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Deliverable 2.1: Technical and socio-economic conditions

A literature review of social acceptance of wind energy development, and an overview of the technical, socio-economic and regulatory starting conditions in the wind energy scarce target regions

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Abstract

The overall objective of the EU project WinWind is to enhance the (socially inclusive) deployment of wind energy by increasing social acceptance of, and support for, onshore wind energy in 'wind energy scarce regions' (WESR). The target regions are: Saxony and Thuringia in Germany, Lazio and Abruzzo in Italy, Latvia as a whole, Mid-Norway, the Warmian-Masurian Voivodeship in Poland and the Balearic Islands in Spain. This report reviews existing literature on the social acceptance of wind energy development and provides an overview of the technical, socio-economic and regulatory starting conditions for conducting case studies of social acceptance of wind energy in the WESR regions.

In part 1, we outline the objective of the WinWind project and of deliverable 2.1 (i.e., this report). Moreover, we present concepts and definitions relevant for the study of social acceptance, and a conceptual framework for analysing the factors that promote or inhibit social acceptance of wind energy. The WinWind project is primarily concerned with analysing community acceptance, but we also illustrate how acceptance at the local scale is related to socio-political and market acceptance.

In part 2, we review the literature on social acceptance of wind energy, focusing in particular on the process of acceptability at the local level. On the one hand, wind energy projects can help achieve energy and climate policy goals and create economic value and employment. On the other, wind energy could potentially entail negative impacts on wildlife, property values and health and well-being. How such impacts are perceived will depend on different factors, including socio-psychological and socio-cultural factors, energy policy and planning frameworks, policy goals and how these are communicated; how the wind energy development and decision-making process is organised; how different stakeholders are involved; how economic benefits and costs are distributed and what ownership models are chosen. To capture the complexity of all these factors, the literature review draws on different strands in the literature including medicine and health sciences, environmental sciences, social sciences and engineering sciences.

In part 3, we provide a brief description of the physical, technical and political context for wind energy development in each WES target region. We describe the technical conditions for wind energy and challenges related to market development and grid connectivity. We also describe relevant policies, support schemes and institutions that govern the development of wind energy. This part complements part 2 by focusing on factors that may influence social acceptance at the socio-political and market scale in the target regions of the WinWind project.

We conclude the report by discussing what may potentially be the most important factors affecting social acceptance of wind energy in the WESRs.

Contents

1. Introduction

The overall objective of WinWind is to enhance the (socially inclusive) deployment of wind energy by increasing social acceptance and support for onshore wind energy in 'wind energy scarce regions' (WESR). WESR are defined by the WinWind project as regions with considerably lower than EU average wind energy penetration levels. The project focuses on six countries (Germany, Italy, Latvia, Norway, Poland and Spain).

The aim of this report is to provide important background information for the WinWind project, where we will carry out case studies and several support tools. This background information includes both (1) a review of existing scientific literature on the social acceptance of wind energy, and (2) information about technical, socio-economic and regulatory conditions in the WESRs.

Wind energy is one of the key technologies in the endeavour to decarbonise the energy sector (European Commission 2011a). However, this implies that more wind turbines need to be set up and that more sites to place them have to be identified. In broad surveys capturing socio-political acceptance, the public is generally in favour of wind energy (Schumann et al. 2012; European Commission 2011b). Implementation on a local level has, however, sometimes proved to be more challenging. For example, when mapping lead times for projects in the EU in 2007-2008, the European project WindBarriers found that over 20% of wind energy projects were delayed and close to 20% were seriously threatened due to appeals from local communities (Iuga et al. 2016).

The focus of this report is primarily on reviewing existing literature on the drivers and barriers of community acceptance of specific wind energy projects. Community acceptance of wind energy projects can ultimately affect the extent to which climate and energy policy targets are met. How local opposition to a specific wind energy project proposal forms – and also its success – depends on a range of factors, including the environmental, economic and societal impacts of wind energy development, but also contextual factors, individual characteristics, and what policy and corporate measures are introduced to address specific issues related to community acceptance. Wolsink (2007a, p. 2694), for instance, notes that "if local interests are not given a voice in decision-making processes, conditional supporters may turn into objectors".

It is also important to note that community acceptance – and the strength of community opposition – interacts with other dimensions of social acceptance. For instance, in Sweden, Anshelm and Simon (2016, p. 1551) argue that local wind power opposition groups failed to attract support at the national level: "opposition to wind power has been articulated almost exclusively on a local scale by action groups and local inhabitants, fishermen, Saami people and the owners of weekend cottages… They have sometimes been successful in enrolling municipal politicians in their cause, but overall, they have lacked the crucial support of national elites... As it stands, the odds seem stacked against them."

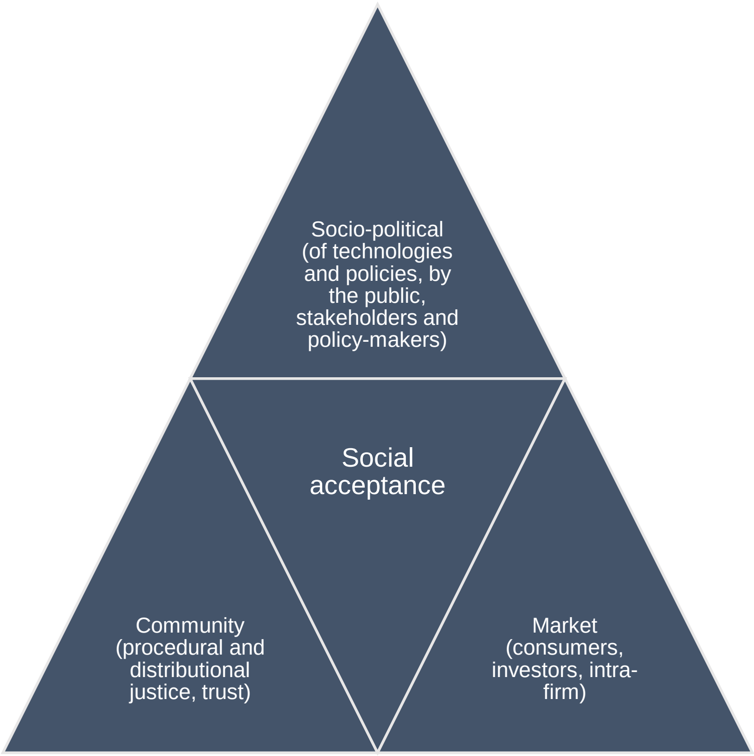
1.1 Concepts, categories and definitions

1.1.1 Community acceptance versus other dimensions of social acceptance

Broadly speaking, social acceptance may be defined as “a favourable or positive response (including attitude, intention, behaviour 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, p. 103).

The triangular concept of social acceptance developed by Wüstenhagen et al. (2007) serves as a reference for the WinWind project. It highlights the fact that social acceptance is multi-dimensional and dynamic. **Socio-political acceptance** refers to the general support for technologies and policies, whereas **market acceptance** relates to the meso level, involving consumer-, investor-, and intra-firm acceptance. **Community acceptance** refers to the specific acceptance of siting decisions and renewable energy projects by local stakeholders, in particular residents and local authorities. Community acceptance is mainly influenced by factors such as distributional justice (costs and benefits), procedural justice (fair and participative decision-making process) and trust (in information and the intentions of investors and other actors) (IEA 2013; Sovacool and Ratan 2012; Wüstenhagen et al. 2007; Zoellner et al. 2008). Figure 1.1. shows how community acceptance interacts with the other dimensions of social acceptance. Sovacool (2009) argues that political, economic, social and cultural dimensions influence each other in an integrated, “pernicious tangle”, shaping social acceptance of energy technology developments.

Figure 1.1. Reference system: The triangle of social acceptance of renewable energy innovation.



Source: Wüstenhagen et al. 2007.

1.1.2 The process of social acceptability and the outcome of social acceptance

In their literature review of existing academic research on the social acceptance of wind energy, Fournis and Fortin (2016, p. 5) distinguish between **social acceptability** on one hand, and **social acceptance** on the other, where the latter should be "seen as one of the possible results (vs. unacceptance), of a complex process of social acceptability". The distinction is proposed to "better differentiate the complex processes underneath (social acceptability), from the results of it (acceptance/unacceptance)" (Fournis and Fortin 2016, p. 15). A similar distinction is made by Szarka (2007, p. 18), who notes that acceptability is not static, but an evolving decision frame. A focus on acceptability highlights the fact that acceptance (or unacceptance) as an outcome "does not arise from subjective whim, but is governed by norms relating to national contexts, traditions and conventions, and to time periods", and the distinction between categorical and conditional viewpoints, where the latter is a judgment arising from the application of an assessment framework to particular circumstances. Focusing on acceptability (i.e. process), moreover, entails focusing on the "social contract negotiation between parties having unequal access expertise and resources", which, in turn "directs attention to the question of the legitimacy of particular types of behaviour that seek to change acceptability" (ibid.).

The conceptual definition of social acceptability proposed by Fournis and Fortin (2016) is further elaborated in a three-level analytical framework: 1) micro-social (attitudes, perceptions), 2) meso-political (political), and 3) macroeconomic (structural). From this, the authors arrive at a hypothesis that social acceptability "emerges when these three sets of processes demonstrate a relative convergence" (Fournis and Fortin 2016, p. 5). The end result of this dynamic process could then be social acceptance, to the extent that the variables at the different levels are brought together into "a coherent frame from which would emerge a project meaningful and desirable for the concerned territory" (Fournis and Fortin 2016, p. 14).

Like Fournis and Fortin (2016) and Szarka (2007), Ferguson-Martin and Hill (2011) also emphasise the distinction between process and outcome. The authors present a framework in which they conceptualise wind energy technology deployment as the outcome of a larger process of investment and local siting decisions. Financial viability and social acceptability are *necessary conditions* for successful deployment. The "nature of the planning and approvals process (i.e. the effectiveness of public engagement), the degree of local ownership, the landscape values held by affected stakeholders, and broader socio-political movements around energy and electricity" together shape stakeholder attitudes toward a specific wind energy project, and stakeholder attitudes in turn shape the social acceptability (Ferguson-Martin and Hill 2011, p. 1650). Stakeholders include both supporters and opponents, where those in favour "are generally centred on environmental concerns, such as climate change or air pollution, but can also include potential economic development, energy security and concerns over other energy technologies", while opponents typically cite concerns such as "noise, health impacts, landscape and aesthetic impacts, wildlife concerns, property value, and procedural fairness".

