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.

Social Acceptance Interventions Framework (updated)

D4.6
WP 4, T4.1

Task 4.1 partners

Leading partner: CBS

Participants: WR, Q-PLAN

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Technical references

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Executive summary

The overall objective of the WENDY project is to increase social acceptability of wind energy at the community level, by triggering a change in societal perception towards onshore and offshore wind energy projects. To this end, Project WENDY aims to study the factors underlying social acceptance through an in-depth analysis at three dimensions: social sciences, environmental sciences, and technological engineering. The deliverable 4.6 has been developed under Task 4.1, Work Package 4 (WP4) of the WENDY project and builds on the insights generated in WP2. WP4 aims to conduct a holistic impact assessment of wind installations and develop an assessment system to analyze cumulative social, technical, and environmental impacts of wind farms. The present report represents the social aspect of this impact assessment and conducts an in-depth review of the social acceptance literature to select relevant best practices, interventions to enhance the community acceptability of wind farms, that have been converted into a decision support tool.

In part 1, we review various definitions of the concept of social acceptance, highlighting its multi-dimensionality, followed by a classification system for categorizing the diverse factors that may support, enhance, or hinder social acceptance of wind farms. These factors drive not just community acceptance, but also socio-political and market acceptance.

In part 2, for each of the category of factors described earlier, we present a subset of best practices and interventions based on wind farm case studies and empirical research. These best practices have been implemented in wind farms across the world with positive results. However, it is important to note, that "*every project is unique and involves specific challenges*" (International Energy Agency, 2013), thus it is advisable to modify these best practices as per the specific wind farm case.

In part 3, we endeavor to convert the best practices framework into a user-friendly tool and briefly describe the characteristics of this social acceptance interventions tool. This tool, given a set of input information, will present a set of behavioral interventions and recommendations, designed to enhance social acceptance of existing or proposed wind energy projects. The target group for this tool would be those concerned with or affected by wind farm projects - stakeholders involved in project development, planning, policy making, local community.

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1. Introduction

Wind energy is one of the important pillars supporting the European Green Deal, that commits to carbon neutrality by 2050 (European Commission, 2019). Decarbonizing the existing energy systems would entail ramifications for the public, which would be expected to accept new energy infrastructure and change its patterns of demand. In such a scenario, public opinion, perceptions, acceptance, behaviors, attitudes assume greater importance for policy makers, energy industry and academics. Unlike traditional power plants, wind energy implementation is more distributed, closer to the users and much more visible. Although there is general agreement, approval, and acceptance of the green transition at the national level, the actual installation of wind farms meets strong criticism and resistance at the local level. This mismatch between the national and local level sentiments, termed not-in-my-backyard (NIMBY), is often and simplistically, attributed to ignorance, irrational and selfish motivations at the local level. There is a growing recognition that social acceptance is a strong influence on energy technology, installations, and usage, and thus, understanding the triggers of social acceptance and the motivations underlying local opposition towards any renewable energy project, requires a much more nuanced approach.

The focus of this report is primarily on reviewing the existing social acceptance literature, selecting interventions to enhance social acceptability and acceptance of wind energy projects, and finally converting this repository of interventions into a guidance tool. We start by explaining the concept of social acceptance and present six categories of factors that, in combination, might drive acceptance or opposition to wind energy projects. Finally, we provide a framework based on the if-this-then-that methodology to catalogue specific strategies and solutions under each factor category, that address the question of how to enhance social acceptance and/or reduce opposition. It is important to note that these intervention strategies are not restricted to experimental interventions and also include informational interventions that inform people and make them more thoughtful about their decisions.

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1.1. Social acceptance: definition

1.1.1. Dimensions of social acceptance

Social acceptance is a pre-requisite for successful implementation of novel technology, especially in the renewable energy sector. But social acceptance is not just the study of public opinion, but 'also a matter of public, political and regulatory acceptance' (Carlman, 1984). Since this early definition, social acceptance, in the context of renewable energy (RE), has largely been understood as encompassing three interdependent dimensions: socio-political acceptance, community acceptance and market acceptance (Wüstenhagen et al., 2007). While socio-political acceptance is the general support for RE technologies and policies by the public, key stakeholders, and the policy makers; market acceptance concerns the market adoption of an RE innovation by supply side actors and demand side users. Lastly, and more relevant to this report, community acceptance is seen as the acceptance of siting decisions and energy projects by local stakeholders, specifically citizens living in the vicinity of proposed or existing RE projects and local authorities (see fig.1). This categorization has been widely adopted (see EWEA [European Wind Energy Association], 2009) by both practitioners and researchers.

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Figure 1. Social acceptance of renewable energy innovation (Source: Wüstenhagen et al., 2007).

Another conceptualization of the term social acceptance is - '*a favorable or positive response (including attitude, intention, behavior and - where appropriate – use) relating to a proposed or in situ technology or socio-technical system, by members of a given social unit (country or region, community or town and household, organization)*' (Upham et al., 2015), which can be interpreted either passively as an absence of oppositional response or more positively as strong support or interest. The authors (Upham et al., 2015) give three principles on social acceptance:

1. Social acceptance of a technology can be examined at three levels: macro, meso, and micro, corresponding to the general policy or country level; the community level; and the individual, household level. These levels further correlate with different '*objects*' of

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acceptance: types of energy technology (at macro level); specific energy projects (at meso level); and on-site energy applications (at micro level)

2. Social acceptance at these three levels will relate to differentiated groups, depending on the ‘*subject*’ of acceptance: political acceptance; stakeholder acceptance; and public acceptance.
3. Public or individual acceptance will include attitude, behavioral intentions, beliefs, feelings, and willingness to use, accept energy projects as well as actual behavior.

Thus, there are different levels, each with different processes and stakeholders involved, at which social acceptance can be analyzed. While some researchers talk of social or public acceptance (Wolsink, 2012; Wüstenhagen et al., 2007), some others focus on *societal* acceptance (Heiskanen et al., 2008) or on social *acceptability* (Szarka, 2007) and some prefer to use these terms interchangeably (C. Warren et al., 2012). The framework given by Szarka, however, defines social *acceptability* as the dynamic process of collective assessment of a project, informed by various political, social, technical factors, and social acceptance or unacceptance as the outcome of this complex process (Szarka, 2007).

Acceptance is a complex construct and is understood as the result of a dynamic social valuation process, which includes the individual’s perception of the acceptance object (i.e., wind energy technology), the features of this object and the social context in which the individual and the object are placed (Lucke, 1995). Basically, acceptance as a *valuation* means a positive estimation and approval of an acceptance object. However, valuation can be active if it is supported by related behaviors or actions, and this is the difference between acceptance and tolerance. Some people often see acceptance as lack of resistance. According to Dethloff's (2004) model of acceptance (translated from German), there are two different dimensions of acceptance (see fig. 2) on the two axes – the valuation or the perception axis (positive – negative) and the action axis (active – passive). These two dimensions can be independent from each other, such that a positive valuation might not necessarily mean supporting actions. Further, there can be passive and active acceptance, as well as passive and active resistance. Passive resistance might get interpreted as acceptance as people might not express their dissatisfaction. In this model, a broader definition will include both active and passive acceptance, and a narrow definition includes only active

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acceptance. Active acceptance, that is to say that an individual has a high valuation of the wind energy system and also acts positively towards the installation of the wind farm.

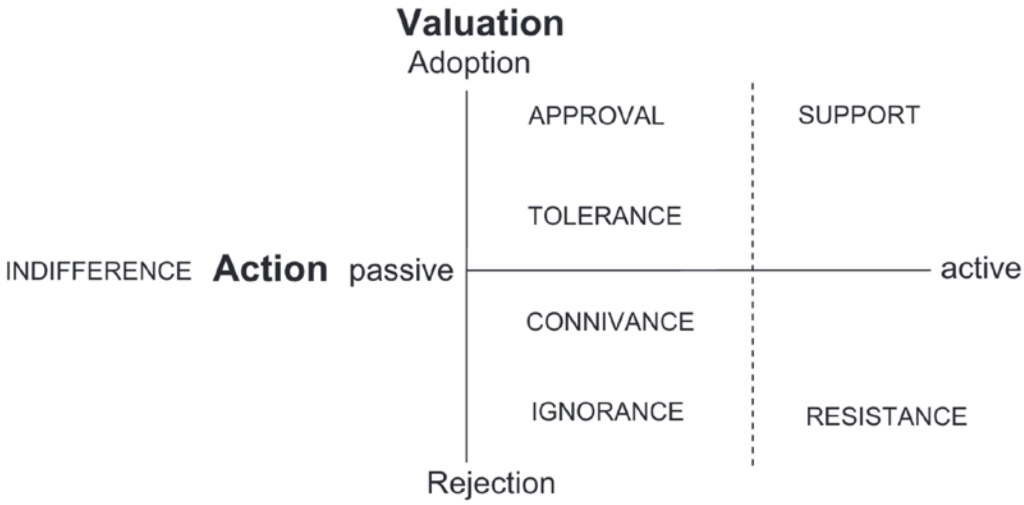

Figure 2. Model of acceptance divided into valuation and action (Source: Schweizer-Ries, 2008).

Social acceptance has been studied across disciplines like geography, psychology, economics, and political science. It has been suggested that geographical concepts like place, space, landscape should be considered to understand people's response to RE technologies (Fast, 2013). Huijts et al. (2012) offer a psychological framework suggesting that the intention to act in favor of (or against) RE technologies is a product of attitude, social norms, perceived behavioral control, personal norms. The authors distinguish between *acceptance*, as the eventual behavior, and *acceptability*, as an attitude or evaluative judgement towards energy technology. This distinction often leads to the discussion around the attitude-behavior gap and the NIMBY phenomenon. Dermont et al. (2017) takes a political science approach and highlight the importance of policy making stages (i.e., drafting, introduction and implementation) and actors involved, to understand social acceptance.

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With such variation in terminology and definitions, it is difficult to explain social acceptance using a single perspective. Social acceptance of renewable energy is not just about accepting a technology or permitting local installations, but also about accepting and supporting, the administrative and social elements that come with it (Azarova et al., 2019).

1.1.2. Why is social acceptance necessary?

As wind energy projects increase globally, it is being recognized that a lack of social acceptance can be a powerful barrier to the achievement of renewable energy targets. While the benefits accruing from a wind energy project are global, affecting the entire population, the costs (social and otherwise) are mostly local in scope, affecting the well-being and quality of life of the people living in proximity, thus creating a situation of environmental and energy injustice. "How we distribute the benefits and burdens of energy systems is preeminently a concern of any society that aspires to be fair", underlines (Sovacool, 2014). It is seen that social issues and perspective are often excluded from energy planning, resulting in local opposition, project delays or project abandonment. The lack of acceptance is problematic, as the negative reaction from the community and the subsequent citizen initiatives can prevent construction of new wind projects. Further, it is also seen as a lack of integration and sustainability in the technical development process. Social acceptance is, thus, of utmost importance for the successful implementation and completion of wind energy projects and for change in the energy culture.

1.1.3. Social license to operate (SLO)

The concept of Social License to Operate, adopted from the stakeholder engagement efforts in mining industry, is strongly relevant for the case of wind energy projects. SLO is defined as an ongoing acceptance or approval for development project granted by the local community and stakeholders (Corvellec, 2007; Thomson & Boutilier, 2011). As the first step, the wind farm developers start with the assumption that they do not yet possess a SLO, and it would take a

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process of dialogue with the local community and understanding of community expectations and perceptions (Parsons & Moffat, 2014). Next, SLO requires continuous efforts as once it is earned it must be maintained, otherwise it is easy to lose an SLO through community complaints, social media campaigns or political regulations. Further, it can be difficult to regain an SLO, once lost. It requires ongoing, open dialogue between community members and other stakeholders to set the stage for new project developments. In this regard, an SLO represents transparency, legitimacy, credibility, and trust. Finally, information from different perspectives is to be provided to affected communities to assist in decision-making.

Thomson & Boutilier (2011) propose that a project begins with an initial level of an SLO, which is "acceptance" or in other words, the stakeholders tolerate, agree or consent" to a development. A higher level of SLO would be "approval", indicating that the stakeholders have favorable opinions, agree with, or are pleased with the development and can result in more beneficial outcomes. It is also suggested that there are "boundaries" between each SLO level that developers need to respond to, to achieve the higher level. These boundaries, in ascending order, are legitimacy, credibility and trust. As the company establishes its credibility with the affected stakeholders, the social license rises to the level of approval. Over time, if sufficient trust is established, the social license could rise beyond approval, possibly to co-ownership. Like the traditional mining industry, siting of wind farms is also subject to geographical conditions and availability of the underlying natural resource (i.e., wind), which often causes disruption and opposition in the local community. In such a scenario, incorporating an understanding of SLO framework and working towards achieving a SLO from the stakeholders can go a long way in achieving a higher level of community acceptance in the wind industry (Hall, 2014; Stephens & Robinson, 2021).

1.2. Factors influencing social acceptance/opposition.

Research has identified several drivers of wind energy acceptance that have been classified using different frameworks (Duarte et al., 2022; Petrova, 2016; Rand & Hoen, 2017; Ruddat, 2022;

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Segreto et al., 2020). For this report, we review these factors in depth and provide a consolidated classification framework with the following categories (fig. 3):

- Socio-economic factors
- Landscape related factors
- Environmental factors
- Institutional factors
- Individual-level factors
- Technical factors

These factors or drivers have been found to explain acceptance of not just wind energy, but also other renewable energy technology. Studies suggest that the most common reasons for opposition to wind energy projects are esthetic degradation, visual and noise impact, and the perceived reduction in landscape value. Additionally, impacts on health, safety of the local community, social benefits also contribute to project siting decisions. These categories of factors explain many of the reasons of opposition, and present opportunities to develop interventions, recommendations, and best practices to address the underlying concerns and transition from *acceptance* to *support* of wind energy projects by the local community. It should be noted that these factors are likely to influence one another. Different stakeholders in wind energy projects can use this classification to anticipate and possibly defuse factors that may lead to wind farm opposition. Although there may be some overlap between the various factors, elements or criteria of any conceptualization, the latter facilitates a more straightforward analysis of the topic discussed, enabling us to gain valuable insights, as we also experienced and understood in D2.1.

In the following sections, we look at each of these categories in detail and understand the different challenges to social acceptance.

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Figure 3. Factors influencing social acceptance of wind energy (figure source: author compilation).

