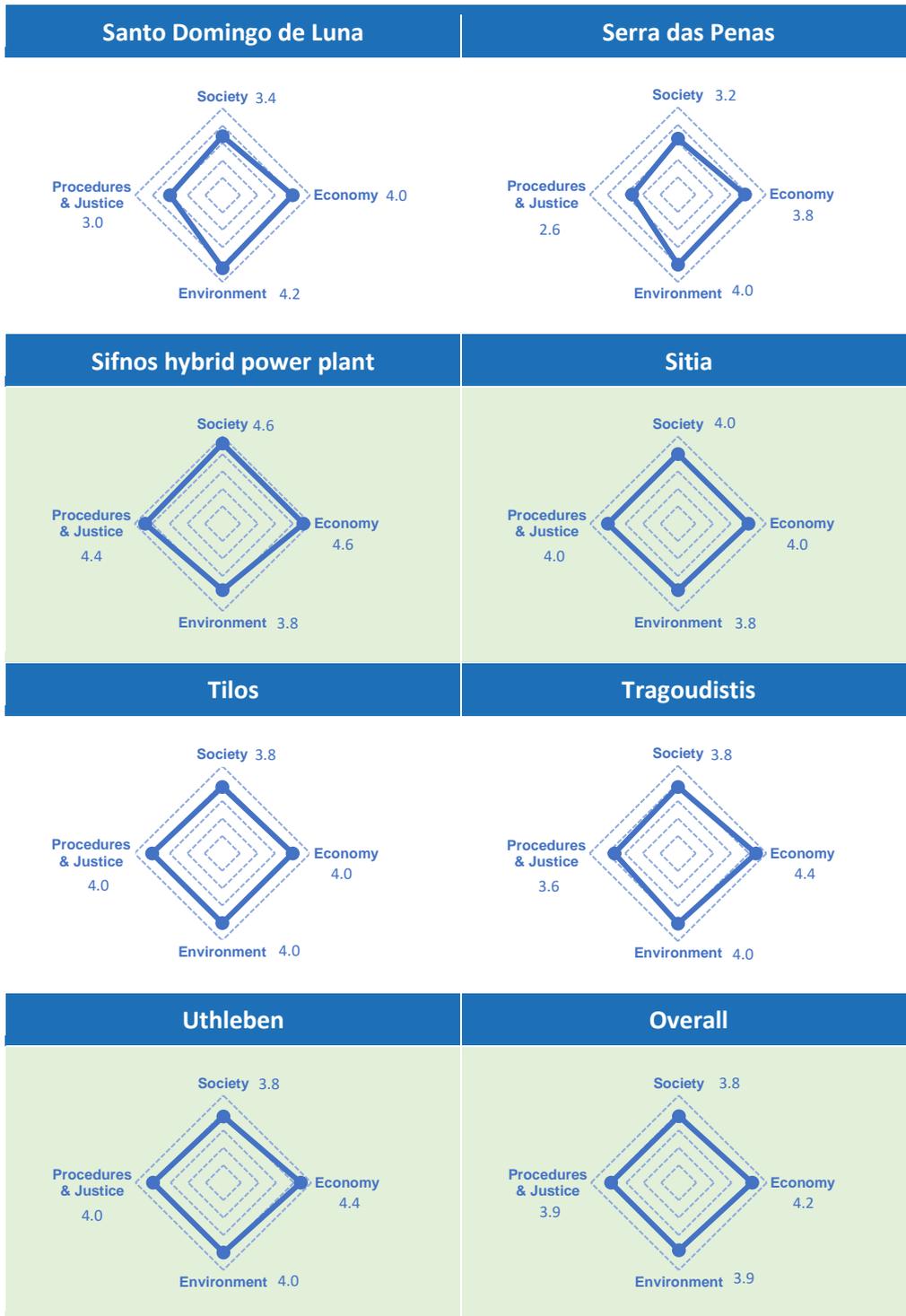
NEEDS	CHALLENGES
Sustainable practices to minimize environmental footprint	challenges such as marine ecosystem impacts, noise pollution, and the use of eco-friendly materials / Potential impact from the use of chemicals and other substances
	As above
	Not co-ordinated with other industries (lack of true Marine Spatial Planning)
Introduction of special measures for safe operation of wind parks	unique challenges such as extreme weather conditions, remote locations, and offshore logistics
	As above
Research on emissions from turbine blade wear and potential impact	Currently no definitive research on this topic (i.e. conflicting opinions, argued based on different data)
	Not access to existing turbine wear data due to competitive issues
Bird migration studies / Research and monitoring programs for fish	Lack of knowledge about impact on local wildlife and ecosystems / Population level effects on fish
system for decommissioning	technical, environmental, and economic consideration
	Extra challenges offshore
	Financial guarantee/mechanism for Decom

## 6.4. Wind farm rating based on four key criteria

Table 14: Spider graphs (quadrant plots) depicting the rating of wind farms based on four key criteria.







## 6.5. Exploitation potential of D2.4 results and findings

This particular section is about the exploitation strategy of the results and findings of D2.4 and their value to the partners who own them. The following table addresses four (4) dimensions: Exploitation Potential, IP Protection, Potential Exploitation Pathways and Partners’ Plans. In addition, it allows for the inclusion of unforeseen dimensions.

Analysis		
1	Exploitation Potential	<p>The <b>main users</b> who may benefit from the results or findings are: Wind farm developers and operators; regulators and/or government agencies responsible for energy and environmental policies and procedures; non-governmental organisations working on issues such as environment, local development, cultural heritage; local authorities/governments and local communities; consultants, citizens living near wind farm installations.</p> <p>The <b>added value</b> of the results or findings for WENDY, its partners or external stakeholders is based on the following aspects: an overall analysis of challenges and needs regarding wind farms’ acceptance and participation at pilot and EU level. It is a pilots’ profiling exercise that helps prioritising the aspects that need to be improved or strengthened and provides a preliminary design of an indicative approach in each area.</p> <p><b>Unique features</b> of the results that could be attractive: i) Defining the regional challenges by providing a set of issues that hinder citizen participation in wind energy and challenge the harmonious coexistence of turbines and local communities; ii) Defining needs by categorising them based on regional stakeholders’ type, relevance and expertise in relation to wind energy initiatives, highlighting – for each pilot case the nature of the examined wind farm and its geographical specificities, iii) a preliminary identification of areas of intervention that can be covered by specific actions and stakeholders in the pilot areas.</p>
2	IP protection	<p>The protection of intellectual property (IP) could be based on the following measures: Application of data protection measures that ensure the confidentiality and security of all personal data collected; Use of Creative Commons to disseminate and use the results and findings.</p>
3	Potential exploitation pathways	<p>Exploitation activities could include the following: Knowledge transfer activities through KEP or other means (e.g. workshops, webinars, publications to disseminate results); development of a new service to improve the social acceptability of wind farms; stakeholder consultation, leveraging the creation of new energy communities and the willingness of companies to comply with ESG criteria or address sustainability priorities (social, economic and environmental); further development of research through other funding opportunities.</p>
4	Partners’ plans	<p>Partners can incorporate the results and findings into their business plans and strategies and use them as an important source of information on the subject. Partners’ plans could include knowledge transfer activities, developing a new service or finding new opportunities for relevant research.</p>
5	Other	<p>Exploring possible collaborations and synergies with key actors and stakeholders could increase the exploitation potential of the results.</p>