The discussion above highlights the complexity of social acceptance. Firstly, the triangular concept developed by Wüstenhagen et al. (2007) illustrates that social acceptance is produced at different scales (socio-political, market and community). Fournis and Fortin (2016) and Szarka (2007) emphasise the difference between outcomes and process; social acceptance (or lack of acceptance) as an outcome is the result of a larger process of developing social acceptability at different scales. Ferguson-Martin and Hill (2011) further show how actual technology deployment depends not only on social acceptability (and acceptance), but also on financial viability. Both are shaped by a range of factors (e.g. social, political and institutional). Social acceptance of wind energy as an object is multi-faceted (as a technology, as projects, and as products), it is produced or constrained within a larger context (social acceptability), at different scales (socio-political, community and market), by actors at different levels (general, local), and by the relationship between them (e.g. Upham et al. 2015).

Thus, although the primary concern of this report is with reviewing the existing literature on community acceptance (i.e. acceptance by local stakeholders, local populations, policy-makers and administration) of wind energy projects (i.e. acceptance of specific wind energy projects at a local level), it is important to be aware that such acceptance (as an outcome) is produced within a larger, complex and dynamic process.

Tables 1.1. and 1.2 below summarise key categories and definitions of social acceptance.

Table 1.1. Acceptance types, objects and subjects.

Acceptance type	Acceptance object	Acceptance subject
Socio-political acceptance	Wind energy, wind energy technology or associated policy	General public, central stakeholders, policy-makers
Community acceptance	Specific wind energy project at local level	Local stakeholders, local populations (particularly affected citizens), local policy makers and administration
Market acceptance	Technological products (wind turbines) or services associated with those products	Consumers, investors, companies, financing institutions.

Sources: Adapted from Sonnberger and Ruddat 2017; Wüstenhagen et al. 2007.

Table 1.2. Definitions.

Key definitions	
Acceptability	"the process of collective assessment of a given project (understood as the specific embodiment of complex interactions between technology and society within a given socio-technical project), integrating a plurality of actors (stakeholders) and spatial scales (from global to local), as well as involving the specific trajectory (past present and future) of a political group or polity (community/society)" (Fournis and Fortin 2016, p. 5).
Acceptance	"a favourable or positive response (including attitude, intention, behaviour 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, p. 103).
Socio-political acceptance	Acceptance of both technologies and policies at the most general level. This general level is not limited to the general public, but also includes acceptance by key stakeholders and policymakers.
Community acceptance	Acceptance of specific projects at the local level, including affected populations, key local stakeholders and local authorities.
Market acceptance	Process by which market actors adopt and support (or otherwise) the energy innovation. Market acceptance is proposed in a wider sense, including not only consumers but also investors and, very significantly, intra-firm acceptance.

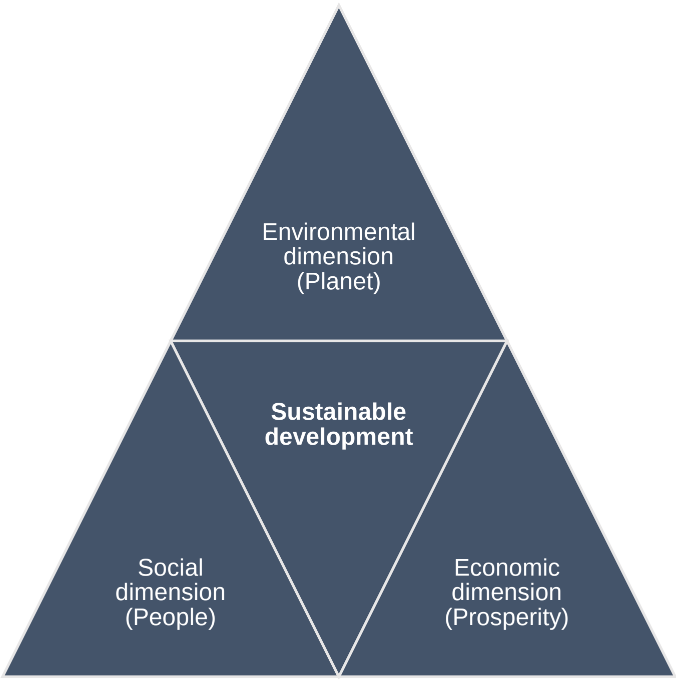
Sources: Fournis and Fortin 2016; Upham et al. 2015; Wüstenhagen et al. 2007.

1.2 A conceptual framework for analysing social acceptance

1.2.1 Impacts of wind energy development on the environment, economy and society

Wind energy development entails impacts on the nature, the economy, human health and well-being, and our ability to reach renewable energy and climate policy goals. How these impacts are perceived and how they influence social acceptance of wind energy will depend on the context (environment, society, policies, economy and technology), on how people are involved and heard in the process (procedural justice), on how cost and benefits are distributed (distributional justice), on what is understood to be the main rationale, at the national and local level, for investing in wind energy and on who owns the wind energy. Some of these factors can be adjusted in order to increase the social acceptance of wind. Figure 1.2. shows how the impacts of a wind energy development, and sustainable development more broadly, can be categorised according to their impacts on the environment, the economy and the society. In order to achieve a sustainable transition to a low carbon energy sector, wind energy projects should balance the consequences for the environment (planet), the society (people) and the economy (prosperity) (Holden et al. 2014, 2017; UN 2015). Social acceptance of wind energy will likely reflect to what extent this balance is achieved and what trade-offs between the three dimensions have been made.

Figure 1.2. Impact of wind energy and sustainable development.



The environmental dimension includes impacts of wind energy development on birds, bats, wildlife and ecosystems and on governments' ability to achieve climate- and renewable-energy goals. The use of scarce minerals, metals and other non-renewable natural resources in the production of wind power (relative to electricity produced from other energy sources) should also be included here.

The economic dimension includes impacts of wind energy development on the economy, i.e., the production, distribution and consumption of goods and services of different agents. Drivers of economic growth may be development of new industries and creation of innovative technologies, both locally, nationally and regionally. On the other hand, development of wind energy may reduce the profitability, growth prospects and employment in other economic sectors. Examples of sectors are tourism (although there are examples of wind energy development also having a positive effect on tourism), agriculture and power production from fossil and other renewable energy sources. The literature also frequently mentions electricity prices for consumers, sometimes discussed in relation to potential impacts on employment, as support schemes for renewable energy technologies sometimes entail higher electricity prices.

The distribution of costs and benefits across stakeholder groups may also be included in the economic dimension, because who gains and who loses from wind energy development and whether this distribution is perceived as fair will affect the social acceptance of wind energy. For example, national goals for more renewable energy may be supported, while the local consequences, such as anticipated declines in property prices, may cause conflict. Or, local authorities and local landowners may appreciate the extra sources of income from wind energy development, while local tourism corporations may anticipate that wind power could reduce their revenues. Ownership models may also affect the social acceptance of wind energy.

The societal dimension includes impacts of wind energy development on human health and wellbeing, such as visual impacts, noise and recreation. More generally, the societal dimension includes all impacts of wind energy projects on human rights, gender, fair labour, workplace conditions, etc.

1.2.2 Factors shaping how wind energy projects are perceived and valued

Contextual factors, **individual characteristics** and wind energy project **measures** influence how the environmental, economic and societal impacts of a project are perceived and valued (figure 1.3). Project **measures** are the *processes* and *activities* specifically related to a particular wind energy project, targeting a particular acceptance factor or groups of acceptance factors to influence community acceptance. Some of the factors are more or less given and cannot easily or without additional cost be altered. Other factors can be adjusted to increase the positive impacts, decrease the negative impacts and improve the social acceptance of wind energy projects.

Examples of contextual factors are:

National (regional) energy market characteristics may differ from one country (region) to another, and these contextual differences may result in differences in social acceptance of wind energy. For example, whether a country (region) is a net exporter or net importer of electricity (i.e. whether the region needs more electricity) may influence social acceptance of wind energy. A second example, whether a country (region) has a high or low share of renewable energy (e.g. in terms of perceptions of whether there is a need for more renewables/wind), may influence social acceptance of wind energy.

The regulatory conditions, political and institutional context shape the social acceptance of wind energy. What arguments are used, heard and valued in the debate for and against wind energy developments (e.g., framework of deliberation and decision making), and the extent to which different impacts are considered during project development and implementation (e.g., the nature of spatial and land use planning requirements), may affect social acceptance. Other factors include how effective various groups of stakeholders are in influencing the legislative system or political system on an issue (i.e., lobbying). Historical conflicts in the community and differences in values and worldviews may strengthen or weaken the arguments used.

Examples of individual characteristics are:

Personal values and socio-demographic factors can have an impact on social acceptance of wind energy. For example, local/place attachment and “sense of place” may influence how individuals assess the visual impacts of wind energy. More generally, gender, education, income, political affiliation, worldview, etc. may be important factors that determine attitudes towards wind energy.