1.2.1. Socio-economic factors

The level of community acceptance of wind energy projects is greatly increased with the financial involvement and engagement of the community members. There are both positive and negative socio-economic aspects that influence support (or opposition) to existing and proposed wind developments. Studies have examined multiple economic factors like community's economic development, impact on jobs and existing traditional occupations, tax revenues for the local areas, tax rates and electricity prices for citizens, infrastructure development in the region, compensation for landowners, community investment and ownership models, and impacts on tourism, and regional recreational activities. It has been found that leasing land to private landowners to operate wind turbines works as a financial incentive for the owners, that might influence their attitude towards wind projects (Swofford & Slattery, 2010). On the other hand, compensation for landowners might create perceptions of 'winners' and 'losers' within the community, even as

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community benefit schemes are seen as a form of bribery (Knauf, 2022; Walker et al., 2014) due to perceived unfair distribution of benefits. Distribution of risks, costs, and benefits of wind projects, known as distributional justice, has been a crucial factor influencing social acceptance (Goedkoop & Devine-Wright, 2016) and an unfair distribution can lead to rural-urban conflicts or injustices towards indigenous communities. Another important factor is the potential negative impact on land and property values near wind farm facilities, especially in case of onshore wind turbines (Sunak & Madlener, 2016) although no significant effect has been found for offshore wind turbines (Dröes & Koster, 2016; Jensen et al., 2018). It can be that fear of loss of property values spreads quickly within the community and leads to negativity and resistance to wind projects.

1.2.2. Landscape related factors

Visual impacts and landscape change are the most frequent concerns behind opposition and negative attitudes to wind farms. Visual impact is in terms of reduced scenic quality or shadow flicker created near turbines. It has been observed that self-reported health effects are strongly related to visual impact and the resulting annoyance than to noise from wind turbines themselves (Knopper & Ollson, 2011). Ladenburg and Dubgaard (2007) have reported that residents have a significant willingness to pay to reduce their view of wind farms. But visual impact can also be viewed positively, especially when the turbines in motion are considered ‘beautiful’, representing economic benefits for residents (Fergen & B. Jacquet, 2016). This underlines the individuality in aesthetic judgements and the potential of visual impacts to exist on either side of the debate. Visual impact would be more relevant if the affected landscape is relevant to the people living there who might feel a sense of place identity and attachment, i.e., an emotional bond between individuals and the surrounding familiar locations. But strong place attachment does not always lead to opposition, as it may depend on how people interpret the change in their landscape (Devine-Wright & Howes, 2010).

In addition to the visual impact of wind turbines is their noise impact. People living close to turbines complain about headaches, sleep disturbance, stress, and other health issues due to infrasound and other sound emissions, collectively known as the ‘wind turbine syndrome’ (Pierpont, 2009).

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These are attributed to deficiencies in turbine noise regulation, annoyance from visual impacts, worry about a new technology, biased social media reporting and possibly the 'nocebo' effect, in which the expectations of negative effects can become self-fulfilling (Michaud et al., 2016). Apart from onshore turbines, noise from offshore constructions while have a lower impact on residents on land, significantly impact marine ecosystems. It is important to note that the sound limits applied to wind turbines have been adopted from industrial sound limits and might not be appropriate, hence there is a need for developing wind turbine sound limits to reduce annoyance (Davy et al., 2018).

1.2.3. Environmental factors

Both supporters and opponents of wind projects base their arguments on environmental factors. While supporters focus on global climate change mitigation, lower air pollution, the opponents highlight the adverse local effects on the environment and wildlife, both on land and water (green vs. green debate). However, some research suggests that highlighting environmental and climate benefits as an argument in support of wind power can be met with indifference and in some cases increase the opposition due to the polarizing nature of such topics (Olson-Hazboun et al., 2016; Parks & Theobald, 2013). A major concern underlying the acceptance of wind farms is the potential threat to wildlife, particularly birds and bats through collisions, habitat disturbance and barriers to movement. However, research suggests that wind farms have a low bird mortality of 0.3 deaths per gigawatt-hour (GWh) of electricity compared to 5.2 deaths per GWh for fossil fueled power stations (Sovacool, 2013). Similarly, another study found that significant impact on bird mortality due to wind turbines is unlikely, provided sensitive areas and bird habitats are avoided (Zimmerling et al., 2013). Compared to other anthropogenic causes of bird deaths, onshore wind turbines affect far fewer birds per year, but there is still a higher impact on certain at-risk bird species (Subramanian, 2012). Similarly, high bat mortality has been observed close to wind farms, not only for local bat populations but also for migratory bats (Voigt et al., 2012). Primary reasons for this include sudden pressure drop near the turbine edges due to which the bats suffered from barotrauma and internal hemorrhaging and impact trauma on collision with the turbine. Research

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has shown that bat mortality increases as the height of the turbine increases (Barclay et al., 2007), which might become a bigger concern as higher turbines are built in future wind farms. Offshore wind farms can have impacts on marine species during construction and operation of wind turbines which could result in changes to their habitat, changes in distribution patterns of species and risk of behavioral stress, although the evidence on this is mixed (Bergström et al., 2013). Apart from the effects on wildlife, construction of wind energy plants can lead to removal of vegetation, soil erosion, bio-system disturbance both in onshore and offshore scenarios – effects which can last even beyond the completion of construction activities.

1.2.4. Institutional factors

Important institutional factors affecting acceptance of a wind project include various policy instruments, processes related to wind project planning, decision-making, bureaucratic issues, public access to information, opportunities for and types of public participation in the planning process. The main problems can relate to a country's spatial planning, energy policy, and environmental policy which shape acceptance by the public, as well as by other stakeholders like government agencies, financial procurement systems, and investors (Wolsink, 2007b). Such institutions either might fail in spreading information, developing energy markets, creating a regulatory framework, or planning and operationalizing energy systems or they may be missing altogether in a country.

The practice of citizen engagement has become a central point in public policy, as it is considered a component of good governance. However, it is not just 'token participation', but the power to have a real influence on the planning process that is valued by citizens in the process of accepting a wind project. This brings forth the idea of procedural justice that includes rights of participation, access to information, trustworthiness of project developers and decision-makers and lack of bias (Wolsink, 2007a). The notion of justice or fairness, at an individual level, can motivate action or inaction; can be the benchmark for evaluating other's behavior; and it can be a precondition for acceptance (Gross, 2007). Procedural justice is subjective, and the feeling of injustice can result from dissatisfaction with both the process and outcome of decision-making. Thus, procedural

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justice can be an important factor in creating a broader acceptance of a planned wind farm. It can increase a project's perceived transparency and create a sense of ownership, instead of feeling foreign and being implemented for profit at the expense of local citizens.

1.2.5. Individual-level and psychological factors

Besides studying social acceptance as a function of proximity or time, research has also focused on individual-level factors influencing acceptance of wind energy. These are either socio-demographic variables such as, age, gender, income, education, or psychological variables such as values, beliefs, and motives. Research on socio-demographic factors does not show consistent findings, possibly due to different operationalizations of acceptance and different levels of individual awareness. For instance, older citizens are less positive towards wind energy (Ek, 2005; Sposato & Hampl, 2018) but also more positive towards renewable energy (Sardianou & Genoudi, 2013), there is lower support for wind amongst women (Klick & Smith, 2010) but also that women, compared to men, are more accepting of wind (Westerlund, 2020). Similarly, results for income and education do not show consistent patterns, with income correlated positively with acceptance (Devine-Wright, 2008) as well as negatively (Langer et al., 2018); education correlated positively with wind energy acceptance (Devine-Wright & Wiersma, 2020) and negatively (Caporale & De Lucia, 2015). It appears that socio-demographics have little explanatory power on their own and can be studied in a specific context or in combination with other factors.

Considering psychological factors, it is well established that individuals' values are indicative of their environmental attitudes and behavior, including towards energy (Dietz et al., 2005; Schwartz et al., 2012). Values affect how people perceive the physical features of a wind energy project and their acceptance levels (Bidwell, 2013) and projects that seem to support core values are more likely to get a positive public response (Perlaviciute et al., 2018). Since wind energy projects have global, collective environmental benefits and a high local, individual cost, support and acceptance is associated with higher altruistic values and lower egoistic levels (Steg et al., 2015). Citizens' beliefs about climate change (or climate change skepticism) and beliefs about RET's costs, benefits, efficacy would certainly define acceptance of local projects (Sposato & Hampl, 2018). Studies have

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also looked at individuals' prior experience with wind farms (living or working close to existing wind farms), environmental knowledge, awareness about consequences (Bamberg & Möser, 2007; Bockarjova & Steg, 2014) emotions as determining pro-environmental behavioral intentions. Emotions, specifically guilt and pride have been used to demonstrate a causal effect on pro-environmental actions (Schneider et al., 2017), for instance, prompting feelings of pride for future positive pro-environmental actions had a more significant effect than feelings of guilt for inaction. Legacy motivations, or interest to pass along knowledge and skills to future generations, is a key motivator of pro-environmental action (Zaval et al., 2015) and can be used to encourage sustainable behaviors. Another variable that has been found to be linked with resistance to wind farms is conspiracy beliefs. People believing in specific conspiracy theories about wind farms, for instance, wind turbines lead to cancer, congenital abnormalities, show strong opposition, and this can be countered by a balanced public communication highlighting the benefits of wind farms (Winter et al., 2022).

1.2.6. Technical factors

Under this category, we focus on physical features of a wind turbine, project siting, geographical distance to homes, distance between the turbines in a wind farm, information about project developers, grid connection challenges. Research shows that higher hub height and a higher number of turbines are negatively associated with wind farm acceptance both for onshore (Dimitropoulos & Kontoleon, 2009; Langer et al., 2016) and offshore farms (Kim et al., 2019). This is important as it is expected that future wind farms will have higher, larger turbines as the technology improves. The turbine materials can also influence social acceptance, by affecting visual perception, turbine stability and raising questions about end-of-life recycling of decommissioned wind turbine components (Beauson et al., 2022). Another turbine design feature which has been studied in connection with public acceptance is whether it is vertical axis or the more common, horizontal axis models. While no significant differences were found in visual impact of the two models (Hui et al., 2018), vertical axis wind systems are preferred due to relatively lower space requirements, lower noise, and lower impact on birds (Ishugah et al., 2014). Another concern is that of integrating wind energy into the existing power grid without affecting the power quality, as wind energy is intermittent by nature. This raises challenges with voltage fluctuation, electromagnetic interference, need for a stable storage system and estimating per unit cost of electricity generation (Shafiullah et al., 2013).

Researchers have also examined the idea that people living close to turbines will have the most negative attitudes towards the wind farm, also known as the proximity hypothesis. There is no consensus as some studies have noted positive attitude increases with distance from the nearest turbine (Swofford & Slattery, 2010) while another study finds the opposite tendency – those living closest to wind farms have the most favorable attitudes (C. R. Warren et al., 2005). In addition to visual impact, local stakeholders are also concerned with ideal location of the wind turbines, energy efficiency and profitability of the entire project (Spiess et al., 2015). Similar concerns about cost effectiveness of wind power have been raised by tourists when vacationing in areas closer to an offshore wind farm (Westerberg et al., 2015). Further, whether the project developer is local, well integrated in the community, and is perceived as honest and competent, is crucial to develop trust in the project and its social acceptance (Jobert et al., 2007; Walter, 2014).

This section summarized the literature on social acceptance issues relating to wind farms. These factors influence each other and should be seen in the backdrop of the three dimensions of social acceptance, as defined by Wüstenhagen et al., (2007) (fig. 1). Focusing exclusively on any single category of factor will leave other important sources of public opposition untackled. Recognition needs to be given to all the drivers of social acceptance in any wind energy project.

1.3. Does social acceptance increase over time?

Existing research on social acceptance has largely neglected to study how local perceptions about a wind farm may change over the project life cycle, as also in context of repowering (replacing existing turbines with new turbines of different size or layout) or life extension (extending the duration of planning permission) of a wind farm. It is important to consider how the factors influencing social acceptance (as discussed earlier) evolve over time, as it cannot simply be

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assumed that familiarity over time with a wind farm will lead to acceptance and eventual positive opinions. Besides, in D2.1 we highlighted that is vital to recognize the need for ongoing and long-term efforts to build and maintain social acceptance at different stages throughout the whole lifecycle of a wind farm, given that social acceptance does not comprise a static outcome but rather a reflection of the dynamics between the community and the wind farm.

Attitudes towards wind farms have been shown to follow a U-shaped curve (fig. 4), moving from high acceptance and positive attitudes when the people are not faced with a wind project, to relatively low acceptance and opposition when a project is announced and during siting phase, and back to high acceptance (though not as high as the pre-project phase) when the project is operational (Wolsink, 2007b). But this is not to say, that the local community will automatically have higher acceptance once the project is completed or that public perceptions will improve over time (Devine-Wright, 2005). Wilson and Dyke (2016) examined community acceptance pre- and post-installation of wind turbines and suggested that it is more layered, nuanced than what the U-shaped curve might suggest. There could be different 'acceptance' curves for different factors of concern like visual impact, noise, economic benefits, and environmental impacts, depending on individuals and contexts. Likewise, community acceptance and support for wind farm repowering or life extension proposals are influenced by long term experiences of living near the wind farm, including benefits received, involvement in decision-making and relationship with the project developer (Windemer, 2023).

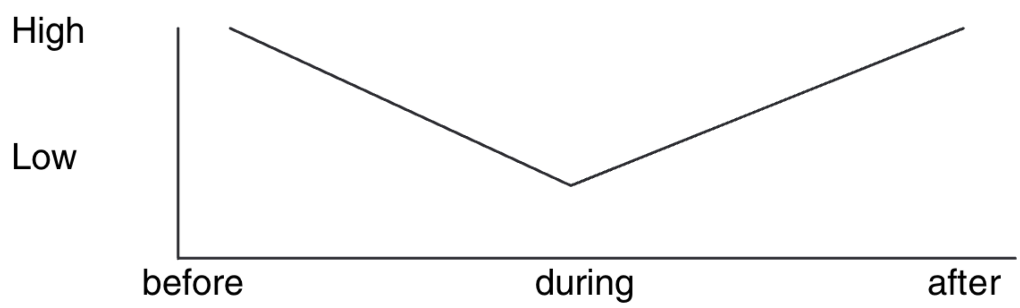

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Figure 4. Level of acceptance of wind energy in a local area before, during and after construction of wind power plant (Source: Devine-Wright, 2005).