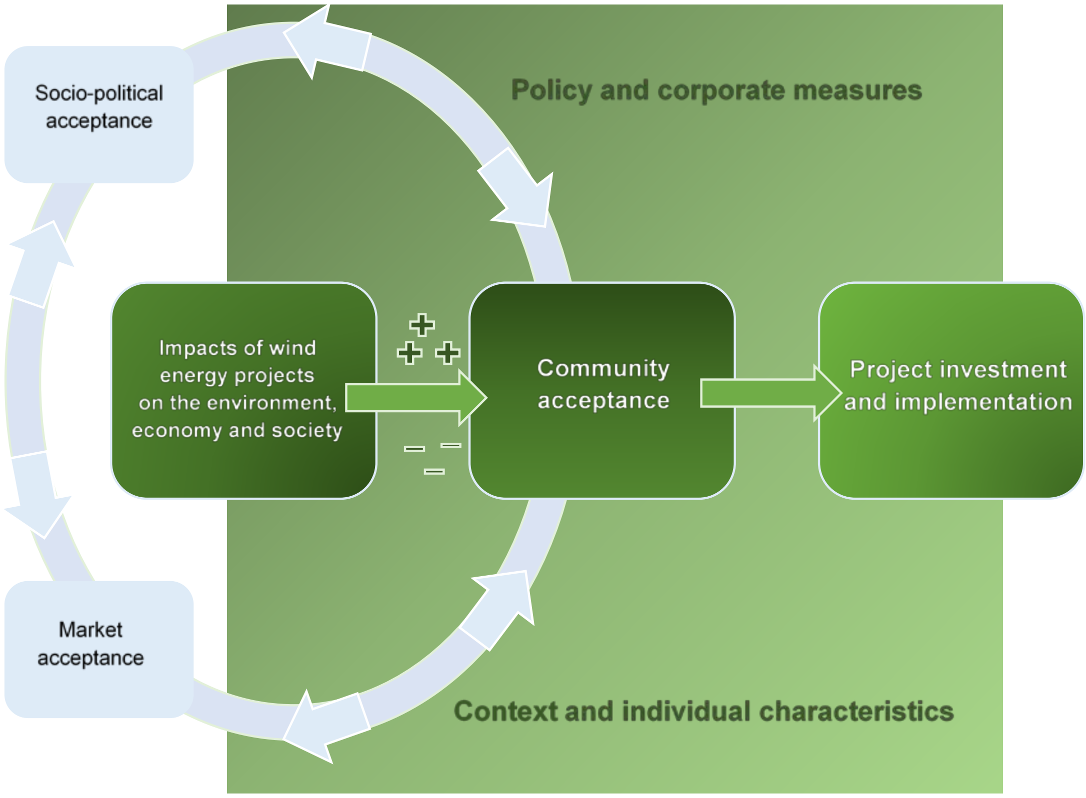
Examples of project measures are:

The way in which stakeholders are involved in the process of wind energy development may affect social acceptance of wind energy. Relevant factors include how institutions, regulations, organisation of development processes, communication, etc. contribute to a high or low involvement of all stakeholders in the process, from initiating the idea to constructing wind power plants to the actual implementation.

Examples of policy and corporate measures include activities aimed at increasing transparency (e.g. sharing of project relevant information) and inclusiveness (e.g. identifying and interacting with all relevant stakeholders) to enhance the perceived procedural justice, and the establishment of a benefit sharing scheme (e.g. a community fund, local contracting and local ownership) to enhance perceived distributional justice. A national, regional or local authority may introduce regulations to ensure a minimum degree of community ownership.

Figure 1.3. below summarises the conceptual framework to analyse factors that promote or inhibit social acceptance of wind energy and how specific policy and corporate measures can address and influence these factors and how they are perceived. The areas shaded in green represent the main focus areas of the WinWind project in studying community acceptance of specific wind energy projects. To emphasise the dynamics of social acceptance at different scales, the areas shaded in blue show the remaining two dimensions (socio-political and market acceptance) of the triangular concept of social acceptance. The figure divides the factors influencing social acceptance of wind energy into (1) impacts of wind energy projects on the environment, economy and society, and (2) contextual factors, individual characteristics and measures that modify how these impacts are perceived.

Figure 1.3. A conceptual framework for analysing social acceptance in the WES target regions



1.3 Structure of the remainder of this report

The remainder of this report is structured as follows. Part 2 presents a literature review on social acceptance for wind energy, with a special focus on factors that influence acceptance at the local or community scale. Part 3 complements part 2 by focusing on factors that may influence social acceptance at the socio-political and market scale in the target regions for the WinWind project. It describes the technical, socio-economic and regulatory conditions for wind energy and is based on descriptions provided by the national partners in the WinWind project. Part 4 concludes the report by discussing what may potentially be the most important factors affecting social acceptance of wind energy in each WES region.

2 Literature on the social acceptance of wind energy development

Part 2 of this report reviews the scientific literature on social acceptance of wind energy. The purpose is to provide a general overview of the main barriers and drivers of social acceptance of wind energy in general, and community acceptance of wind energy projects in particular. The main focus has been on covering the key peer-reviewed contributions published in scientific journals, primarily from the period 2007 to present. Relevant literature was identified through several key word searches (e.g. “wind energy” or similar, “social acceptance” or similar) in Scopus, Web of Science, and Google Scholar. We also supplemented using a snowballing approach, where the sources cited in the literature identified through searches were included to the extent that they too were assessed as relevant. The articles represent a broad range of themes, variables, disciplines and methodologies. In addition to the peer-reviewed journal articles, we have also included a few contributions in the grey literature, such as technical reports, where relevant.

Information on each article was entered into a detailed summary matrix to catalogue the year, research questions, methods, analysis techniques, geographic coverage, explanatory variables examined, major conclusions, and additional research recommendations of each study. These data formed the basis for structuring the present literature review around key themes and categories of factors that shape social acceptance of wind energy.

In addition to reviewing the general literature on social acceptance of wind energy, this report also covers literature aimed at understanding the impacts of wind energy on the environment, economy and society, since such impacts – whether anticipated or actual – shape social acceptance. We therefore include studies from medicine and health sciences, environmental sciences, social sciences and engineering sciences. Examples of such studies are life cycle assessment of environmental impacts of wind energy production. Relevant literature was identified using key words such as “biodiversity”, “tourism” and “shadow flicker”, in combination with “wind energy” or similar.

Finally, we have also consulted with the WinWind project partners and country desks in order to ensure adequate coverage of factors that reflect the context of the WESRs and that were particularly interesting for them. For example, in Norway, the impact of wind energy projects on indigenous groups is an important concern. Also, the importance of wind energy in the energy transition was brought up by members of the national desk as especially relevant in Norway. In Spain, and especially the islands, energy security is an important factor. In Italy and Germany, the role of wind energy in protected areas were emphasised. In Latvia, spatial planning was highlighted as critical. All project partners were asked to provide information on important literature, including contributions written in the language of the partner country and/or with a relevant regional scope.

In the following sections, we structure our review of the literature around two main categories of factors that shape social acceptance of wind energy (1) environmental, economic and societal impacts of wind energy and (2) contextual factors, individual characteristics and measures that modify how these impacts are perceived.

2.1 Impacts of wind energy development

This section covers actual and potential impacts of wind energy development on the environment, economy and society. Most importantly, from the perspective of the WinWind project, it covers how these impacts influence the social acceptance of wind energy. The discussion of impacts below follows the three dimensions of sustainability illustrated in Figure 1.2. on page 10; that is, the environmental, economic and societal dimensions.

2.1.1 Technical factors and project design

The technical characteristics of the project, including the number, size, colour and shape of wind turbines (e.g. Roques et al. 2010; Wizelius 2007), will influence the type and scope of impacts on the environment, economy and society, as will geographical factors, including visibility, distance from residential and protected areas, the number of neighbouring projects, and grid capacity (e.g. Jobert et al. 2007). Table 2.1. below, taken from Langer et al. (2016), summarises some of the key technical and geographical issues of wind energy development, and how these issues shape social acceptance. The findings are based on a review of existing literature (146 studies in total, see Langer et al. 2016). These factors will also be discussed in more detail in the following sections.

Table 2.1. Technical and geographical characteristics of wind energy development and their influence on social acceptance.

Factor	Study	Key findings
Hub height	Wolsink 2000, 2007a; Kaldellis et al. 2013; McLaren 2007; Meyerhoff et al. 2010; Söderholm et al. 2007.	Hub height shapes visual perception, which has an impact on the acceptance of wind energy.
Performance and number of turbines	Wolsink 2007a; Devine-Wright 2007; Van der Horst 2007; Gibbons 2015; Ladenburg et al. 2013	The number, size scale and type of wind turbines affect acceptance. Studies show that small scale renewable energy systems are more positively evaluated.
Emission	Ek 2005; Wolsink 2000; McLaren 2007; Longo et al. 2008; Warren et al. 2005	The production, transport and installation of turbines produce emissions which may decrease acceptance of wind energy technologies.
Design of turbine	Fehrenbach 2009; Schacht and Wiese 2009; Mukinovic et al. 2009; Ifeu 2009; Hübner et al. 2010	Wind turbines can be aligned horizontally or vertically, which might influence acceptance.
Material	Aitken 2010a; Hübner et al. 2010	It remains to be clarified whether the type of material (e.g. wooden material) plays a role in the acceptance of the population.
Colour	Kaldellis et al. 2013	Wind turbine colour shapes social acceptance.
Composition	Devine-Wright 2005	The composition of wind turbines in a park, such as cluster, line or mosaic construction, influence acceptance.
Distance to place of residence	Devine-Wright 2005, 2007, 2011; Jones and Eiser 2009; Graham et al. 2009; Pasqualetti 2000, Hübner and Pohl 2015	Studies find both positive and negative effects on social acceptance with respect to the installation of renewable energies close to residents' homes.

Source: Langer et al. 2016.

Throughout this report, we cover studies of social acceptance in the six WinWind countries, where such studies have been identified. Table 2.2. below summarises relevant studies of wind energy development and how technical features shape social acceptance in the WinWind countries.

Table 2.2. Overview of literature on wind energy development and technical and geographical characteristics in the WinWind countries.

Examples
Pohl et al. (2012) study perceptions of visual impacts of wind energy on the landscape, and how aircraft obstruction markings are related to stress and social acceptance. A questionnaire survey was distributed to residents in Germany with direct sight of turbines (N=420). The authors used environmental and stress psychology methodologies to analyse the relationship between obstruction markings and stress. The authors found no evidence of substantial annoyance with obstruction markings. However, the type of obstruction marking appeared to have an effect both on and on social acceptance. Specifically, residents exposed to xenon lights reported more intense and multifaceted stress responses than those exposed to LED or colour markings on blades. Moreover, xenon lights negatively affected the general acceptance of wind energy. Additionally, synchronised navigation lights were found to be less annoying than non-synchronised lights under certain weather conditions. Markings with light intensity adjustment were also preferred. The authors conclude that, in order reduce stress and increase social acceptance of wind power, xenon lights should be avoided, navigation lights should be synchronised, and light intensity adjustment should be applied.

2.1.2 Environmental impacts of wind energy development

Greenhouse gas and other emissions and resource efficiency

This category includes studies of how wind energy may help governments meet their national climate and renewable energy targets, and whether such arguments influence social acceptance of wind energy. The category includes studies that link natural science/technological/economic methods for assessing greenhouse gas (GHG) and other emissions, and the resource efficiency of wind energy. Also, the category includes social science studies that assess to what extent such GHG or other environment related arguments are important in shaping social acceptance of wind energy.

Wind energy is generally seen as a sustainable and environmentally friendly source of energy. Nevertheless, in a life cycle perspective there are non-renewable resource demands and environmental impacts associated with wind energy. The energy performance and natural resource and environmental requirements can be quantified using life cycle assessments (LCAs). Several meta-studies of LCAs of wind energy have been published in recent years (e.g. Arvesen and Hertwich 2012; Davidsson et al. 2012; Nugent and Sovacool 2014).

Results from existing LCAs of the energy and GHG intensity of wind energy show considerable variations. Nugent and Sovacool (2014) conduct an in-depth examination of 153 studies that explore the lifecycle GHG emissions of wind (and solar photovoltaic (PV)) electricity generation, to determine the average lifecycle emissions and what factors cause variation in the literature. According to the most relevant, current, peer-reviewed studies, average lifecycle GHG emissions for wind energy is 34.1 g CO_2-

equivalents (CO_2-eq) per kWh of electricity, with a range of 0.4 g CO_2-eq/kWh to 364.8 g CO_2-eq/kWh. In comparison, solar PV averaged 49.9 g CO_2-eq (with a range of 1 g CO_2- eq/kWh to 218 g CO_2-eq/kWh). Based on their review, the authors conclude that LCAs of GHG emissions need to become more methodologically rigorous; the types of lifecycle stages and the ways in which they are defined differed across studies, and the studies relied on different assumptions related to a several factors, including resource inputs, manufacturing and fabrication, sizing and capacity, and longevity.

Kubiszewski et al. (2010) review net energy assessments of wind electricity generation. The authors survey estimates of the energy return on investment (EROI), defined as the ratio of the “electricity generated to the amount of primary energy used in the manufacture, transport, construction, operation, decommissioning, and other stages of a facility’s life cycle”, and find an average EROI of 19.8 (N = 60 wind turbines; standard deviation = 13.7), excluding conceptual studies. Compared to fossil fuels, nuclear and solar energy technologies, wind energy has a relatively high EROI. Like Nugent and Sovacool (2014), the authors discuss methodological issues of the existing studies, noting that “one of the most critical differences among the diverse studies is the number of stages in the life cycle of an energy system that are assessed and compared against the cumulative lifetime energy output of the system”. Studies also differed in terms of methodology (process analysis, input-output analysis and hybrid analysis) and assumptions made (e.g. assumed lifetime and capacity factors), and a distinction can also be made between empirical studies and conceptual studies. Such differences help explain the variations in previous studies in the EROI estimates of wind energy.

Surveying LCA studies published since 2000, Arvesen and Hertwich (2012) synthesise and critically review present knowledge of the life cycle environmental impacts of wind energy, focusing not only on energy and GHG emissions intensity, but also on a wider set of impact categories (including resource requirements, human and eco-toxicity, particulate matter formation, land use and land transformation). Arvesen and Hertwich (2012) find that discrepancies between existing studies “can likely be explained by a combination of actual differences in the systems studied (e.g., small versus large wind turbines), key assumptions (e.g., capacity factor and lifetime), data inconsistencies (e.g., emission intensities of materials), and differences in methodologies and approaches (e.g., process-LCA or hybrid IO-LCA, accounting of recycling benefits).” The authors summarise the state of existing knowledge about the life cycle performance of wind energy in different phases: 1) the production of components is generally covered in most LCAs, research results are generally in agreement, and the quality of research is good; 2) the transportation to site and on-site construction is covered to varying degrees, there is somewhat less agreement between results, and the quality of existing studies is lower than for the production of components; 3) the operation and maintenance is covered to varying degrees, and the level of agreement and quality of knowledge is similar to that of phase two; 4) end-of life performance is rarely assessed in detail, results are generally in agreement, but the quality of knowledge is lacking. The existing literature generally finds that wind energy has a good environmental performance compared to fossil fuel-based energy.

Methodological concerns are also expressed by Price and Kendall (2012), who review previous wind LCAs and assess these studies for reporting transparency. They find that “only a small subset of studies proved to be sufficiently transparent for the normalization of system boundaries and modelling assumptions required for meta-analyses.”

The abovementioned meta-studies of LCAs of wind energy suggest that wind energy performs better than many other energy technologies in terms of GHG emissions, EROI, and environmental impacts more broadly. This impression is confirmed in the meta-study conducted by Evans et al. (2009), who review existing LCAs based on a range of sustainability indicators, including the price of generated electricity, GHG emissions, availability of renewable sources, energy efficiency, land requirements, water consumption and social impacts. The authors find that wind energy has the lowest relative GHG emissions, the least water consumption requirements and the lowest negative societal impacts, but that wind energy requires larger land and has high relative capital costs compared to alternative energy sources. Assuming that all sustainability indicators have equal weight, wind energy ranks highest in terms of sustainability, followed by hydropower, PV and geothermal.

An argument that is often presented by opponents of wind energy development is that wind energy requires more land than conventional energy sources (e.g. Katsaprakakis 2012), but this is not necessarily the case if one takes into account the amount of land required before, during and after power production (i.e. if one considers wind energy development in a life-cycle perspective); analyses suggest that thermal and nuclear plants require a larger amount of land than does wind (Fthenakis and Kim 2009).

Table 2.3. below summarises some of the most relevant literature. To the extent that relevant literature has been identified, we include studies from the six WinWind countries (Germany, Italy, Latvia, Norway, Poland and Spain).

Table 2.3. Overview of literature on life-cycle assessments of the GHG and other emissions and resource efficiency of wind energy

Type of study	Examples
Meta-analyses	Dolan and Heath (2012) analyse reasons for variability in GHG emissions estimates. Dolan and Heath (2012) and Asdrubali et al. (2015) suggest methodologies for harmonising LCA results. Zakeri and Syri (2015) compare LCA environmental indicators of different energy technologies. Fthenakis and Kim (2009) compare the land use requirements of different energy technologies (coal, natural gas, nuclear, hydroelectric, photovoltaics (PVs), wind and biomass). They find that PVs require the least amount of land among the renewables options, while biomass requires the largest amount of land.
General	Wiedmann et al. (2011) explore methodological options for hybrid LCAs to account for indirect GHG emissions. Crawford (2009) and Tremeac and Meunier (2009) study the effect of turbine size on energy yield and GHG emissions. Guezuraga et al. (2012) compare emissions and energy payback time from different wind energy technologies. Arvesen and Hertwich (2011) analyse a range of different environmental impacts. Weisser (2007) compares GHG emissions of different energy technologies, including fossil, nuclear and renewable. Zhong et al. (2011) compare the environmental impacts of a PV module and a wind turbine from a life-cycle perspective. Impact categories include land use and mineral use requirements, and the authors find that the impacts of the PV module are higher than those of the turbine in all but two categories (land change and land use, use of cooper, iron and steel).
WinWind countries	Martínez et al. (2008) study environmental impacts of wind energy of the Gamesa wind turbine in northern Spain, and Ardente et al. (2008) in Sicily, Italy. Priedite and Bazbauers (2016) study the combination of wind power plants and district heating systems in Latvia. Stanek et al. (2018) conduct a comparison of cumulative environmental impacts based on a thermo-ecological cost assessment of different renewable energy sources in Poland. Smarsly et al. (2013) assess a monitoring system for life-cycle management of wind turbines installed in Germany. Höfer et al. (2016) present a multi-criteria decision-making framework that incorporates techno-economic, socio-political, and environmental criteria, with a special emphasis on social acceptance, for a German region. Martinez et al. (2010) study the impacts of a multi-megawatt turbine in Spain using a life-cycle perspective, including land use and minerals requirements. Sovacool et al. (2016) determine the environmental costs and benefits of wind turbines in Norway.

The potential of wind energy to reduce GHG emissions is an argument often used by those in favour of the technology (Anshelm and Simon 2016; Ertör-Akyazi et al. 2012; Petrova 2013). However, as Rand and Hoen (2017) point out, based on an extensive review of North American wind energy social acceptance research “concern for climate change alone does not fully explain support for wind. Accordingly, efforts to encourage support by emphasizing climate benefits may be met with indifference”, or even serve to increase opposition in some contexts. That considerations of GHG emissions reductions and national energy policy fail to explain social acceptance of wind energy, is also noted by Bergek (2010) in a study from Sweden. The author finds that environmental concerns are not mentioned as a barrier for social acceptance, but that they are not a driver either. In a study of local communities in Norway, Rygg (2012) reports that considerations of the impact of wind energy on GHG emissions were mentioned by some of the respondents as a motivating factor for supporting wind energy development. However, considerations of local benefits such as economic development, modernisation and employment/new industry were mentioned far more often; “most of the arguments in favour of wind power development addressed local concerns regarding the economy, modernization, and employment opportunities and not a need for sustainable energy”.

Species and ecosystems

This category includes natural sciences studies of how birds, bats, wildlife and ecosystems are affected by wind energy development. Moreover, it includes social science/multidisciplinary studies of how social acceptance of wind energy is affected by these impacts on the environment.