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2. Interventions and best practices

2.1. Interventions

In our lives all decisions, including sustainability related decisions and pro-environmental behaviors are under the influence of many conflicting and competing factors. The effectiveness of behavioral interventions would increase if they were aimed at specific antecedents of the relevant behavior. Therefore, it is important to understand which factors promote or inhibit desirable behavior. In addition to the factors mentioned in the previous section, individuals' habits, desire for comfort, convenience, reluctance to change the status quo would also affect their decision to adopt, accept and support wind energy projects in their neighborhoods and wind energy in their lives. Although, social acceptance is understood at the level of the community, efforts to enhance social acceptance can also focus on changing individuals' attitudes and behavior, as communities are after all, an aggregate of individual-level changes.

Some psychological theories have suggested that people are motivated by self-interest (theory of planned behavior, Ajzen, 1985), some others assume that it is altruism that motivates people (value-belief-norm theory, Stern, 2000), while others suggest that behavior change occurs as a sequential process in which people move to different stages of 'readiness to change' (transtheoretical model, Prochaska et al., 2009). On the other hand, theories of social norms explain individual behavior as being directed by what other people do, or by society's expectations (focus theory of normative conduct, (Cialdini et al., 1991). Thus, understanding people's motivations for engaging in or opposing pro-environmental behaviors, such as acceptance of wind energy projects, can be a starting point for developing impactful behavior change interventions. Acceptance of environmental policies, projects has been defined as a specific, nonactivist type of pro-environmental behavior distinguishing it from other more direct environmental behaviors, e.g., recycling, taking part in environmental demonstrations, taking public transport (Stern, 2000).

Behavioral interventions help improve citizens' decisions in a transparent manner, without affecting their freedom of choice. Interventions have been implemented in diverse sectors to

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induce different behaviors, for instance, to encourage recycling, reduce meat consumption, reduce energy consumption, increase financial savings, reduce plastic use, install water or energy saving appliances or use sustainable sources of energy. The types of interventions typically range from providing financial incentives, conducting information and feedback campaigns, structural measures like removing plastic bags or reducing visibility of junk food in stores, social influence and messaging, policy measures like pricing or regulatory measures, and other technical solutions. When it comes to social acceptance of wind farms, there is no one specific intervention since there are a range of underlying mechanisms and motivations affecting citizens attitudes and behaviors towards wind farms. Hence, it would be appropriate if different kinds of interventions are adopted for different contexts, cultures, different stages in the wind farm decision process, and different stakeholders.

As we find through the qualitative review of lighthouse wind farm cases in D2.1, there is no one-size-fits-all approach to ensure the social acceptance of any wind farm case. Each case is unique in terms of its specific context, location, historical time, and characteristics. To effectively address the challenge of social acceptance, it is crucial for the relevant stakeholders, including public authorities, energy communities, developers, and operators, to adopt a tailored approach that is specifically designed to meet the local needs and circumstances. It is essential to carefully examine the specific characteristics of each wind farm before implementing any practice to ensure its effectiveness and suitability. There is no panacea solution that can be universally applied.

While some interventions can be ***informational***, relying on specific message framing for specific communities, others can be ***incentive driven***. On the other hand, some other interventions can build on individuals' ***psychological*** *traits*, motivations, and social norms, while others can be based on ***structural*** **strategies**. Further, some interventions can be ***community-based***, yet others can be focused on ***individual citizens***.

More formally a distinction has been made in the literature, between **antecedent** and **consequence** strategies (Geller et al., 1982). Antecedent strategies aim at changing factors **before the behavior** (for instance, re-designing a wind farm to reduce visual impact or make a wind farm more esthetically pleasing, providing detailed information about the wind energy project to the local community, leading to higher social acceptance before building the wind farm). Consequence

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strategies focus on changing the outcomes **following behavior** or prevent continuation of a behavior (for instance, providing compensation, other benefits to local communities to maintain high social acceptance after wind farm is commissioned).

Another distinction is between **informational strategies** that aim at changing perceptions and motivations without changing the context in which choices are made, and **structural strategies** that change the context or circumstances under which choices are made (Steg & Vlek, 2009). So, if social acceptance is found to be strongly related to attitudes, interventions can focus on attitude change, or if it is contextual factors that reduce social acceptance, efforts should be directed at removing those barriers.

In the backdrop of the social acceptance (of wind energy) literature, we focus on the second categorization - informational vs. structural behavior change interventions.

2.1.1. Informational interventions

First, general information provision aims to increase the knowledge and awareness of the target audience, to change their attitudes, perceptions, and motivations, more so when information is tailored for that audience. It has also been found that information provision is more effective when some **social norm** is made salient (e.g., "did you know 75% of our guests help save the environment by re-using their towels", message used by a hotel to enhance towel re-use, see Goldstein et al., 2008) or when information is given in a social context (e.g., community program aimed at promoting adoption of energy-saving measures was more effective in neighborhoods with stronger ties, Weenig & Midden, 1991). Second is **message framing**, i.e., giving the communicated information a specific focus and aligning the message with people's values and beliefs. For instance, a study shows that public support for a proposed wind farm was higher when community benefits were framed as a collective benefit instead of focusing on individual benefits (Walker et al., 2014). On the other hand, framing the community benefits as 'compensation' for the impact of windfarms instead of 'benefit payments' has shown mixed effects (Kerr et al., 2017).

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Another approach is referred to as the **'block leader' approach**, which in our context of social acceptance of wind farms translates into 'local champions' who mobilize community, social networks and raise awareness about wind energy citizenship. In this approach, motivated volunteers from the local community are selected to act as opinion leaders who encourage pro-environmental behaviors. For instance, to promote recycling behavior in the neighborhood (Abrahamse & Steg, 2013). This method is found to be effective as people are more likely to accept information, requests from individuals they know or perceive to be like themselves (Cialdini, 2001).

Last, is **group or comparative feedback**, whereby feedback about individual or community in relation to performance of others is helpful in changing behavior. For instance, group feedback on own community's performance on energy saving campaign compared to another community's performance (Staats et al., 2004). This method can be adapted and applied to social acceptance context by presenting information about successful adoption of wind energy projects by certain communities (success stories) to other similar communities where a wind energy project is expected to be developed.

Informational interventions can be effective when individuals do not face strong external constraints on their behavior, but the effectiveness of such strategies over the long term has been varied. The provision of information can result in increased awareness but not necessarily in behavior change that is sustained over long periods of time (Abrahamse et al., 2005). Such informational interventions can in turn, support structural strategies that encourage behavior change.

2.1.2. Structural interventions

Structural interventions aim at changing contextual factors such as availability of alternatives, their costs and benefits, and the decision-making framework. Structural measures are based on the idea that people are motivated to do something by the promise of outcomes, or to achieve positive consequences or to avoid negative consequences. The behaviors resulting in positive consequences are repeated and those resulting in negative consequences are avoided. This idea is

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the basis of influencing behavior by giving **rewards** or **penalties**. Such strategies change the circumstances under which decision is made, in a way that increases individual's opportunities to act pro-environmentally (Thøgersen, 2005). These may also indirectly affect perceptions and motivational factors. For instance, closing off the city center for motor traffic and promoting cycles or walking areas. Structural strategies can be ***financial measures*** like monetary incentives, taxes, or pricing mechanisms, ***technological solutions*** like installing electricity or water saving appliances at home, using an app to monitor energy consumption or ***legal regulations and policies*** that require a certain behavior to be performed or banned. Regulatory measures would mean that the specific laws are enforced and that violations result in some type of punishment. Interventions that use rewards and penalties to influence behavior must be designed carefully, as it might happen that with large rewards, behavior change can be due to the reward and not due to change in personal attitudes. Such behavior changes might be short-lived, as long as the reward or penalty is in place.

Looking at the case of wind energy projects, large number of the strategies used to enhance social acceptance address contextual variables. Foremost, is the **procedural aspect** of the project under which developers interact with local communities. Here, the most effective structural measures are prioritizing a more inclusive, participatory approach to project decision-making, engaging the community using carefully framed rhetoric, ensuring fairness in distribution of risks, costs, and benefits in the community, promoting transparency and fairness in the decision process. For **socio-economic aspects**, several financial measures have been employed - various community benefit and development schemes, community ownership models, citizen investment schemes, provision of discounted electricity to local community or environmental tax (also considered a regulatory measure) on wind farms for visual and environmental impact. Although the success of these measures might be contingent on the **level of trust** between community and project owners/developers, the perception of fairness and the correct framing of these benefits (community benefits being pitched as compensation or bribe). Technical solutions, on the other hand, have predominantly been suggested for reducing **environmental impact** - reducing visual impact, noise impact, impact on birds/bats/marine species or tackling technical challenges related to wind turbines, electricity grids.

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Whether we select informational or structural interventions would depend on the specific challenges faced by the local communities that inhibit acceptance of a wind energy project. Generally, a **combination of measures** for behavior change will be successful, as most often, there are a range of target groups, motivations, and barriers to social acceptance. This has been substantiated by our findings in D2.1, where we qualitatively reviewed lighthouse wind farm cases and reported that social acceptance of a wind farm is typically influenced by a combination of multiple factors rather than a single, distinct cause. The various recorded approaches examined in D2.1, highlighted "*the importance …of considering multiple factors and employing a set of strategies to enhance social acceptance in wind farm projects*".

However, before developing **individual-level**, psychological measures to change attitude and behavior, it seems prudent to address **community-level** challenges of lack of transparency, information, and citizens' trust in project developers and operators.

Table 1. Summary of intervention types and strategies.

Intervention Type	Strategy
Informational	• Salient social norm • Message framing • Block leader • Group/comparative feedback
Structural	• Rewards, penalties • Financial measures • Technological solutions • Legal regulations, policies

It is also important to note that social acceptance is a complex and varied topic, involving different stakeholders (local community, project developers, local authorities, investors, interest associations, wind industry, academics) and contributions from many disciplines (psychology, sociology, geography, policymaking, spatial planning, economics), resulting in linkages and inter-dependencies amongst the various challenges, discussed earlier in this report. Currently, there are

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no ***specific behavioral/psychological*** interventions targeted ***directly*** at enhancing social or community acceptance of wind farms, as social acceptance might not be a ***behavioral/psychological*** issue at the individual or community level (for e.g., changing individual behavior to increase recycling, conservation of electricity or to reduce household food waste). Most of the recommendations from the academic literature revolve around best practices or strategies aimed at removing structural barriers to social acceptance. Another view is that acceptability (and support) of environmental policies and technology are a special type of a 'pro-environmental behavior' (Stern, 2000) and can be seen as a social dilemma (where individual interests might conflict with collective interests, Hardin, 1968) and so interventions designed to enhance pro-environmental behavior might also be applied to social acceptance.

2.2. Recommendations framework

Drawing on the ‘if this, then that’ (IFTTT) principle, a concept of conditions or triggers and subsequent responses, we develop a set of recommended interventions, tailored to different conditions in the social acceptance of wind energy projects. For consistency, we adopt the same classification framework as in section 1.2 and present our recommendations for each category of factors (i.e., socio-economic, landscape, environmental, individual, institutional, and technical). These will be in the form of a list of recommendations, supported by academic references, that can be filtered and accessed based on certain input criteria - impact category, type of windfarm project, a sub-category of factors, and project phase (fig. 5). These recommendations are generated through an extensive survey of the social acceptance literature and align with the results from WP2 of the WENDY project.

The online version of this framework would be developed as a tool (see section 3) accessible to the public, including stakeholders of a wind energy project. This repository of recommendations would be open to receiving new recommendations, feedback, comments from the stakeholders of wind energy projects, ensuring an ongoing interaction with the tool users and update of its contents.

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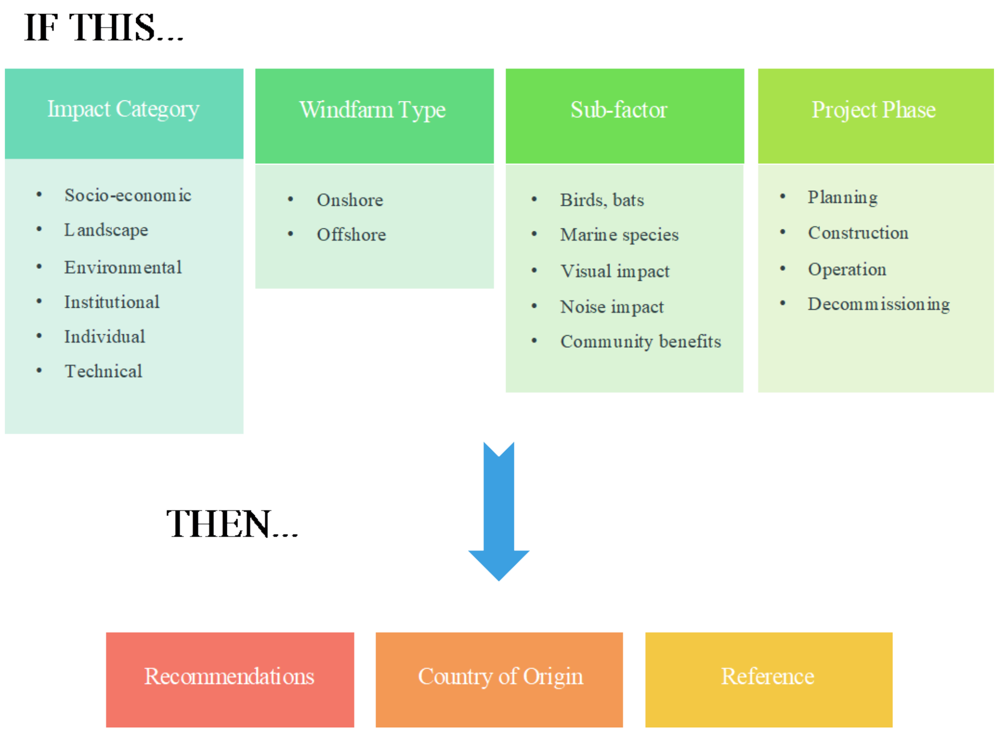

Figure 5. Recommendations framework for social acceptance of wind energy projects.

2.3. Recommendations and good practices

The following recommendations are based on the survey of social acceptance literature and identify some innovative strategies being implemented in wind energy projects across the world. These are not meant as a 'checklist' for any wind stakeholder or project but as a 'good-to-implement' measures which can smoothen the transition to wind energy implementation. We follow the same categorization developed in section 2 and present here a subset of the recommendations. For a detailed, full list of recommendations, please refer the recommendations repository (updated Sep 2024).

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Table 2. Compilation of recommendations based on the social acceptance literature.