The potential impact of wind energy development on species and ecosystems has been the subject of several studies, especially the potential impacts on birds and bats. Impacts can be significant, although some studies point out that the present knowledge of wind turbines’ impact on bird fatalities is “sparse and unsystematic” (Wang and Wang 2015), and a general conclusion seems to be that impacts are context-specific and depend on a multitude of factors including turbine height and speed, species, weather and seasonality (e.g. Arnett et al. 2008; Arnett et al. 2011; Barclay et al. 2007). Loss et al. (2013) estimate that annual bird fatalities due to collisions with wind turbines in the US is between 140,000 and 328,000. Worth noting, however, is that the impacts of wind turbines on bird mortality is smaller than those caused by fossil fuelled power plants, when comparing mortalities per kWh of electricity generated (Sovacool 2009). The impact of wind energy on bird mortalities is also relatively small compared to other sources of human-influenced mortality (Zimmerling et al. 2013).

Nevertheless, concerns about impacts on wildlife do play a role in shaping the social acceptance of wind energy. In a study of opposition toward wind energy in Norwegian communities, for instance, Rygg (2012) finds that concerns about the potential impact on birds and wildlife were mentioned as a reason for opposition in six out of 13 communities.

Research also suggests that wind energy development has an impact on bat mortalities (e.g. Arnett and Baerwald 2013; Rollins et al. 2012; Rydell et al. 2010). Some studies also estimate that adverse impacts on bat populations caused by wind energy development entails substantial economic losses to agriculture (Boyles et al. 2011).

While the literature on the impact of wind energy development on birds and bats is extensive, the literature referring to other types of wildlife is much more limited (Lovich and Ennen 2013), and as a result, knowledge of the potential impacts is incomplete. The potential impact of wind energy on reindeer is a concern in Scandinavia, where many sites for existing and planned wind power projects are found in reindeer habitat.

Reindeer range over large areas. Colman et al. (2012) study whether wind power plants act as barriers for reindeer movement and find no barrier effect. This contrasts with other studies that find barrier effects of infrastructure such as roads and power lines, suggesting variation in the extent to which infrastructure acts as a behavioural barrier (ibid.). Vistnes and Nellemann (2008), for instance, find that wind turbines, and the roads and power lines required to support wind energy developments, fragment reindeer grazing lands and impact upon reindeer behaviour.

Table 2.4. provides an overview of the literature on wind energy, species and ecosystems from the WinWind countries.

Table 2.4. Overview of literature on wind energy, species and ecosystems in the WinWind countries.

Examples
Korner-Nievergelt et al. (2011) study the impacts of wind energy development on bats and birds, and Lehnert et al. (2014) and Voigt et al. (2015) study the impact on bats, in Germany. Tellería (2009) conducts a geographical assessment of the impact on birds and bats in Spain, while Tapia et al. (2009) examine the impacts on the population of golden eagles in northwestern Spain. Ferri et al. (2016) study the impact on bats in a mountainous landscape in Italy. Łopucki and Mróz (2016) explore the impact on non-volant terrestrial vertebrates in Poland. Dahl et al. (2012) study the impact on white-tailed eagles in Smøla, Norway.
Rygg (2012) examines the extent to which potential impacts on birds and wildlife shape social acceptance in Norway. Solli (2010) studies local opposition to two wind energy projects in Norway, where concerns about impacts on sea eagles formed part of the arguments against project development. Meyerhoff et al. (2010) use choice experiments to study residents' attitudes toward wind energy development in the regions Westsachsen and Nordhessen, Germany. They find that concerns about impacts on red kite populations were among the most important choice attributes in both regions.

Change of landscape

Wind energy development requires large areas of land and entails changes to landscape. Studies of social acceptance suggest that how these impacts are perceived depend on location. Perceptions of the impacts of wind energy on landscape also depend on technical features and project design (briefly covered in section 2.1.1., and we now return to how technical features shape acceptance via the extent and scope of landscape change) and on a range of individual characteristics and preferences (see section 2.2.2.).

Regarding location, wind turbine siting close to the most sensitive and protected landscapes provoke the most negative responses (Betakova et al. 2015; Molnarova et al. 2012). Molnarova et al. (2012) find that a "sensitivity of respondents to the placement of wind turbines in landscapes of high aesthetic quality, and, on the other hand, a relatively high level of acceptance of these structures in unattractive landscapes". Moreover, Molnarova et al. (2012) find that acceptance is higher if the turbines are kept away from observation points, such as settlements, transportation infrastructure and viewpoints.

Public response could also depend on the geographical conditions, such as the topography or the distance of residential areas to wind turbines (e.g. Watson et al. 2012). Rand and Hoen (2017), however, note that there is no clear consensus in the literature on the relationship between social acceptance and distance to wind turbines, and that it is unclear whether existing studies account for confounding variables (e.g. community economic benefits). While some studies find that positive attitudes increase with increasing distance (e.g. Swofford and Slattery 2010), other studies suggest that those living near wind turbines have more positive attitudes (e.g. Baxter et al. 2013; Groth and Vogt 2014).

Other technical characteristics of wind energy projects, such as turbine height, could also shape community acceptance, but the findings are inconclusive. While some studies (e.g. Dimitropolous and Kontoleon 2009) find that acceptance decreases with increasing height, others find no effect (e.g. Meyerhoff et al. 2010; Wolsink 2007b). It should be noted that Dimitropolous and Kontoleon (2009, p. 1852) find that "the siting and institutional factors were perceived as more important than the physical attributes of the wind farms by the majority of respondents."

Landscape change impacts on social acceptance depend not only on the size and siting of specific turbines, but also on the cumulative effects (i.e. the number of neighbouring projects). Regarding cumulative effects, Jones et al. (2011) report multiple-regression analyses performed on survey data from the UK and find that the majority of respondents would support some local development; however, there was substantial variability in the upper level that was considered acceptable. Ladenburg et al. (2013) analyse the cumulative effects of wind power on the social acceptance of wind power in Denmark and find that attitudes toward wind energy is influenced by the number of turbines subjects see daily. This finding is also reported by Olson-Hazboun et al. (2016), who study attitudes in the Rocky Mountain region in the US. Importantly, however, Ladenburg et al. (2013) also find that if people cannot see turbines from their residence, there is no significant evidence of cumulative effects on attitudes toward wind energy. Cumulative effects are also not significant if smaller turbines are replaced by larger turbines (ibid.). Based on a sample of close to 1,100 respondents in Denmark, Ladenburg and Dahlgaard (2012) find that attitudes toward wind energy is negatively related with the number of turbines encountered daily. If the respondents see more than five on-land turbines, they are less positive. However, beyond this threshold, opposition does not increase with increasing turbine encounters.

Firestone et al. (2015) conduct a mail survey to explore individuals' attitudes toward the visual (and noise) impacts from existing, community-based, small-scale wind energy projects. The respondents are individuals residing near a 2MW wind turbine that is located on the edge of the historic coastal town of Lewes, Delaware in the United States, and adjacent to Delaware Bay and the Great Marsh Preserve. They find that seventy-eight percent hold positive or very positive attitudes toward the wind turbine, with only 10% having negative or very negative attitudes. Moreover, 82% liked the look of the wind turbine (and 60 % indicated that they had never heard any sound).

Table 2.5. below summarises some of the key contributions on wind energy development and change of landscape in the six WinWind countries.

Table 2.5. Overview of literature on wind energy and change of landscape in the WinWind countries

Examples
Mariel et al. (2015) study the perceptions of landscape impacts of wind turbines in Germany. Sklenicka and Zouhar (2018) present objectively measurable landscape indices to predict the visual impact on landscapes, and test these on respondents from Central European countries, including Germany and Poland. Rygg (2012) examines the importance of landscape change impacts in shaping opposition toward wind energy development in Norwegian communities. Baraja-Rodríguez et al. (2015) present a study of how wind energy development has contributed to intensifying territorial debates and the social awareness of landscape in Spain. Caporale and De Lucia (2015) conduct a choice experiment to study social acceptance of wind energy in the Apulia region in Italy, including respondents' willingness to pay for a hypothetical re-development of on-shore wind farms; potential trade-offs between on-shore wind farms, landscape conservation and socio-economic issues; and problems of asymmetric information between developers, residents and policy-makers in the development of wind energy.

2.1.3 Economic impacts of wind energy development

Impacts on local economy

Drivers of economic growth may be development of new industries and creation of innovative technologies. Wind energy development could also be associated with local tax revenues (e.g. Slattery et al. 2012), the creation of local jobs and other economic opportunities (Phimister and Roberts 2012; Slattery et al. 2012), and increased tourism (Groth and Vogt 2014). Wind energy development could moreover be associated with reduced electricity rates (Baxter et al. 2013). Economic benefits, such as increased tax revenues, is associated with higher support of wind energy development (e.g. Slattery et al. 2012). While wind energy development could entail opportunities for economic development, employment and other benefits, there may also be reduced profitability, growth prospects and employment in other economic sectors, including tourism (e.g. Broekel and Alfken 2015; Frantal and Kunc 2011; Landry et al. 2012).

Ejdemo and Söderholm (2015) explore the possible impacts of wind energy on local development and employment by performing a quantitative assessment of the impacts of an ongoing project in Norrbotten, Sweden. They explore impacts under different benefit-sharing scenarios. They find significant and positive impacts from wind energy construction work (especially in the presence of local manufacturing). Employment impacts during the operating phase are modest in the absence of a benefit-sharing mechanism (e.g. a community fund). Significant positive impacts are observed, even when assuming that only a low share of the revenues accrue to the local government. Thus, the authors conclude that more research is needed on different benefit-sharing approaches.

Hartley et al. (2015) investigate the impact of wind (and shale gas) energy development on employment rates and wages in Texas using a panel econometric model. Their results suggest only negligible impacts on employment rates and wages (for shale-gas development, the authors find strong positive impacts on employment, but no impact on wages). Brown et al. (2015) conduct an ex post econometric analysis of economic development impacts of wind power installations from 2000 through 2008 in a large, wind-rich region in the US, finding positive impacts of wind energy development both on employment and on wages.

Based on a review of recent literature on wind energy and externalities, Zerrahn (2017, p. 251) concludes that the findings with respect to the impact of wind energy development on the local economy are inconclusive; in the studies from Europe, for instance, “results range between substantial positive permanent GDP and job effects, modest permanent job effects, and at most marginal financial benefits, with no positive spill overs on local GDP”.

Studies of the relationship between the economic impacts of wind energy development and social acceptance suggest that such impacts, whether anticipated or actual, shape acceptance. Slattery et al. (2012) present results from a questionnaire distributed in Texas and Iowa in the US. They find that support for wind energy was associated with perceived economic benefits, including impacts on local employment and economic activity. Overall, they find strong support for wind energy development, with close to 70% of respondents indicating that they would support development within the community. Roughly 70% of respondents similarly reported that they believed their community had benefitted economically from wind energy development and that wind energy had created jobs. 59% responded that wind energy had increased tax revenues, and 56% that increased tax revenues had benefitted local schools. Rygg (2012) conducted in-depth interviews with central actors in 13 mostly small, communities in Norway. She found that most of the arguments in favour of wind power development addressed local concerns regarding the economy, modernization, and employment opportunities and not a need for sustainable energy. Based on a survey of residents of coastal Michigan, Bidwell (2013) explores the role of general values and beliefs in shaping attitudes toward wind energy projects in or near respondents’ communities, finding that support is associated with the belief that wind energy development will provide economic benefits to the community.

Wind energy development may also be associated with negative impacts on local economy. Some studies suggest that wind energy could negatively affect recreational tourism (e.g. Blaydes Lilley et al. 2010; Firestone et al. 2009; Voltaire et al. 2017), and such impacts, in turn, could negatively affect social acceptance of wind energy development (e.g. Devine-Wright and Howes 2010; Pasqualetti 2011; Rygg 2012).

Sæþórsdóttir et al. (2017) study the potential impacts of wind turbines on tourism in Iceland, where a majority of tourists travel to experience nature. They examine tourists' opinions and perceptions of wind energy development in the Southern Highlands using an on-site questionnaire survey, and compare how the number, size and proximity of wind turbines, and the landscape in which they are located, influence tourists' perceptions. The results indicate that one-third of the travellers would be less likely to visit the Southern Highlands in the presence of wind turbines, and two-thirds think that turbines would decrease the area's attractiveness.

Perceived negative impacts on tourism shape community acceptance of wind energy development, as Pasqualetti (2011) finds in his study of public resistance in Palm Springs and Cape Cod in the US. He finds that "the primary objections to the projects in the US were the visual change they would produce and the impact of such changes on the economy". In Palm Springs, tourists are attracted to the opportunities to "relax, rejuvenate, and escape the cold", and "the last thing community leaders wanted was an industrial landscape that could interfere with the enjoyment of the visitors who were the backbone of the local economy".

Frantál and Kunc (2011), argue that, with the right support, wind energy development could also result in new forms of tourism. Using a combination of questionnaires and semi-structured interviews, Frantál and Kunc (2011) examined the subjective perception of wind energy among tourists and local business representatives from the tourism sector in the Czech Republic. Their findings indicate that wind turbines "in suitably selected locations may have only a minor or negligible negative impact on tourists´ perception and experience of landscape, and their destination choice". In fact, wind turbines could be used "to support development of new forms of tourism with the support of proper marketing promotion" (ibid.). Moreover, wind turbines are perceived more positively compared to other industrial facilities.

Wind energy development might also entail other negative impacts on local economy, for instance through interference with existing telecommunications systems (e.g. Eltham et al. 2008; Frantal 2009). Angulo et al. (2014) present a comprehensive review on the impact of wind turbines on the telecommunication services. Certain telecommunications systems have proved to be especially vulnerable to wind energy development and have required corrective measures because of the impacts from wind turbines (ibid.). In the UK, concerns about interferences with telecommunications systems have resulted in formal objections to proposed wind energy projects (Pinto et al. 2010). Angulo et al. (2014) and Pinto et al. (2010) both propose measures aimed at preventing and/or correcting the impacts of wind energy projects on telecommunications services.

Table 2.6. below summarises the identified literature on wind energy and impacts on the local economy in the six WinWind countries.

Table 2.6. Overview of literature on wind energy and local economy in the WinWind countries.

Examples
Heinbach et al. (2014) study impacts on employment of renewable energy technologies in Germany. Czapiewska (2015) studies the impact on economic development in rural areas of northern Poland. Broekel and Alfken (2015) study the impact of wind energy on tourism demand, using secondary statistics on tourism and wind turbine locations at the level of German municipalities. Using spatial panel regression techniques, they authors find a negative impact of wind turbines on tourism demand for municipalities not located near the coast. In the latter regions, the relation between wind turbines and tourism demand is more complex. Voltaire et al. (2017) study the effects on beach recreational demand in Catalonia, Spain because of offshore wind energy development. The region is a popular tourist destination. Using a combined revealed and stated preferences approach, they find that the installation of wind farms will cause a shift in trips to beaches without wind farms. The results demonstrate a significant welfare loss up to €203 million per season. Rygg (2012) finds that community economic benefits, modernization and employment were frequently presented as motivations for supporting local wind energy projects in Norway.

The literature suggests that local benefits are associated with higher degrees of support for wind energy development (e.g. Toke et al. 2008; Zoellner et al. 2008). However, the way in which project benefits are distributed and community benefits governed also shape social acceptance (e.g. Bristow et al. 2012; Cass et al. 2010; Walker et al. 2014; Wolsink 2007b). Relevant factors include which benefit-distribution mechanisms are employed (e.g. community funds versus community (co)-ownership), the share of benefits, how recipients are defined, and how these aspects contribute to a perceived fair distribution of costs and benefits. Rand and Hoen (2017) argue that financial compensation may create perceptions of “winners” and “losers”. More generally, perceptions of unfair distribution of costs and benefits may result in conflicts, including intra-community and centre-periphery conflicts (e.g. Hirsch and Sovacool 2013; Phadke 2013). Such conflicts could generate opposition, but the conditions under which they do so are complex (Rand and Hoen 2017).

Bristow et al. (2012) study the provision of community benefits in Wales. Policy-makers are increasingly involved in the governance of benefits, in an effort to enhance the legitimacy and transparency of the provision of community benefits and, to some extent, promote the practice, including through (Bristow et al. 2012):

- A range of protocols to guide benefit discussions have been produced.
- Community benefits have been supported in planning guidance.
- Proposals have been made for registers detailing the community benefits agreed with developers.

Bristow et al. (2012) point out that the growing scale, formalisation and detailed governance practices of community benefit provision is creating a risk of conflict around both the governance of benefits and how to define the recipient community (i.e. who is entitled to receive benefits).

Walker and Baxter (2017) report on the findings from a mixed-methods study concerning distributive justice elements in two rural communities in Canada. The two regions, Ontario and Nova Scotia, are very different with respect to what approach to distributing benefits is taken; in the former, developer-led initiatives without any level of community ownership is typical, while in the latter, policy has encouraged some degree of local ownership. The authors used a combination of interviews and surveys with different stakeholders (residents, municipal leaders, developers and policy experts). They show that both the *fair* distribution and the *amount* of local benefits are important predictors of project support. Interestingly, they find that concerns with the fair distribution of benefits (as opposed to the amount of benefits) dominate in a regression on the *adequacy* of those benefits.

Fast et al. (2016) analyse what factors might explain current wind energy disputes in Ontario, Canada, where development has increased rapidly. According to the authors, one key explanation is the allocation of financial benefits from wind energy projects. Currently, benefits from wind energy development are transferred as direct compensation to landowners that lease their land to host turbines, but as the authors note, “residents that host turbines represent a small segment of the population… whereas most neighbours currently receive no compensation despite experiencing noise and visual impacts”. The authors argue that these transfers have served to “exacerbate pre-existent socio-economic disparity and contribute to community division and opposition”. Fast et al. (2016) argue that “policy tools such as restricting ownership of wind projects to local citizens, as was done historically in Denmark, or mandates to procure wind-generated electricity with a 50% municipal government ownership stake (Quebec), have a better chance of incentivizing stronger forms of community-based energy development than the price premium and priority grid access mechanisms pursued by Ontario”. To achieve a higher degree of community ownership, strong policy support may be needed, including funding for project development. But as the authors argue, “local community ownership is about not only the more equitable distribution of financial benefits, but also participation and influence across all aspects of a project. If wind-energy developments are locally owned, the need for elaborate compensation schemes is greatly reduced”.

Cass et al. (2010), too, raise concerns about the consequences of offering direct financial compensation. They explore how key stakeholders (including developers, local publics, politicians, activists and consultants) involved in renewable energy policy development view different mechanisms for distributing benefits from private developer-led projects to the local community. They report a high degree of ambivalence towards the provision of benefits and the reasons for providing them; “the normative case for providing community benefits appears to be accepted by all involved, but the exact mechanisms for doing so remain problematic”. Financial transfers to the community can be interpreted as bribes. Other possible approaches could be to offer cheaper electricity (but regulatory obstacles linked to the energy market prevent this form of benefit distribution in the UK), and formalised benefits in-kind as an established right rather than a voluntary offer (ibid.).

Impacts on individuals' economy

Wind energy development could entail impacts on individuals' economy, and the prospect of such impacts can influence social acceptance. Examples include discounts on electricity prices (economic benefit) and a potential reduction in property prices due to the proximity to the wind energy site (economic burden/risk). This section includes studies of such impacts and how they affect social acceptance of wind energy.

Hoen et al. (2011) analyse around 7,500 sales of single-family homes located near existing wind facilities in the US. They find no statistically significant effect of the view of wind facilities from the home on housing prices, and no effect of the distance of the home to those facilities. Hoen et al. (2015) extend the data set in Hoen et al. (2011) to more than 50,000 home sales, including 1,198 within 1 mile of a turbine (331 of which were within a half mile), covering the period before and after the construction of wind turbines. Again, the authors find no statistical evidence that wind energy development entails negative impacts on home values, neither in the period between announcement and construction, nor in the period after construction.