Category	Recommendations
Socio-economic	• Creation of a **Community Engagement Plan** (CEP) at the beginning of the project, that outlines engagement activities over the life cycle of a project, key stakeholders, engagement strategies, timetable, engagement monitoring. It must be recognized that community benefits are not the same as benefits to a group of individuals in the community. • **Community compensation** measures be institutionalized, be more prescriptive instead of being ad-hoc and voluntary, as this will help build trust and remove the negative connotations associated with such compensation. Such institutionalization should also allow for discussion between communities and developers regarding the type and amount of compensation. • To address concerns about **community benefit schemes** as a form of 'bribery' or being 'unethical' the conversation about community benefit schemes should be kept separate from, and secondary to project planning decisions and community consultations. The community members should be made aware that their support to the wind energy project cannot be contingent on community benefits. • Community benefits are not able to win-over strong opponents of the wind energy project, these should be seen in combination with **early and transparent provision of information** to community and developing perceptions of trust and fairness in project processes and outcomes. • In communities where livelihoods are dependent on nature (e.g., **farming, fishing, tourism**), benefits should strengthen, support such livelihoods, and offer land-tenure security, wherever possible. For offshore wind farms, such benefits should help diversify the types of fishing practices and support local initiatives, instead of just offering the fishing community monetary compensation. • Developer to share information about the electricity infrastructure and whether the **generated electricity** would benefit the local community. • Local citizens, both permanent and seasonal residents (and tourists), to be consulted and be allowed to **participate in designing** of community development/compensation schemes.

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Category	Recommendations
	• Siting decisions should consider not just the financial value of land, but also the *cultural* value, especially for **indigenous people**.
Landscape	• Quantify visual impact by conducting **visual impact assessment** (VIA) using visual mapping, photography, simulation. Each land/seascape can be divided into visual units which can then be evaluated for diversity, distinctiveness, visual absorptive capacity. Set visual quality objectives to maintain scenic quality. • Develop a link between existing tourist attraction (or heritage, other special sites) near proposed wind farm site and the future wind project, i.e., the wind farm can be projected as a tourist destination and incorporated into the tourism industry. This can be proposed as **'eco/energy tourism'** or 'industrial tourism', especially for those seeking educational and environmental experiences. • Early engagement with the local community and planning to assess potential impact on tourism and recreational activities, before (baseline) and after construction of a wind farm, as also a longer-term impact monitoring. This can be proposed as a **Tourism and Recreation (T&R) Impact Assessment** as part of other technical assessments, to be conducted by the wind farm developers. • Project developer **sponsored visits to another existing wind farm** (boat tours for offshore wind farms) for the community members potentially going to be affected by a new wind project. This can alleviate some apprehensions, concerns about visual impact and dispel some common myths. Similarly, school trips can be organized as an educational experience for children in the community. • Strong emphasis should be given to an **inclusive and participatory project planning process**, with transparency about both positive and negative effects of wind turbines (WT). • Project developers can create a **noise-demonstration kit** so that the local community members can be given an audio demonstration through special headsets, of wind turbine noise under varying conditions. • **WT noise measurement** to include both **objective** (sound pressure levels, distance to WTs, number of visible turbines, wind direction, weather conditions) and **subjective** measures (attitude towards WT, noise sensitivity, perceptions about wind project).

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Category	Recommendations
	Project developers, planners would benefit by using the **noise-annoyance-stress (NAS) scale**, developed, and tested in US, Europe by Hübner et al. (2019).
Environmental	• Conduct **sensitivity mapping assessments** over a 12-month period to determine baseline number of animal species (birds, bats, reindeers, marine species) during an annual cycle, using different monitoring methods (radar, thermal animal detection system, acoustics). • **Timing construction, decommissioning** activities to avoid sensitive periods (roosting, migration, breeding) specific to bird or bat species in the area, which might differ based on regions, seasons, weather conditions. • Implement **shut down-on-demand** (SOD) for WTs, which sets clear rules for the operation of wind farms including monitoring demands, operating guidelines, and standards for temporary shutdown. • Redevelop and **reinstate vegetation** using locally indigenous plants, in areas surrounding WTs post construction and decommissioning. • Develop stringent regulations for collection, dissemination of **wildlife monitoring data** with all stakeholders, environmental authorities. • Combine **coast conservation measures** (e.g., building sea walls) with offshore wind farms development to support the coastal community.
Institutional	• Country's **energy policy and land-use policy** need to be aligned, keeping in mind the interest of both national and local stakeholders of wind energy projects. • Policy makers can draft guidelines informing wind project stakeholders about different **financial participation models** and their pros and cons. • **Wind energy strategic planning** to include details on public participatory procedures, target amount of energy, priority areas and communication measures (quality, timing, frequency of communication). • **Adapt strategic planning** to the local, regional context (e.g., in terms of communication culture, level of self-organization). • To ensure **procedural justice**, efforts to be directed towards public trust-building measures, like increasing transparency around project relevant information, costs, risks, benefits, and ensuring project outcomes are appropriate, fair and equitable.

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Category	Recommendations
	• Enhance **formal and informal community engagement** at all stages of the project to increase 'sense of co-ownership' of wind energy projects.
Individual level	• Community benefits can be framed sensitively and in a timely manner, to avoid **individual's perceptions** of bribery. • **Framing of information** about the wind project should avoid paternalistic, instructive tones so as not to give rise to psychological reactance in individuals. • Providing clear, **balanced information** about both positives and negatives of wind energy projects and proposed mitigation, based on real cases or academic research will help build trust in the community members and lead to informed decision-making. • Enabling community members to visit and experience successful wind farms will **improve knowledge and dispel myths** around wind energy. • Selecting prominent experts or well-networked community members to act as **local champions** of wind energy project can enhance acceptance. • Highlight other **pro-environmental behavior** of community members, to build an environment-friendly image and community belief that aligns with wind energy.
Technical	• Employ a comprehensive **strategic planning approach** for wind farm siting decisions, based on balanced land development, keeping in mind values of place attachment and local concerns. • Early **engagement and consultation** with the local community on **siting decisions**, alternative sites, and design of wind farm, to reduce visual impact and meet aesthetic requirements. • **Assess** the vertical axis wind turbine (VAWT) design compared to the horizontal axis wind turbine (HAWT) design on parameters of efficiency, visual, environmental impact, and suitability for urban locations. • Developers can consider **changing project features** (distance to residences, location, design) to accommodate community concerns. • If possible, **maintain local or national ownership** and development (vs. foreign) of wind energy projects and ensure local use of generated electricity. • Explore **novel energy market models** (e.g., hedge-based model) to manage wind energy intermittency and related risks.

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3. Social acceptance interventions tool methodology (updated)

This section describes the principles and methodology followed in designing the online version of the social acceptance interventions (SAI) tool. This interactive, user-friendly tool has been built on the basis of recommendations highlighted in the previous section of the report.

3.1. Target audience

The SAI tool is directed at wind energy project stakeholders, but also stakeholders of RE projects, in general. Such stakeholders would include:

- Government (public authorities, local government, policy makers)
- Wind (renewable) energy project developers
- Wind farm operators
- Wind farm owners (investors, shareholders)
- Local community members (residents, associations)
- Environmental sector (NGOs, interest groups)

The tool will be linked to the main WENDY project website (wendy-project.eu) and the WENDY Knowledge Exchange Platform (KEP), being accessible to everyone under open access policy.

3.2. Tool design

The tool design has been developed after discussion and exchange of ideas with the task leader (CIRCE) and partners (Q-Plan, White Research). Final design and implementation of the online tool has been completed by CBS, in consultation with the task partners. The tool has been designed keeping in mind the recommendations framework introduced in the previous section (section 2.2)

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and the aim is that it would be incorporated in the wind energy project decision-making process and serve as a knowledge assessment and decision support tool for different stakeholders. The design is simple, easy to understand, read and interact with. In the process of designing the social acceptance interventions tool, we explored and drew inspiration from the following similar tools from other projects:

- PocketWinWind (https://www.pocketwinwind.eu): It is an online, open access resource designed to promote socially inclusive wind energy development. The tool allows friendly access to the outcomes of the WinWind project, that focused on regions with a comparatively low market uptake of wind energy. WinWind results are published here since they proved useful resources for understanding and addressing the lack of social acceptance with tailored and socially inclusive measures.
- CIPTEC Innovation tool (http://toolbox.ciptec.eu/). A simple tool where you select some parameters and the page filters and displays the innovations that are suitable for the selected combination of parameters in the field of Public Transport.

The SAI tool is a consolidation of best practices, interventions and strategies implemented to enhance acceptance or reduce opposition of wind farms across EU and various other countries (like UK, US, Australia, Brazil, Ethiopia) and to increase support towards wind energy. Based on specific filtering criteria, the tool presents a description of the recommendation, the geographical location (country) of implementation and the reference for further details. The online version has been developed in form of a R Shiny App[1] with the following sections:

- Home page - the user is presented with information about the WENDY project, the details about the WP4 (T4.1).
- SAI tool page - the user is presented with brief information about social acceptance, the aims of the tool and instructions for using the tool. The option to download recommendations from the tool can also be provided in future iterations of the tool.

[1] Shiny is an open-source R package that provides an elegant and powerful web framework for building web applications using R programming language. More details - https://shiny.posit.co/

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- About page - the user is provided with information about how the tool was developed, the consortium partners involved. The user is also be provided with ways to connect with the tool developers (e.g., contact form, email) by redirecting to the main project website contact form.

From September 2024, the SAI tool is live on shinyapps.io hosting platform, with the URL: https://wendy-cbs.shinyapps.io/wendy/. Following the tool design description, the SAI tool has three web pages - the home page (fig. 6), the SAI tool page (fig. 7), and the about page (fig. 8).

Figure 6. Home page of the social acceptance tool.

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The Home page begins with a wind farm graphic with three keywords - 'acceptance', 'support' and 'collaboration', that reflect the social acceptance theme. This is followed by a brief description of the WENDY task (T4.1) objective and the tool objective. Next, we present a definition of the concept 'social acceptance' and its three dimensions - community acceptance, socio-political acceptance and market acceptance, with relevant academic references.

Figure 7. Social acceptance interventions tool page.

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On the tool page, we provide a brief background about the tool's development and the way in which the tool can be used. The user needs to select relevant options from the three dropdown sections (impact category, windfarm type, factor), for relevant recommendations and the region/country of implementation to be displayed. These recommendations, interventions or best practices are presented in a simple language so as to be understood by different stakeholders. These recommendations are suggested to influence and improve social acceptance of wind energy developments. If the user prefers to read the detailed version of the recommendation, she is required to follow the academic reference URLs.

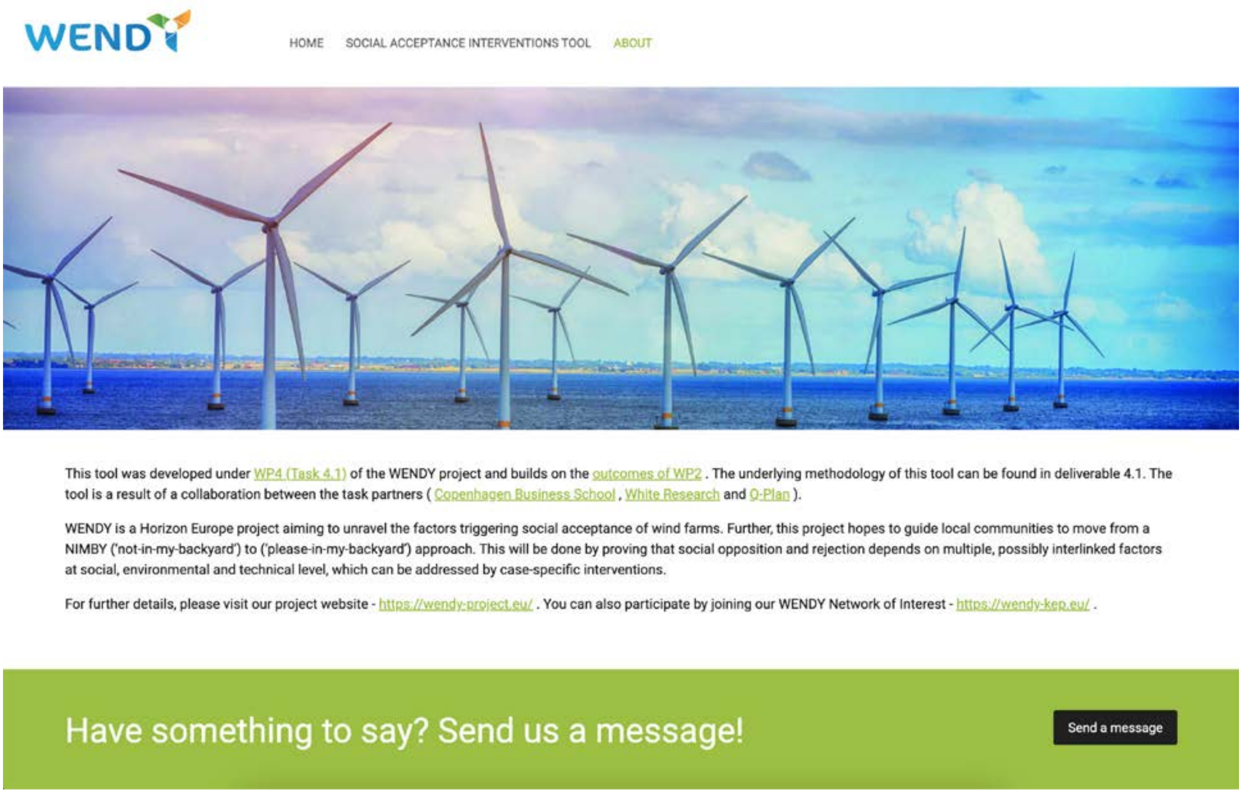

Figure 8. About page of the social acceptance tool.

On the about page, we provide further details about the tool, along with URLs directing to the WENDY work package documents on the project website. The user is further invited to

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join the WENDY network of interest (NoI), developed under WENDY WP6 (T6.2). Finally, the user can also provide feedback on the 'send a message' URL that redirects to the contact form on the main project website.

The social acceptance interventions tool, i.e., the code and the underlying data (in excel format), would be registered under the Creative Commons Attribution Non-Commercial-Share Alike' (CC-BY-NC-SA) license. This would allow other users, researchers to re-use, modify, distribute, build upon the existing code/data, for non-commercial purposes with attribution, provided they use the same license for anything that includes this data. Further details can be found here - https://creativecommons.org/licenses/by-nc-sa/4.0/deed.en

3.3. Exploitation strategy

This section discusses the exploitation strategy of the social acceptance interventions tool as part of D4.1 findings, and its value to the partners who own it.

Table 3. Exploitation strategy

Dimensions	Analysis
1. Exploitation potential	**Main actors** that stand to benefit from findings/SAI tool are - wind farm developers and operators; regulatory authorities, government agencies responsible for energy and environmental policies; environmental NGOs; local authorities/governments; local communities; consultants, law firms specialised in wind farms' planning & licensing. The **added value** of the findings for WENDY, its partners or external stakeholders is based on the following aspects: comprehensive overview of regulatory conditions and consenting procedures in selected EU countries; structured identification of supporting and hindering factors in relation to the planning, licensing, and implementation phase of a wind energy project; emergence of interesting practices or areas for improvement. **Unique features** of the deliverable's results that may be attractive: focusing on countries across the world with varying regulatory conditions and consenting procedures; resulting from a combination of desk and field research; addressing aspects of sustainability, transparency, and fairness.

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Dimensions	Analysis
2. IP protection	IP protection could be based on the following measures: applying data protection measures that ensure confidentiality and security of any personal data collected; use of Creative Commons to disseminate and use the results and findings.
3. Potential exploitation pathways	Exploitation actions could include, among others, the following: knowledge transfer activities such as workshops, training webinars, publications, to disseminate the findings; development of a new service/application based on the inputs of involved stakeholders; further development of research through other publication and funding opportunities.
4. Partners' plans	Partners can inform their business plans and policy strategies considering the results and findings as a key information resource on the topic. Partners' plans could include knowledge transfer activities; development of a new service; seeking new opportunities for relevant research.
5. Other	The exploration of potential collaborations and synergies with key actors and stakeholders could enhance the exploitation potential of the results.

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4. Social acceptance interventions tool usage (updated)

In this section, we present different scenarios to demonstrate the tool functionality. Additionally, we assess the tool on Technology Readiness Levels and create a future development plan.

4.1. Tool usage scenarios

We present one example of each impact category (see section 1.2 for categories) to demonstrate the functionality. The impact categories in the tool are arranged alphabetically.

4.1.1. Environmental interventions

Under this impact category, we consolidate all recommendations, best practices, interventions to address environmental challenges to social acceptance of wind energy. At the second level, these have been classified into offshore and onshore scenarios, and subsequently into a third level of classification dependent on the second level. For instance, under 'onshore' selection, we present recommendations relevant to bird and bat protection (fig. 9), while under 'offshore' selection, we present recommendations relevant for marine species, marine litter, seafloor integrity and water quality (fig. 10).

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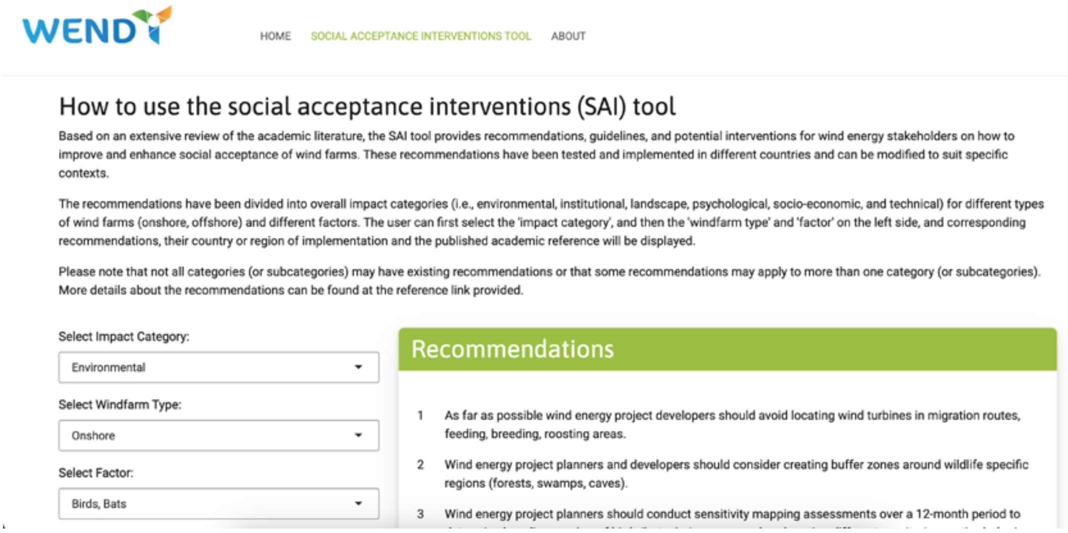

Figure 9. Environmental onshore recommendations.

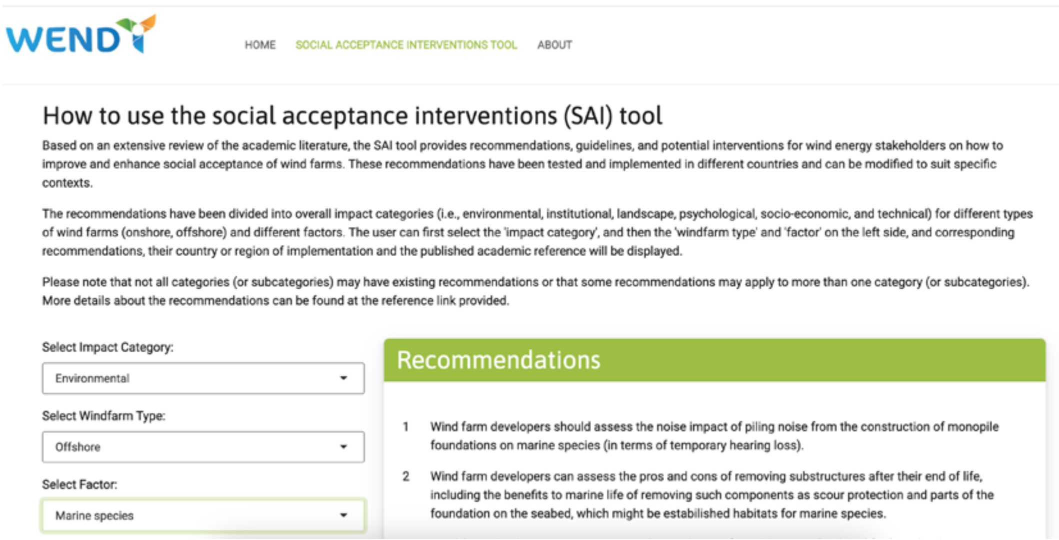

Figure 10. Environmental offshore recommendations.

4.1.2. Institutional interventions

Under this impact category, we present recommendations for enhancing social acceptance by improving energy planning and decision-making processes. These include recommendations related to wind energy policy, overall energy policy, taxation, policies around community energy,

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spatial planning, feed-in-tariff policies, which are relevant not just for the public but also government agencies and institutions that shape energy policies. In this impact category, recommendations are common across onshore and offshore scenarios (figs. 11 - 12).

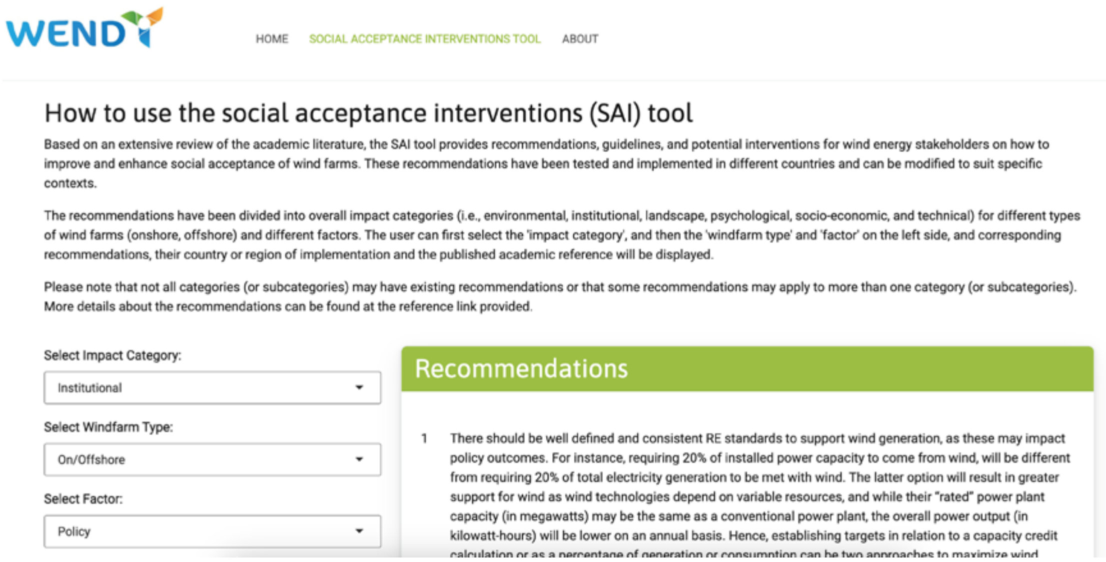

Figure 11. Institutional - policy recommendations.

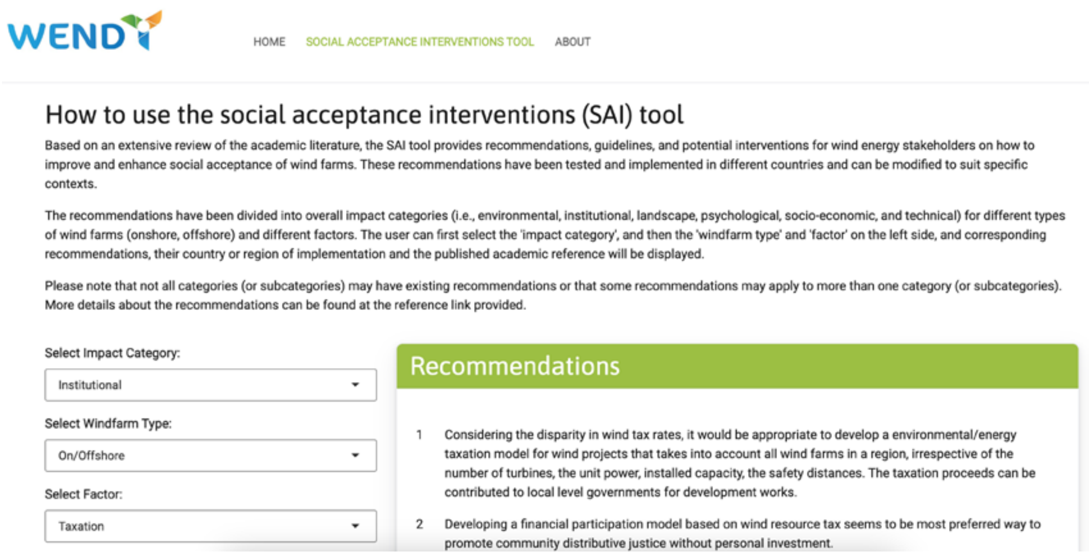

Figure 12. Institutional - taxation recommendations.

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4.1.3. Landscape interventions

Under this impact category, we present recommendations to alleviate challenges related to landscape disamenities, like visual impact, noise impact, and deforestation, often found accompanying wind farms (figs. 13 - 14). Landscape related barriers have received the most research attention and this has resulted in innovative solutions for onshore (e.g., a simulation method called '**visualization dome**' to better communicate benefits of wind farms.[2]) and offshore scenarios.

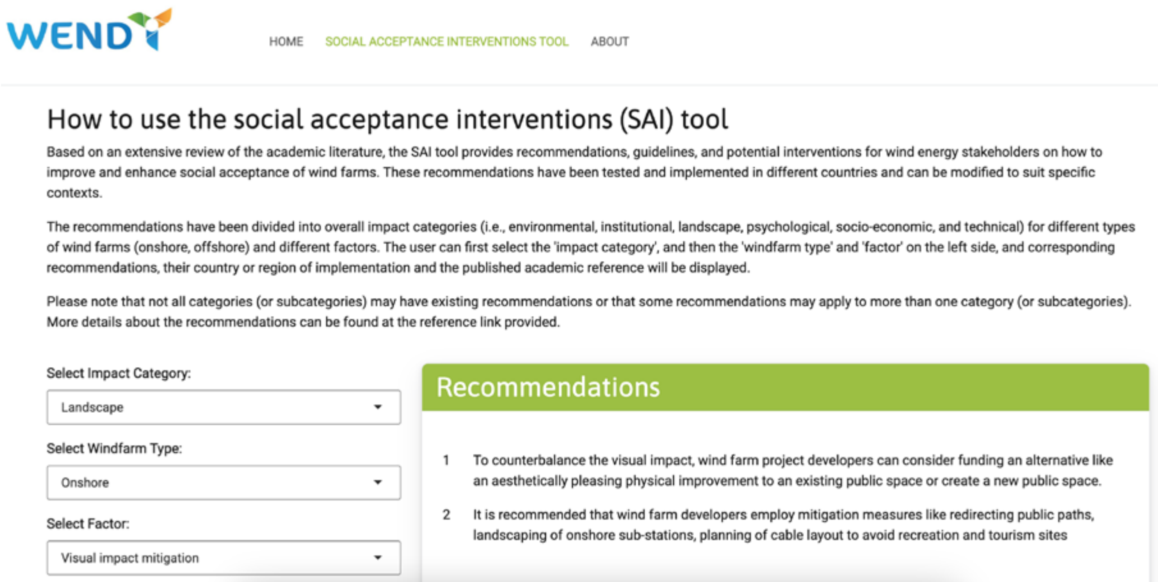

Figure 13. Landscape related onshore recommendations.