Gibbons (2015) presents results from a study in England and Wales, covering close to 38,000 housing price observations over 12 years. A quasi-experimental research design that compared price changes occurring in locations where wind turbines were visible, with price changes in appropriate comparison groups, was used. The results suggest that turbine visibility has a negative impact on residential property prices, and that the negative impacts are larger the larger the wind farm. The author found a reduction in property prices of 5 - 6% when the property was located within 2 km of a turbine, a reduction of 2% when the property was located between 2 to 4 kilometres from the turbines, and a near zero reduction in prices for properties located between 8 to 14 kilometres from wind energy projects.

Dröes and Koster (2016) explore about 2.2 million transactions in the Netherlands. They identify a negative effect of wind turbines on housing prices. House prices within 500 to 750 metres from a turbine were on average 2.6% lower than prices in comparable areas without turbines, houses within a 2-kilometre radius were on average 1.4%, while no effect is found on prices for houses located more than 2 kilometres away from turbines. The negative impact on housing prices is observed about three years before the actual placement of the turbine, and no evidence is found that the effect either increased or decreased after construction.

Jensen et al. (2018) report findings from a large-scale analysis of how on-shore (and off-shore) wind turbines affect property prices of nearby residential and vacation homes in Denmark. They find that on-shore wind turbines negatively affect property prices for properties located within three kilometres from the turbine, and that the negative effect increases with increasing numbers of turbines, but at a declining marginal rate and declining with distance.

Fears that wind energy development will negatively affect property prices increase the likelihood of opposition, but as Ellis and Ferraro (2016) note, other types of development also entail potentially negative impacts on property prices, and wind energy development should be seen in this context. Whether perceived or actual, impacts on property prices will continue to act as a factor shaping the social acceptance of wind energy development (ibid.). Dröes and Koster (2016) suggest that a possible strategy to reduce the effect of anticipated economic losses on social acceptance is to allow homeowners to become shareholders, as is currently being implemented in the Netherlands.

Table 2.7. below summarises literature on wind energy development and individuals' economy in the WinWind countries.

Table 2.7. Overview of literature on wind energy development and individuals' economy in the WinWind countries

Examples
Sunak and Madlener (2016) use a quasi-experimental approach to explore the impacts of wind energy development on property prices in the state of North Rhine-Westphalia, Germany, and find that the asking price for "properties whose view was strongly affected by the construction of wind turbines decreased by about 9–14%. In contrast, properties with a minor or marginal view on the wind turbines experienced no devaluation."

2.1.4 Societal impacts of wind energy development

Health

As with the introduction of any new technology, concerns have been raised that wind energy development could adversely affect human health and well-being. Firstly, concerns have been raised about wind turbine noise, and the extent to which such noise is associated with health issues such as learning, sleep and cognitive disruptions, and stress and anxiety (Knopper and Ollson 2011; Knopper et al. 2014). Secondly, concerns have been raised about the extent to which wind turbines and accompanying infrastructure results in electromagnetic frequencies from transmission lines, shadow flicker and operational risks. Knopper and Ollson (2011, p. 1) review existing literature on the potential health effects and conclude that "no peer reviewed scientific journal articles demonstrate a causal link between people living in proximity to modern wind turbines, the noise (audible, low frequency noise, or infrasound) they emit and resulting physiological health effects." Nevertheless, because such concerns continue to be expressed, and importantly because such concerns have been shown to negatively affect social acceptance (e.g. Baxter et al. 2013; Magari et al. 2014), in the following sections we briefly discuss the existing literature.

Noise

The rotation of the wind turbine blades creates aerodynamic noise (e.g. Bolin et al. 2011). In a comprehensive review of the existing literature on the health risks of such noise, McCunney et al. (2014) conclude that 1) infrasound sound near wind turbines does not exceed audibility thresholds, and 2) infrasound and low-frequency sound do not present unique health risks. However, some studies find correlations between annoyance and stress-related health responses, for example disrupted sleep (Bolin et al. 2011). There are also studies that suggest that such annoyance may be related to individual characteristics, rather than the actual noise from wind turbines (McCunney et al. 2014; Klæboe and Sundfør 2016).

Pedersen (2011) conducted three cross-sectional studies in two areas in Sweden and on area in the Netherlands to explore the possible adverse health effects from wind turbine noise. Two of the areas had flat terrain, and one area had hilly terrain. Questionnaires were distributed to residents in the three areas, and the sound pressure levels (dB(A)) of wind turbines in the respondents' surroundings were also recorded. Results indicated that increasing sound pressure levels were associated with a higher frequency of annoyance and associated with reported sleep interruption in the two areas with flat terrain. Sleep disturbance spiked at 40 dBA and 45 dBA rather than increase linearly with increasing sound pressure levels.

Concerns have also been raised about the potential effects on human health of sub-audible (infrasound) noise from wind turbines (Crichton and Petrie 2015). No direct causal effect has been identified in the literature. Rather, symptoms may be explained by a nocebo response, where social discourse and media reports trigger health concerns and symptom reporting. Crichton and Petrie (2015) conducted an experiment to test whether providing an explanation of the nocebo effect would result in changes in reported symptoms during exposure to infrasound. Subjects were randomly assigned to two groups and participated in two sessions. Before the first session, all participants watched a presentation that included media warnings about health risks associated with infrasound. Participants reported increased symptoms and mood deterioration after having watched the presentation, compared to baseline. Before session two, one group watched a presentation explaining how symptoms could be related to nocebo effects, while the other watched a presentation suggesting that symptoms could be biological. The first group reported symptoms and mood that were like those at the beginning of the experiment (i.e. the symptoms returned to baseline), while the second group reported symptoms similar to those reported in session one. In other words, the results suggest that providing an explanation of the nocebo response could potentially serve to reduce symptoms attributed to turbine generated infrasound.

Table 2.8. below provides an overview of the literature on wind energy development and noise in the WinWind countries.

Table 2.8. Overview of literature on wind energy development and noise in the WinWind countries

Examples
Klæboe and Sundfør (2016) report results from a socio-acoustic after-study of annoyance from a wind energy project in the South of Norway. The study was requested by local health officials requested due to neighbourhood complaints. The results show stronger reactions to noise than that found in other studies internationally, but the sample size is small (N = 90). The authors note, however, that responses were coloured by the existing local conflict surrounding wind energy development. About 60 % of the respondents felt that turbines degraded the landscape aesthetically and were not convinced that land-based wind energy was desirable as a renewable energy source. Thus, the authors conclude that attitudes play an important role in addition to visual aesthetics in determining the acceptance of wind energy projects and the resulting noise annoyance.
Pohl et al. (2018) conducted a longitudinal study of residents near a wind farm in Lower Saxony. Residents were interviewed on two occasions (2012, 2014) and given the opportunity to use audio equipment to record noise. On average, both the wind farm and road traffic were somewhat annoying. More residents complained about physical and psychological symptoms due to traffic noise (16%) than to wind turbine noise (10%, two years later 7%). Noise annoyance was minimally correlated with distance to the closest wind turbine and sound pressure level, and moderately correlated with perceived fair planning.

Shadow-flicker

Shadow-flicker (also known as wind turbine blade flicker) is the result of wind turbine blade rotation causing alternating periods of shadow and light. Concerns have been raised that shadow-flicker could result in photo induced epilepsy.

Harding et al. (2008) apply known seizure provoking effects of flicker (contrast, frequency, mark-space ratio, retinal area stimulated, and percentage of visual cortex involved) to determine the effect of wind turbine shadow-flicker on epileptic seizures. They find that flash frequency is the critical factor and should be kept to a maximum of three per second, i.e., 60 revolutions per minute for a three-bladed turbine, and that the shadows cast by one turbine on another should not be viewable by the public if the cumulative flash rate exceeds three per second. Also, turbine blades should not be reflective. Normally, the flash frequency for large wind energy farms is well below the threshold of 60 revolutions per minute (Knopp and Ollson 2011). But as Knopp and Ollson (2011) note, “although shadow flicker from wind turbines is unlikely lead to a risk of photo-induced epilepsy there has been little if any study conducted on how it could heighten the annoyance factor of those living in proximity to turbines”.

Operational safety

The possible impact on health from operational risks such as fire risk and ice throw from rotor blades have also been raised as concerns associated with wind energy development. Regarding the latter type of risk, minimum setback distances could help minimize such risks, and such setback distances are now common in areas with wind energy development (Knopp and Ollson 2011). Numerous studies also exist of the several de-icing and anti-icing techniques that can be employed to reduce the potential hazard of turbine icing (e.g. Parent and Ilinca 2011).

Electromagnetic fields

Concerns have been expressed that wind turbines operations and associated infrastructure could result in exposure to electromagnetic fields (McCallum et al. 2014; McCunney et al. 2014). McCallum et al. (2014) conducted a study in Ontario, Canada to estimate these effects. Magnetic field measurements were collected in the proximity of 15 wind turbines, two substations, various buried and overhead collector and transmission lines, and nearby homes, under different operational scenarios (high wind, low wind and shut off). They found that the magnetic field levels diminish with increasing distance, and that none of the potential sources of electromagnetic fields appeared to influence the magnetic field levels at nearby homes. In fact, the authors note that the magnetic fields levels near wind turbines were lower than those produced by many common household electrical devices, and well below any existing regulatory guidelines with respect to human health.

Contested land use

This category includes social studies of conflicts over land use in connection with wind energy development, and how such conflicts affect social acceptance. Conflicts may arise because the area planned for wind energy contains/is close to cultural and historical monuments or contains/is close to recreational areas. The interests of indigenous peoples and their historical use of and relation to a given geographic area are also covered in this category.

Dimitropoulos and Kontoleon (2009) explore the determinants of local acceptance of wind energy projects in the Greek Aegean Islands using a choice experiment. Their results show that the conservation status of the area where wind energy projects were to be implemented was the most important determinant of local community acceptance, together with the governance characteristics of the planning procedure.

Wind energy development could potentially have a negative effect on recreational opportunities (e.g. Blaydes Lilley et al. 2010; Firestone et al. 2009; Voltaire et al. 2017), and such impacts, in turn, could negatively affect social acceptance of wind energy development (e.g. Devine-Wright and Howes 2010; Pasqualetti 2011; Rygg 2012). Johansson and Laike (2007) report findings from a study of 80 subjects living in different distances from a wind energy project in Sweden. Personal attitudes toward the impact of wind energy development on landscape and recreational opportunities was identified as the second most important predictor of intention to oppose.