[2] Gawlikowska et al., 2018 (http://dx.doi.org/10.13044/j.sdewes.d5.0165)

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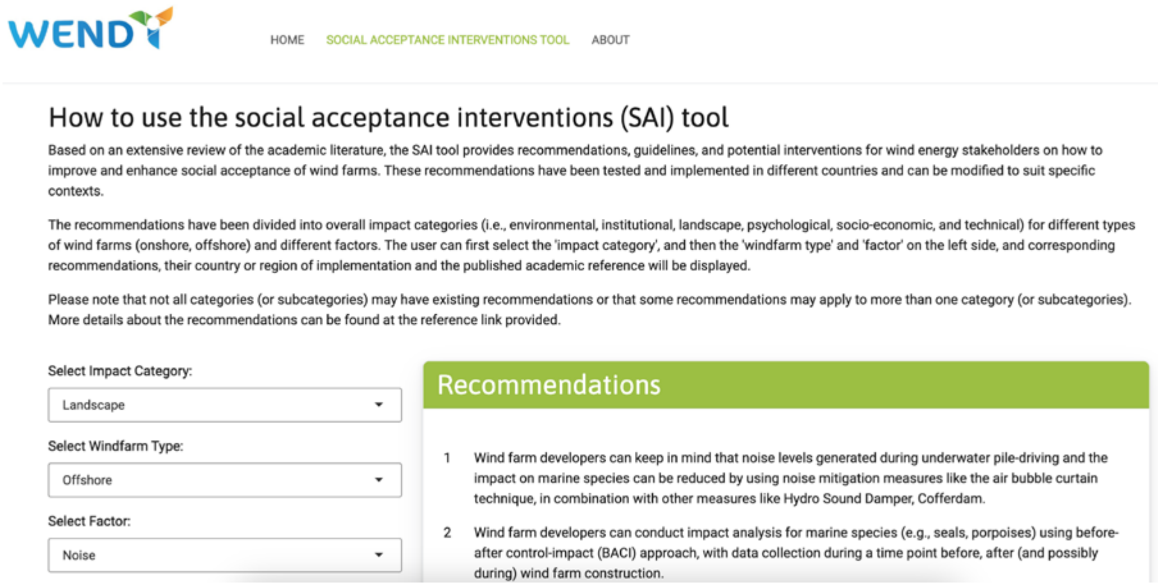

Figure 14. Landscape related offshore recommendations.

4.1.4. Psychological interventions

Under this impact category, we include interventions that can be implemented at a community level, but their impact is more on an individual level, i.e., they can influence an individual citizen's thoughts, attitudes and eventual behavior. These include strategies, applicable to both onshore and offshore scenarios, to enhance community engagement and improve wind energy project communication directed towards the community members (figs. 15 - 16). These interventions have a psychological underpinning, hence the category name - for instance, while using emotional messages to present wind energy projects, it is advisable to induce positive emotions, like future feelings of pride and satisfaction in saying 'yes' to wind power in the present, instead of negative emotions like guilt or shame about not supporting wind energy.

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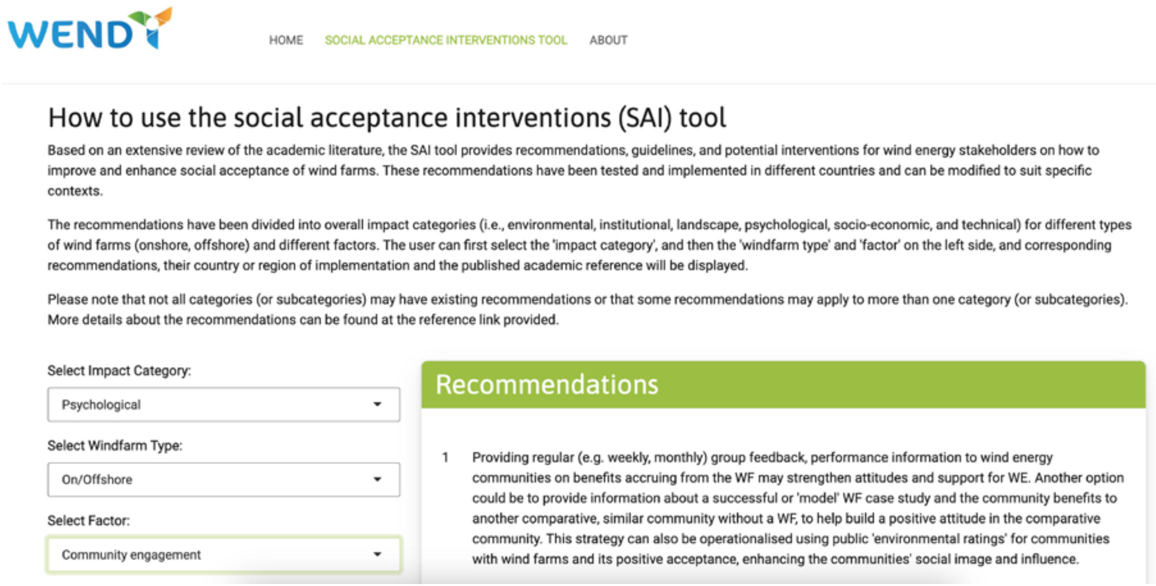

Figure 15. Psychological - community engagement recommendations.

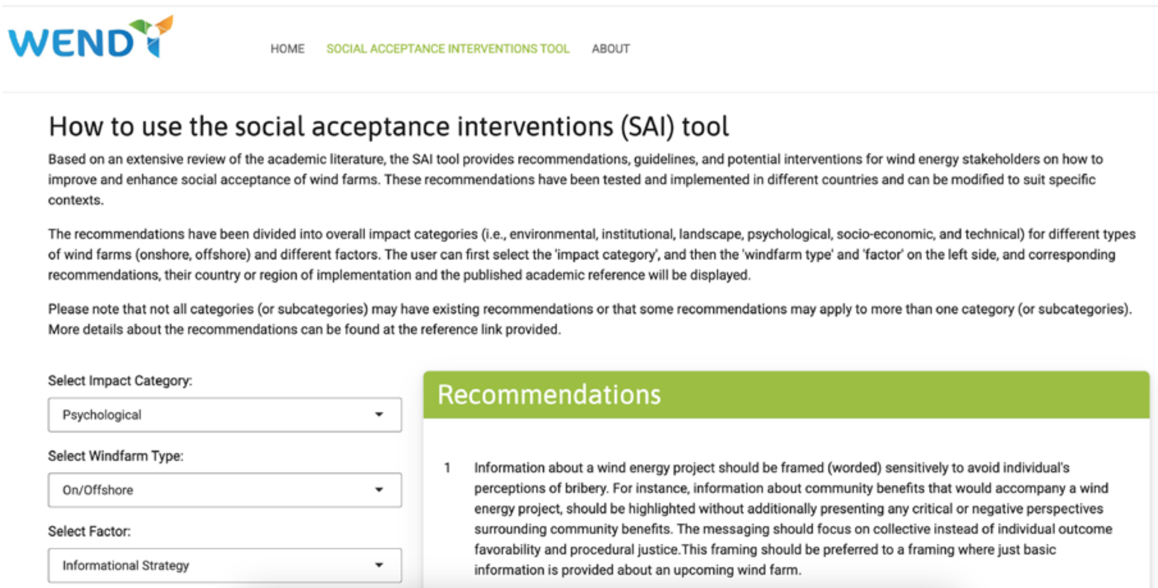

Figure 16. Psychological - informational recommendations.

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4.1.5. Socio-economic interventions

Under this impact category, we present interventions related to a range of social and economic impacts of wind energy developments, or the 'people effects'. These include interventions based on community engagement, community involvement in energy planning and decision-making, community employment, and community benefits, applicable to either/both onshore and offshore scenarios (figs. 17 - 18).

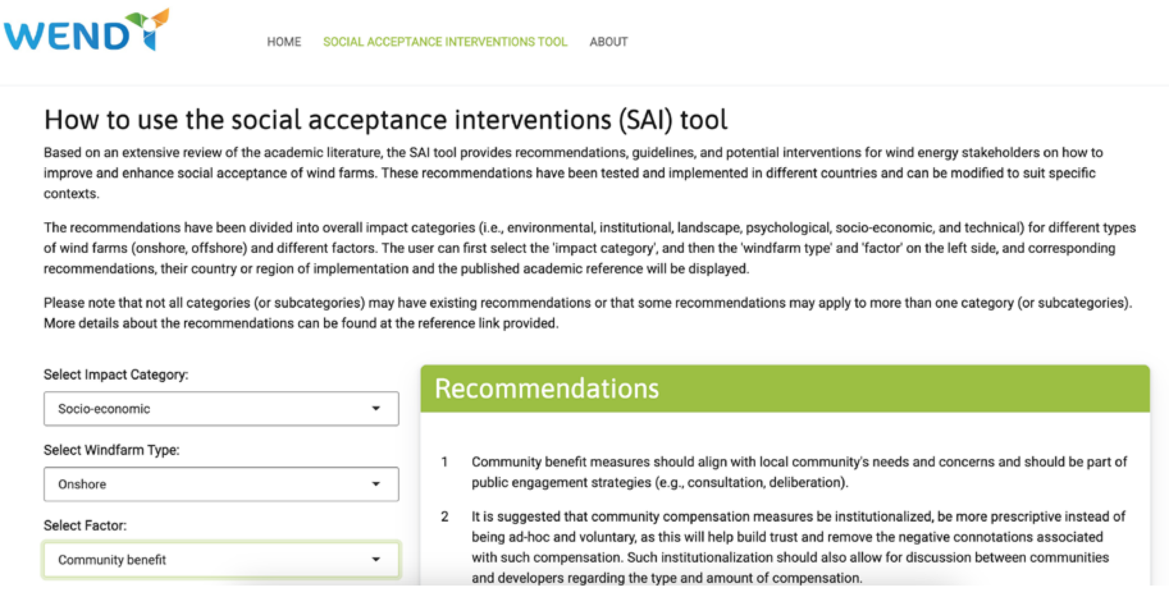

Figure 17. Socio-economic onshore recommendations.

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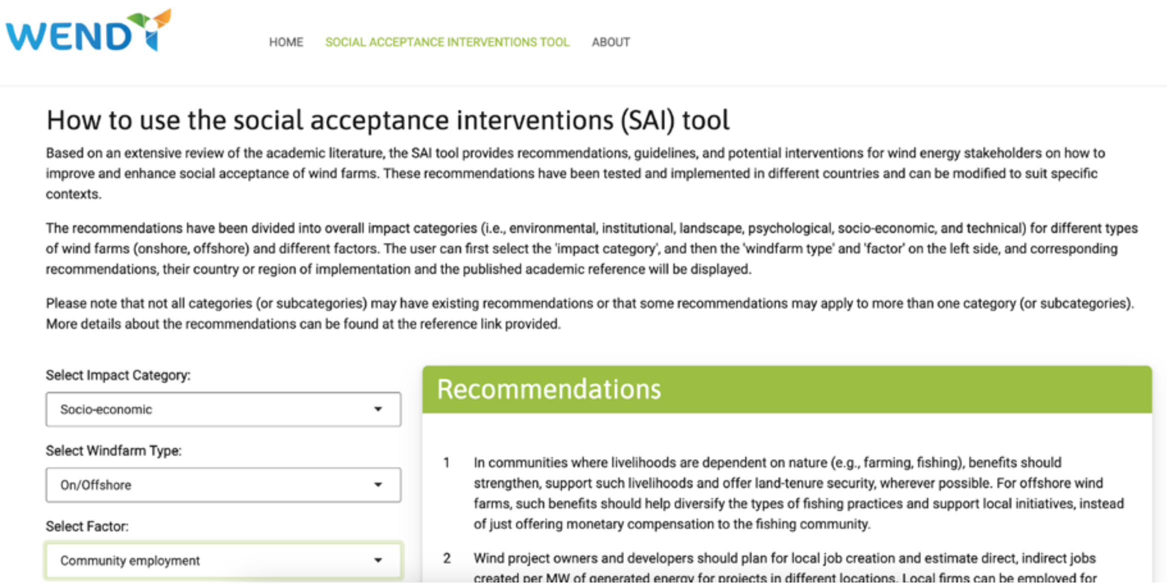

Figure 18. Socio-economic on/offshore recommendations.

4.1.6. Technical interventions

Under this impact category, we consolidate recommendations, innovative technical solutions for wind turbine design, siting, quantification and measurement of visual and noise impact, which can be implemented by project developers to address some aspects of social opposition (figs. 19 - 20). Public concern about visual and noise disturbance resulting from a wind farm, is a major opposition factor. However, this subjective disturbance needs to be quantifiable and comparable across wind energy projects, onshore and offshore, before developing effective mitigation or preventive solutions for it.

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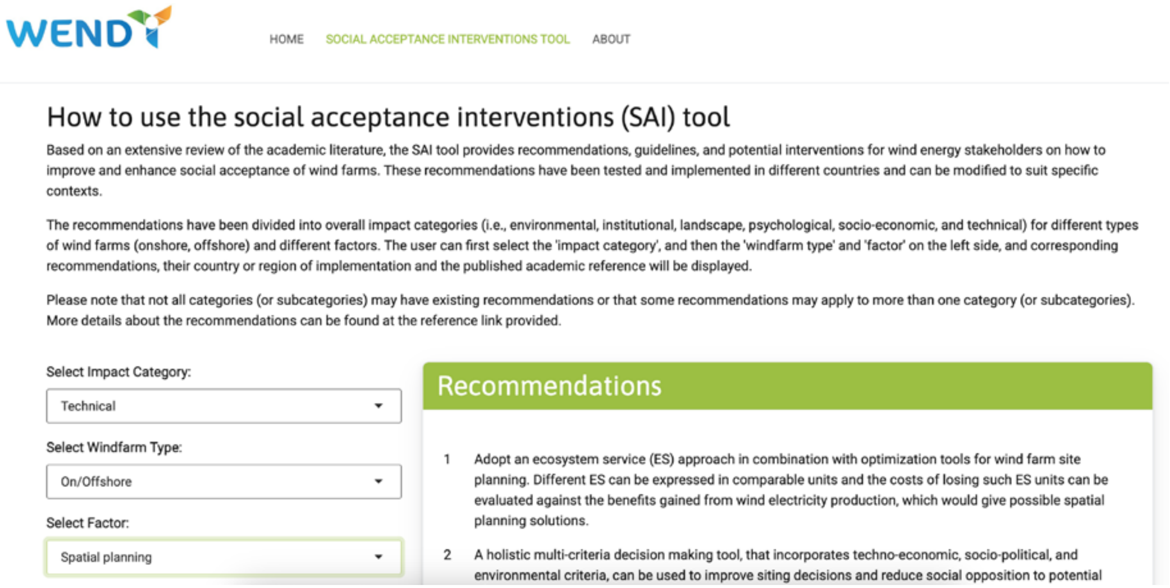

Figure 19. Technical on/offshore recommendations.

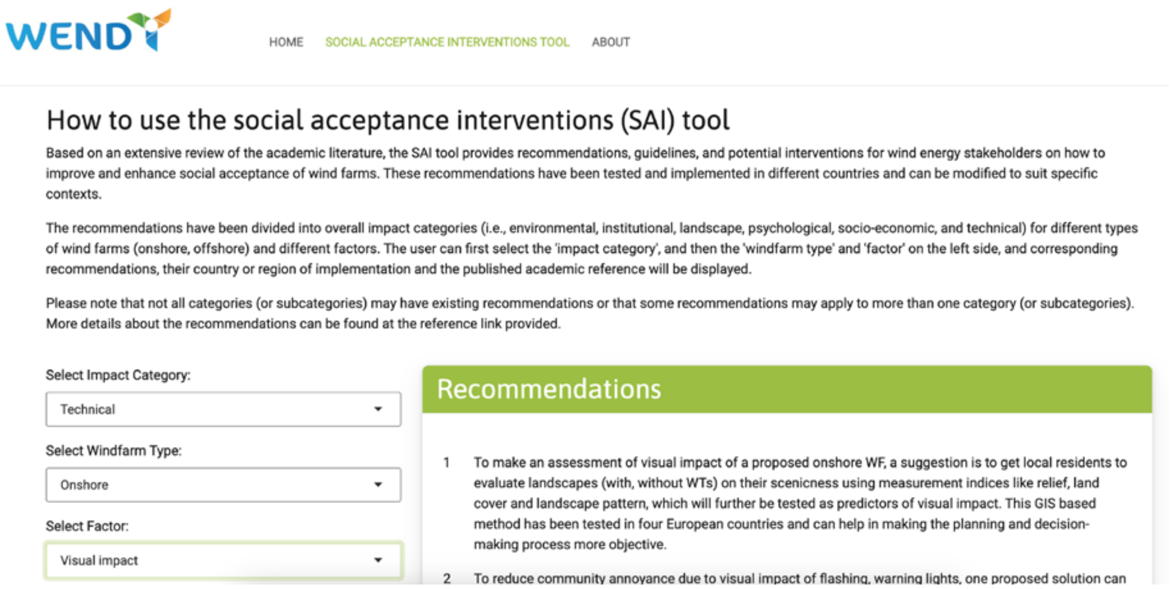

Figure 20. Technical onshore recommendations.

These recommendations form part of an evolving repository, with recommendations being added quarterly. Further, the tool is open to feedback and suggestions from the users.

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4.2. Technology readiness level

In line with EU's guiding principles on technology readiness levels (TRL), we assess our social acceptance interventions (SAI) tool on the TRL scale. The TRL scale, originally developed by NASA[3], consists of a measurement system used to assess the maturity level of a technology, with TRL 1 being the lowest level and TRL 9 the highest level (fig. 21). As the project or technology progresses and meets the technology requirements of each technology level, it is assigned a TRL rating.

Figure 21. Technology readiness levels[4].

Assessing the SAI tool in its current state, TRL 4 seems appropriate for the progress level - the tool is based on extensive research and scientific evidence, has a well-functioning proof of concept that has been tested amongst the internal stakeholders of project WENDY. The potential users and practical application of the tool have been identified. Further, the SAI tool is already serving as a

[3] https://esto.nasa.gov/trl/
[4] Image source: https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels.

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guidance source for designing behavioral interventions to enhance social acceptance in WENDY use case areas, as part of T5.2.

4.3. Next steps

The next steps in SAI tool development are proposed to be:

- The tool to be completely integrated with project WENDY main website and the Knowledge Exchange Platform, developed under T6.2
- The tool to be tested on usability in larger samples consisting of wind energy stakeholders (external to project WENDY, for instance in sister projects WIMBY and Justwind4all)
- The tool to promoted through upcoming WENDY communication activities, e.g., webinars, workshops, newsletter.
- The tool to be the base of a potential peer-reviewed publication about the underlying research and application.

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5. Conclusion

In this section we summarize the findings of the literature review of social acceptance of wind energy technology. Based on the comprehensive review, it can be said that **social acceptance** is a complex, dynamic construct that includes acceptance, support, and adoption of wind energy policies, projects, innovation and technologies of storage and distribution, not just by the public, but also by the socio-political system, the energy industry, and markets.

The social acceptance of wind energy projects depends on a range of factors which have been largely categorized into six: 1) socio-economic factors that affect the local economy, infrastructure, community benefits and investments, 2) landscape related factors focusing on visual, acoustic impact, and related health concerns, 3) environmental factors affecting the local flora and fauna, 4) institutional factors that derive from communication, planning and decision-making processes at the national and local level, 5) individual level factors like prior knowledge about, experience with wind farms, trust in governance and project developers, environmental attitude, and 6) technical factors based on the project characteristics (ownership, number of turbines, size, offshore/onshore, VAWT/HAWT), location, characteristics of project developer.

With this background, it is difficult to assume a 'one size fits all' approach to designing interventions for wind energy contexts. But a good starting point would be to pinpoint the underlying causes (e.g., lack of trust, issues of perception, understanding) and then develop a combination of measures to enhance social acceptance. To this end, this report presents a framework and interventions tool methodology that have been tested and implemented across different countries. These interventions can be further informed by insights from the academic literature, that are relevant to the topic addressed by this report. This repository of interventions, in its online form, will inform different wind energy stakeholders and serve as the basis for further social acceptance enhancement interventions to be designed and implemented in WP5 (T5.2).

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6. References

Abrahamse, W., & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. Global Environmental Change, 23(6), 1773–1785. https://doi.org/https://doi.org/10.1016/j.gloenvcha.2013.07.029

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. Journal of Environmental Psychology, 25(3), 273–291. https://doi.org/https://doi.org/10.1016/j.jenvp.2005.08.002

Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In J. Kuhl & J. Beckmann (Eds.), Action Control: From Cognition to Behavior (pp. 11–39). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-69746-3_2

Azarova, V., Cohen, J., Friedl, C., & Reichl, J. (2019). Designing local renewable energy communities to increase social acceptance: Evidence from a choice experiment in Austria, Germany, Italy, and Switzerland. Energy Policy, 132, 1176–1183. https://doi.org/10.1016/j.enpol.2019.06.067

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. Journal of Environmental Psychology, 27(1), 14–25. https://doi.org/https://doi.org/10.1016/j.jenvp.2006.12.002

Barclay, R., Baerwald, E., & Gruver, J. (2007). Variation in bat and bird fatalities at wind energy facilities: Assessing the effects of rotor size and tower height. Canadian Journal of Zoology, 85, 381–387. https://doi.org/10.1139/Z07-011

Beauson, J., Laurent, A., Rudolph, D. P., & Pagh Jensen, J. (2022). The complex end-of-life of wind turbine blades: A review of the European context. Renewable and Sustainable Energy Reviews, 155, 111847. https://doi.org/https://doi.org/10.1016/j.rser.2021.111847

Bergström, L., Sundqvist, F., & Bergström, U. (2013). Effects of an offshore wind farm on temporal and spatial patterns in the demersal fish community. Marine Ecology Progress Series, 485, 199–210. https://doi.org/10.3354/meps10344

Bidwell, D. (2013). The role of values in public beliefs and attitudes towards commercial wind energy. Energy Policy, 58, 189–199. https://doi.org/https://doi.org/10.1016/j.enpol.2013.03.010

Bockarjova, M., & Steg, L. (2014). Can Protection Motivation Theory predict pro-environmental behavior? Explaining the adoption of electric vehicles in the Netherlands. Global Environmental Change, 28, 276–288. https://doi.org/https://doi.org/10.1016/j.gloenvcha.2014.06.010

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Funded by the European Union. Views and opinions expressed are however those of the author(s) 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.

Caporale, D., & De Lucia, C. (2015). Social acceptance of on-shore wind energy in Apulia Region (Southern Italy). Renewable and Sustainable Energy Reviews, 52, 1378–1390. https://doi.org/10.1016/j.rser.2015.07.183

Carlman, I. (1984). The views of politicians and decision-makers on planning for the use of wind power in Sweden. European Wind Energy Conference, 339–343.

Cialdini, R. B. (2001). The Science of Persuasion. Scientific American, 284(2), 76–81. http://www.jstor.org/stable/26059056

Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). A FOCUS THEORY OF NORMATIVE CONDUCT: A THEORETICAL REFINEMENT AND REEVALUATION OF THE ROLE OF NORMS IN HUMAN BEHAVIOR.

Corvellec, H. (2007). Arguing for a license to operate: the case of the Swedish wind power industry. Corporate Communications: An International Journal, 12(2), 129–144. https://doi.org/10.1108/13563280710744810

Davy, J. L., Burgemeister, K., & Hillman, D. (2018). Wind turbine sound limits: Current status and recommendations based on mitigating noise annoyance. Applied Acoustics, 140, 288–295. https://doi.org/https://doi.org/10.1016/j.apacoust.2018.06.009

Dermont, C., Ingold, K., Kammermann, L., & Stadelmann-Steffen, I. (2017). Bringing the policy making perspective in: A political science approach to social acceptance. Energy Policy, 108, 359–368. https://doi.org/10.1016/j.enpol.2017.05.062

Dethloff, C. (2004). Akzeptanz und Nicht-Akzeptanz von technischen Produktinnovationen. Pabst Science Publisher.

Devine-Wright, P. (2005). Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy. Wind Energy, 8(2), 125–139. https://doi.org/10.1002/we.124

Devine-Wright, P. (2008). Reconsidering public acceptance of renewable energy technologies: a critical review. In M. Grubb, T. Jamasb, & M. G. Pollitt (Eds.), Delivering a Low-Carbon Electricity System: Technologies, Economics and Policy (pp. 443–461). Cambridge University Press.

Devine-Wright, P., & Howes, Y. (2010). Disruption to place attachment and the protection of restorative environments: A wind energy case study. Journal of Environmental Psychology, 30(3), 271–280. https://doi.org/10.1016/j.jenvp.2010.01.008

Devine-Wright, P., & Wiersma, B. (2020). Understanding community acceptance of a potential offshore wind energy project in different locations: An island-based analysis of 'place-technology fit.' Energy Policy, 137, 111086. https://doi.org/https://doi.org/10.1016/j.enpol.2019.111086

Dietz, T., Fitzgerald, A., & Shwom, R. (2005). ENVIRONMENTAL VALUES. Annual Review of Environment and Resources, 30(1), 335–372. https://doi.org/10.1146/annurev.energy.30.050504.144444

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Dimitropoulos, A., & Kontoleon, A. (2009). Assessing the determinants of local acceptability of wind-farm investment: A choice experiment in the Greek Aegean Islands. Energy Policy, 37(5), 1842–1854. https://doi.org/https://doi.org/10.1016/j.enpol.2009.01.002

Dröes, M. I., & Koster, H. R. A. (2016). Renewable energy and negative externalities: The effect of wind turbines on house prices. Journal of Urban Economics, 96, 121–141. https://doi.org/10.1016/j.jue.2016.09.001

Duarte, R., García-Riazuelo, Á., Sáez, L. A., & Sarasa, C. (2022). Analysing citizens' perceptions of renewable energies in rural areas: A case study on wind farms in Spain. Energy Reports, 8, 12822–12831. https://doi.org/10.1016/J.EGYR.2022.09.173

Ek, K. (2005). Public and private attitudes towards "green" electricity: the case of Swedish wind power. Energy Policy, 33(13), 1677–1689. https://doi.org/https://doi.org/10.1016/j.enpol.2004.02.005

European Commission. (2019). The European Green Deal. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX%3A52019DC0640

EWEA [European Wind Energy Association]. (2009). Wind Energy - The Facts. A Guide to the Technology, Economics and Future of Wind Power.

Fast, S. (2013). Social Acceptance of Renewable Energy: Trends, Concepts, and Geographies. Geography Compass, 7(12), 853–866. https://doi.org/10.1111/gec3.12086

Fergen, J., & B. Jacquet, J. (2016). Beauty in motion: Expectations, attitudes, and values of wind energy development in the rural U.S. Energy Research & Social Science, 11, 133–141. https://doi.org/https://doi.org/10.1016/j.erss.2015.09.003

Gawlikowska, A.P., et al., Visualisation and immersion dome experience for inspired participation. Journal of Sustainable Development of Energy, Water and Environment Systems, 2018. 6(1): p. 67-77. http://doi.org/10.13044/j.sdewes.d5.0165

Geller, E. S., Winett, R. A. (Richard A., & Everett, P. B. (Peter B. (1982). Preserving the environment: new strategies for behavior change. Pergamon Press. https://cir.nii.ac.jp/crid/1130282271882043904.bib?lang=en

Goedkoop, F., & Devine-Wright, P. (2016). Partnership or placation? the role of trust and justice in the shared ownership of renewable energy projects. Energy Research and Social Science, 17, 135–146. https://doi.org/10.1016/j.erss.2016.04.021

Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels. Journal of Consumer Research, 35(3), 472–482. https://doi.org/10.1086/586910

Gross, C. (2007). Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance. Energy Policy, 35(5), 2727–2736. https://doi.org/10.1016/j.enpol.2006.12.013

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Hall, N. L. (2014). Can the “Social Licence to Operate” Concept Enhance Engagement and Increase Acceptance of Renewable Energy? A Case Study of Wind Farms in Australia. Social Epistemology, 28(3–4), 219–238. https://doi.org/10.1080/02691728.2014.922636

Hardin, G. (1968). The Tragedy of the Commons. Science, 162(3859), 1243–1248. http://www.jstor.org/stable/1724745

Heiskanen, E., Hodson, M., Mourik, R. M., Raven, R. P. J. M., Feenstra, C. F. J., Torrent, A. A., & Brohmann, B. (2008). Factors Influencing the Societal Acceptance of New Energy Technologies: Meta-Analysis of Recent European Projects. Deliverable 3.1, 3.2 and 4. Cultural influences on Renewable Energy Acceptance and Tools for the development of communication strategies to promote acceptance among key actor groups.

Hübner, G., Pohl, J., Hoen, B., Firestone, J., Rand, J., Elliott, D., & Haac, R. (2019). Monitoring annoyance and stress effects of wind turbines on nearby residents: A comparison of U.S. and European samples. Environment International, 132. https://doi.org/10.1016/j.envint.2019.105090

Hui, I., Cain, B., & Dabiri, J. (2018). Public receptiveness of vertical axis wind turbines. Energy Policy, 112, 258–271. https://doi.org/10.1016/j.enpol.2017.10.028

Huijts, N. M. A., Molin, E. J. E., & Steg, L. (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. In Renewable and Sustainable Energy Reviews (Vol. 16, Issue 1, pp. 525–531). Elsevier Ltd. https://doi.org/10.1016/j.rser.2011.08.018

International Energy Agency. (2013). RECOMMENDED PRACTICES 14. SOCIAL ACCEPTANCE OF WIND ENERGY PROJECTS 1. www.ieawind.org

Ishugah, T. F., Li, Y., Wang, R. Z., & Kiplagat, J. K. (2014). Advances in wind energy resource exploitation in urban environment: A review. Renewable and Sustainable Energy Reviews, 37, 613–626. https://doi.org/https://doi.org/10.1016/j.rser.2014.05.053

Jensen, C. U., Panduro, T. E., Lundhede, T. H., Nielsen, A. S. E., Dalsgaard, M., & Thorsen, B. J. (2018). The impact of on-shore and off-shore wind turbine farms on property prices. Energy Policy, 116, 50–59. https://doi.org/10.1016/j.enpol.2018.01.046

Jobert, A., Laborgne, P., & Mimler, S. (2007). Local acceptance of wind energy: Factors of success identified in French and German case studies. Energy Policy, 35(5), 2751–2760. https://doi.org/https://doi.org/10.1016/j.enpol.2006.12.005

Kerr, S., Johnson, K., & Weir, S. (2017). Understanding community benefit payments from renewable energy development. Energy Policy, 105, 202–211. https://doi.org/https://doi.org/10.1016/j.enpol.2017.02.034

Kim, H.-J., Kim, J.-H., & Yoo, S.-H. (2019). Social acceptance of offshore wind energy development in South Korea: Results from a choice experiment survey. Renewable and Sustainable Energy Reviews, 113, 109253. https://doi.org/10.1016/j.rser.2019.109253

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) 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.

Klick, H., & Smith, E. (2010). Public understanding of and support for wind power in the United States. Renewable Energy, 35, 1585–1591. https://doi.org/10.1016/j.renene.2009.11.028

Knauf, J. (2022). Can't buy me acceptance? Financial benefits for wind energy projects in Germany. Energy Policy, 165. https://doi.org/10.1016/j.enpol.2022.112924

Knopper, L. D., & Ollson, C. A. (2011). Health effects and wind turbines: A review of the literature. Environmental Health, 10(1), 78. https://doi.org/10.1186/1476-069X-10-78

Ladenburg, J., & Dubgaard, A. (2007). Willingness to pay for reduced visual disamenities from offshore wind farms in Denmark. Energy Policy, 35, 4059–4071. https://doi.org/10.1016/j.enpol.2007.01.023

Langer, K., Decker, T., Roosen, J., & Menrad, K. (2016). A qualitative analysis to understand the acceptance of wind energy in Bavaria. In Renewable and Sustainable Energy Reviews (Vol. 64, pp. 248–259). Elsevier Ltd. https://doi.org/10.1016/j.rser.2016.05.084

Langer, K., Decker, T., Roosen, J., & Menrad, K. (2018). Factors influencing citizens' acceptance and non-acceptance of wind energy in Germany. Journal of Cleaner Production, 175, 133–144. https://doi.org/https://doi.org/10.1016/j.jclepro.2017.11.221

Lucke, D. (1995). Akzeptanz. Legitimität in der "Abstimmungsgesellschaft." Leske + Budrich.

Michaud, D. S., Feder, K., Keith, S. E., Voicescu, S. A., Marro, L., Than, J., Guay, M., Denning, A., McGuire, D., Bower, T., Lavigne, E., Murray, B. J., Weiss, S. K., & van den Berg, F. (2016). Exposure to wind turbine noise: Perceptual responses and reported health effects. The Journal of the Acoustical Society of America, 139(3), 1443–1454. https://doi.org/10.1121/1.4942391

Olson-Hazboun, S. K., Krannich, R. S., & Robertson, P. G. (2016). Public views on renewable energy in the Rocky Mountain region of the United States: Distinct attitudes, exposure, and other key predictors of wind energy. Energy Research & Social Science, 21, 167–179. https://doi.org/https://doi.org/10.1016/j.erss.2016.07.002

Parks, J. M., & Theobald, K. S. (2013). Public engagement with information on renewable energy developments: The case of single, semi-urban wind turbines. Public Understanding of Science, 22(1), 49–64. https://doi.org/10.1177/0963662511400962

Parsons, R., & Moffat, K. (2014). Constructing the Meaning of Social Licence. Social Epistemology, 28(3–4), 340–363. https://doi.org/10.1080/02691728.2014.922645

Perlaviciute, G., Schuitema, G., Devine-Wright, P., & Ram, B. (2018). At the Heart of a Sustainable Energy Transition: The Public Acceptability of Energy Projects. IEEE Power and Energy Magazine, 16, 49–55. https://doi.org/10.1109/MPE.2017.2759918

Petrova, M. A. (2016). From NIMBY to acceptance: Toward a novel framework — VESPA — For organizing and interpreting community concerns. Renewable Energy, 86, 1280–1294. https://doi.org/10.1016/j.renene.2015.09.047

Pierpont, N. (2009). Wind Turbine Syndrome: A Report on a Natural Experiment.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) 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.

Prochaska, J. O., Johnson, S., & Lee, P. (2009). The Transtheoretical Model of behavior change. In The handbook of health behavior change, 3rd ed. (pp. 59–83). Springer Publishing Company.

Rand, J., & Hoen, B. (2017). Thirty years of North American wind energy acceptance research: What have we learned? Energy Research & Social Science, 29, 135–148. https://doi.org/10.1016/j.erss.2017.05.019

Ruddat, M. (2022). Public acceptance of wind energy - concepts, empirical drivers and some open questions. Wind Energy Science, 7(4), 1679–1691. https://doi.org/10.5194/wes-7-1679-2022

Sardianou, E., & Genoudi, P. (2013). Which factors affect the willingness of consumers to adopt renewable energies? Renewable Energy, 57, 1–4. https://doi.org/https://doi.org/10.1016/j.renene.2013.01.031

Schneider, C. R., Zaval, L., Weber, E. U., & Markowitz, E. M. (2017). The influence of anticipated pride and guilt on pro-environmental decision making. PLOS ONE, 12(11), e0188781-. https://doi.org/10.1371/journal.pone.0188781

Schwartz, S., Cieciuch, J., Vecchione, M., Davidov, E., Fischer, R., Beierlein, C., Ramos, A., Verkasalo, M., Lönnqvist, J.-E., Demirutku, K., dirilen-gumus, O., & Konty, M. (2012). Refining the theory of basic individual values. Journal of Personality and Social Psychology, 103, 663–688. https://doi.org/10.1037/a0029393

Schweizer-Ries, P. (2008). Energy sustainable communities: Environmental psychological investigations. Energy Policy, 36(11), 4126–4135. https://doi.org/10.1016/j.enpol.2008.06.021

Segreto, M., Principe, L., Desormeaux, A., Torre, M., Tomassetti, L., Tratzi, P., Paolini, V., & Petracchini, F. (2020). Trends in Social Acceptance of Renewable Energy Across Europe—A Literature Review. International Journal of Environmental Research and Public Health, 17(24), 9161. https://doi.org/10.3390/ijerph17249161

Shafiullah, G. M., M.t. Oo, A., Shawkat Ali, A. B. M., & Wolfs, P. (2013). Potential challenges of integrating large-scale wind energy into the power grid-A review. In Renewable and Sustainable Energy Reviews (Vol. 20, pp. 306–321). Elsevier Ltd. https://doi.org/10.1016/j.rser.2012.11.057

Sovacool, B. K. (2013). The avian benefits of wind energy: A 2009 update. Renewable Energy, 49, 19–24. https://doi.org/https://doi.org/10.1016/j.renene.2012.01.074

Sovacool, B. K. (2014). What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. Energy Research and Social Science, 1, 1–29. https://doi.org/10.1016/j.erss.2014.02.003

Spiess, H., Lobsiger, E., Carabias-Hütter, V., & Marcolla, A. (2015). Future acceptance of wind energy production: Exploring future local acceptance of wind energy production in a Swiss alpine region. Technological Forecasting and Social Change, 101. https://doi.org/10.1016/j.techfore.2015.06.042

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) 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.

Sposato, R. G., & Hampl, N. (2018). Worldviews as predictors of wind and solar energy support in Austria: Bridging social acceptance and risk perception research. Energy Research & Social Science, 42, 237–246. https://doi.org/10.1016/j.erss.2018.03.012

Staats, H., Harland, P., & Wilke, H. A. M. (2004). Effecting durable change: A team approach to improve environmental behavior in the household. Environment and Behavior, 36(3), 341–367. https://doi.org/10.1177/0013916503260163

Steg, L., Perlaviciute, G., & van der Werff, E. (2015). Understanding the human dimensions of a sustainable energy transition. In Frontiers in Psychology (Vol. 6). Frontiers Media S.A. https://doi.org/10.3389/fpsyg.2015.00805

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. Journal of Environmental Psychology, 29(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Stephens, S., & Robinson, B. M. K. (2021). The social license to operate in the onshore wind energy industry: A comparative case study of Scotland and South Africa. Energy Policy, 148. https://doi.org/10.1016/j.enpol.2020.111981

Stern, P. C. (2000). Toward a Coherent Theory of Environmentally Significant Behavior. In Journal of Social Issues (Vol. 56, Issue 3).

Subramanian, M. (2012). The trouble with turbines: An ill wind. Nature, 486(7403), 310–311. https://doi.org/10.1038/486310a

Sunak, Y., & Madlener, R. (2016). The impact of wind farm visibility on property values: A spatial difference-in-differences analysis. Energy Economics, 55, 79–91. https://doi.org/10.1016/j.eneco.2015.12.025

Swofford, J., & Slattery, M. (2010). Public attitudes of wind energy in Texas: Local communities in close proximity to wind farms and their effect on decision-making. Energy Policy, 38(5), 2508–2519. https://doi.org/10.1016/j.enpol.2009.12.046

Szarka, J. (2007). Wind Power in Europe. Palgrave Macmillan UK. https://doi.org/10.1057/9780230286672

Thøgersen, J. (2005). How May Consumer Policy Empower Consumers for Sustainable Lifestyles? Journal of Consumer Policy, 28(2), 143–177. https://doi.org/10.1007/s10603-005-2982-8

Thomson, I., & Boutilier, R. (2011). The social licence to operate. SME Mining Engineering Handbook, 1779–1796.

Upham, P., Oltra, C., & Boso, À. (2015). Towards a cross-paradigmatic framework of the social acceptance of energy systems. Energy Research & Social Science, 8, 100–112. https://doi.org/10.1016/j.erss.2015.05.003

Voigt, C. C., Popa-Lisseanu, A. G., Niermann, I., & Kramer-Schadt, S. (2012). The catchment area of wind farms for European bats: A plea for international regulations. Biological Conservation, 153, 80–86. https://doi.org/https://doi.org/10.1016/j.biocon.2012.04.027

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) 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.

Walker, B. J. A., Wiersma, B., & Bailey, E. (2014). Community benefits, framing and the social acceptance of offshore wind farms: An experimental study in England. Energy Research & Social Science, 3(C), 46–54. https://doi.org/10.1016/j.erss.2014.07.003

Walter, G. (2014). Determining the local acceptance of wind energy projects in Switzerland: The importance of general attitudes and project characteristics. Energy Research & Social Science, 4, 78–88. https://doi.org/https://doi.org/10.1016/j.erss.2014.09.003

Warren, C., Cowell, R., Ellis, G., Strachan, P. A., & Szarka, J. (2012). Wind Power: Towards a Sustainable Energy Future? In Learning from Wind Power (pp. 1–14). Palgrave Macmillan UK. https://doi.org/10.1057/9781137265272_1

Warren, C. R., Lumsden, C., O'Dowd, S., & Birnie, R. V. (2005). 'Green On Green': Public perceptions of wind power in Scotland and Ireland. Journal of Environmental Planning and Management, 48(6), 853–875. https://doi.org/10.1080/09640560500294376

Weenig, M. W., & Midden, C. J. (1991). Communication network influences on information diffusion and persuasion. Journal of Personality and Social Psychology, 61(5), 734–742. https://doi.org/10.1037/0022-3514.61.5.734

Westerberg, V., Jacobsen, J. B., & Lifran, R. (2015). Offshore wind farms in Southern Europe – Determining tourist preference and social acceptance. Energy Research & Social Science, 10, 165–179. https://doi.org/10.1016/j.erss.2015.07.005

Westerlund, M. (2020). Social Acceptance of Wind Energy in Urban Landscapes. Technology Innovation Management Review.

Wilson, G. A., & Dyke, S. L. (2016). Pre- and post-installation community perceptions of wind farm projects: The case of Roskrow Barton (Cornwall, UK). Land Use Policy, 52, 287–296. https://doi.org/10.1016/j.landusepol.2015.12.008

Windemer, R. (2023). Acceptance should not be assumed. How the dynamics of social acceptance changes over time, impacting onshore wind repowering. Energy Policy, 173, 113363. https://doi.org/10.1016/j.enpol.2022.113363

Winter, K., Hornsey, M. J., Pummerer, L., & Sassenberg, K. (2022). Anticipating and defusing the role of conspiracy beliefs in shaping opposition to wind farms. Nature Energy, 7(12), 1200–1207. https://doi.org/10.1038/s41560-022-01164-w

Wolsink, M. (2007a). Planning of renewables schemes: Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. Energy Policy, 35(5), 2692–2704. https://doi.org/10.1016/j.enpol.2006.12.002

Wolsink, M. (2007b). Wind power implementation: The nature of public attitudes: Equity and fairness instead of 'backyard motives.' Renewable and Sustainable Energy Reviews, 11(6), 1188–1207. https://doi.org/10.1016/J.RSER.2005.10.005

Wolsink, M. (2012). Wind Power: Basic Challenge Concerning Social Acceptance. In R. A. Meyers (Ed.), Encyclopedia of Sustainability Science and Technology (pp. 12218–12254). Springer New York. https://doi.org/10.1007/978-1-4419-0851-3_88

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Funded by the European Union. Views and opinions expressed are however those of the author(s) 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.

Wüstenhagen, R., Wolsink, M., & Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. Energy Policy, 35(5), 2683–2691. https://doi.org/10.1016/j.enpol.2006.12.001

Zaval, L., Markowitz, E. M., & Weber, E. U. (2015). How Will I Be Remembered? Conserving the Environment for the Sake of One's Legacy. Psychological Science, 26(2), 231–236. https://doi.org/10.1177/0956797614561266

Zimmerling, J. R., Pomeroy, A. C., d'Entremont, M. V, & Francis, C. M. (2013). Canadian Estimate of Bird Mortality Due to Collisions and Direct Habitat Loss Associated with Wind Turbine Developments. Avian Conservation and Ecology, 8(2). https://doi.org/10.5751/ACE-00609-080210

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) 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.