Lawrence (2014) shows how disputes over wind energy developments in traditional Saami areas in Sweden have refuelled existing conflicts between the Saami people and the Swedish state. In 2008 the regional state authority in mid-Northern Sweden invited private wind energy companies to tender for the right to explore the feasibility of a wind energy park in Stekenjokk, located in the traditional territories and homeland of the indigenous Saami people. The Saami community have constitutionally protected user rights over the area for reindeer grazing, and the area is culturally and spiritually significant. Lawrence (2014, p. 1037) argues that contestations over wind energy developments on traditional Saami lands are not isolated local disputes; "just as indigenous protests against resource projects on traditional lands are rarely limited to actual project sites, contestations over wind power developments cut to the heart of indigenous claims to self-determination and resource sovereignty". That protests are not just a matter of isolated protests toward specific projects, but also has deeper historical roots, including the rights of indigenous people, is also noted by Pasqualetti (2011) in his study of opposition to wind project development in Mexico and the US, and by Zografos et al. (2009) in their study of conflicts surrounding wind energy development in Catalonia, Spain.

Wind energy development on indigenous lands conflicts with indigenous claims to self-determination and resource sovereignty (Lawrence 2014; Anshelm and Simon 2016). The United Nations declaration on the rights of indigenous peoples defines the individual and collective rights of indigenous peoples, including rights to culture, identity and language. Although examples exist of wind energy projects violating these rights (e.g. in Sweden), there are also examples of inclusion of indigenous peoples' rights in wind energy projects (e.g. Canada) (Huesca-Pérez et al. 2016).

Table 2.9. below summarises relevant literature on wind energy development and contested land use in the WinWind countries.

Table 2.9. Overview of literature on wind energy development and contested land use in the WinWind countries

Examples
Voltaire et al. (2017) study the effects on beach recreational demand in Catalonia, Spain because of offshore wind energy development. Using a combined revealed and stated preferences approach, they find that the construction of wind energy facilities will cause a shift in demand, from beaches with turbines to beaches without turbines. Veidemane and Nikodemus (2014) explore the attitudes of two groups (residents and tourists/recreational users) regarding the location of wind parks off-shore versus on-shore along the Latvian coast of the Baltic Sea. Their results show that the visibility of wind turbines influences the willingness of recreational users to visit recreation sites and that the presence of turbines will negatively affect the duration of stay. In her study of wind energy development in small communities in Norway, Rygg (2012, p. 172) notes that one of the conflicts in Narvik revolved around the impacts of wind development on historical monument and the opportunities for reindeer husbandry; "Narvik got some objections from the Reindeer Husbandry and the Central Office of Historic Monuments, the latter concerning some cultural monuments not far from the park. The former was resolved through an economic agreement with the Reindeer Husbandry. The objection from the Central Office of Historic Monuments was appealed to the department, where it was rejected". More generally, concerns about the impact of wind energy development on use of area/interventions/cultural monuments were mentioned and used as arguments against wind energy by 8 of the 13 small communities (only visual impacts/noise were mentioned more frequently). Jerpåsen and Larsen (2011) discuss different approaches to considering the visual impacts of wind energy development on cultural heritage in project planning. The authors argue that current methods for assessing the impacts of wind energy development, focusing on for example visibility and distance, do not adequately capture some of the key contentious issues, and that a more integrated assessment of cultural heritage, nature and landscape within impact assessments could help promote social acceptance.

2.2 Factors shaping how wind energy projects are perceived and valued

Contextual factors, individual characteristics and wind energy project measures influence how the environmental, economic and societal impacts of a project are perceived and valued. These factors are not necessarily local in nature. Yet, as Enevoldsen and Sovacool (2016) emphasise, although community acceptance typically revolves around local impacts on the environment, economy and society, and procedural and distributional justice and trust, at larger scales community acceptance also involves broader socio-political and market dimensions, and some forms of community opposition can “cut across community, socio-political and market dimensions simultaneously”. For example, house owners’ opposition may be motivated by expected losses in property values, while environmentalists may be concerned about GHG emissions associated with fossil-fuelled power stations to back up wind power, and investors’ opposition motivated by worries about potential delays in project implementation (ibid.).

In the following sub-sections, we review relevant literature on the relationship between contextual factors, personal characteristics and social acceptance, and what measures might be taken to enhance social acceptance of wind energy development (including measures to enhance the perceived procedural fairness and distributional justice).

2.2.1 Context

Energy market characteristics

Differences in energy market characteristics and energy policies, regulations and institutions may result in differences in social acceptance of wind energy from one country to another. For example, whether a country is a net exporter or net importer of electricity (e.g. Brennan et al. 2017), whether a country has a high or low share of renewable energy and whether and how a country economically supports wind energy development may all influence social acceptance (e.g. Breukers and Wolsink 2007).

In general, a great influx or intermittent renewable electricity, like wind power, makes it more difficult to balance supply and demand of electricity, resulting in more volatile electricity prices and possibly affecting energy supply security. How these market and technical challenges are dealt with, will influence social acceptance of wind energy. Solutions may include investments in storage capacity, investments in transmission grids and interconnectors between countries and demand and supply management. Energy policies and instruments may contribute to solve these challenges or make them worse.

Energy security could also be a motivating factor in shaping support for renewable energy projects, as Fast (2013) shows in his case study of rural communities in the Eastern Ontario Highlands, Canada. Specifically, he finds high levels of community support for renewable energy development, and that such support was motivated by local energy security rather than preventing climate change. Similar motivations were also identified by Mårtensson and Westerberg (2007), in their study of support for bioenergy development in Sweden.

Brennan et al. (2017) rely on focus groups and a survey to investigate the relationship between wind energy development for domestic use versus for exports and social acceptance in Ireland. Their findings suggest that the support for wind energy development for domestic use is somewhat stronger than the support for wind energy for exports. Similarly, in a factorial survey experiment conducted in Germany and Poland, Liebe et al. (2017) find that the willingness to accept hypothetical wind energy projects depends on whether the electricity will be consumed within the region or exported, and that this effect is stronger in Germany than in Poland.

Eltham et al. (2008) study pre- and post-construction attitudes toward a wind energy project in Cornwall, England. The authors find statistically significant changes in attitudes between 1991 (pre-construction) and 2006 (post-construction), including with regard to the importance of the energy security that wind energy development provides. The period between 1991 and 2006 witnessed an increased concern with energy security, and the contribution of wind energy to national energy security was an important factor shaping support for wind energy in 2006.

Political-administrative factors

Below we draw attention to some of political-administrative factors that may shape social acceptance. There are several studies that suggest that these factors should be addressed simultaneously, and that an integrated framework is needed that can respond to the associated challenges of for example financial incentive structures, the public administration and planning procedures, and the local economy and development dynamics (e.g. Sperling et al., 2010).

Project-specific decision-making

The way in which stakeholders are involved in the process of wind energy development may affect social acceptance of wind energy (e.g. Firestone et al. 2015). Relevant factors include how institutions, regulations, organisation of development processes, communication, etc. contribute to a high or low involvement of all stakeholders in the process, from initiating the idea to constructing wind power plants to the actual implementation.

Bergek (2010) examines how the choice of planning strategy influences the extent to which wind energy development is seen from the perspective of various local private interests or from the perspective of a national public interest. She focuses on two national planning instruments implemented in Sweden in the early 2000s: a national planning target and an appointment of areas of national interest for wind power. She finds that “the national planning target actually made local planning officials even more inclined to treat wind power as a private rather than a public interest. For example, at the county level, there was no sense of responsibility for national environmental targets, if county level targets were already met."

In a highly cited paper in *Biological Conservation*, Reed (2008) argues that the complex nature of environmental problems requires decision-making processes that embrace a diversity of knowledges and values. He examines the literature on participatory approaches across different disciplines and geographical contexts and identifies a set of principles for best practice participation. First, stakeholder participation should be based on the values of empowerment, equity, trust and learning. Second, participation should be considered as early as possible and throughout the process. Third, the process needs to have clear objectives and to be facilitated by a skilled person. Fourth, local and scientific knowledge can be integrated to provide a more comprehensive understanding of the environmental challenges, and to evaluate the appropriateness of potential technical and local solutions to environmental problems. The author argues that stakeholder participation should be institutionalised, creating organisational cultures that can facilitate processes where goals are negotiated, and outcomes of the process are uncertain.

Agterbosch et al. (2009) examine the interaction between social and institutional conditions in the planning of wind power projects. They analyse two wind power cases in the municipality of Zeewold in the Netherlands, one planned by a regional energy distributor and the other planned by small private investors. Both cases illustrate that social conditions (management styles, interests and informal contacts) are more important than institutional conditions (formal rules, procedures and instruments) in forming social acceptance. They show that negative local social conditions can frustrate public policy, but more interestingly, positive local social conditions can compensate for a negative public policy framework. The authors conclude that process and distributive equity combined is a strong forecast for community acceptance.

Gross (2007) conducts an empirical study of this combined effect of procedural and distributive equity on community acceptance. She investigates a wind farm pilot case located in a rural region of Australia and conducts a small number of interviews with stakeholders to gain insight into how perception of fairness is formed. She finds that perceptions of fairness influence how people perceive the legitimacy of the outcome, and that a fairer process will increase acceptance of the outcome. Moreover, different sections of a community are likely to be influenced by different aspects of justice. An example of such differences was "landholders that received financial benefits came out as winners, but neighbouring landholders with turbines close to their properties, but with no revenues, came out as losers." Based on this finding, she develops a community fairness framework that can be applied in community consultation to increase social acceptance of the outcome.

The increasing focus on procedural and distributive equity in projects using natural resources has resulted in new concepts and theories, such as 'the social licence to operate' (e.g. Prno and Slocombe 2012). The theory recognises the local communities as particularly important governance actors in the transition toward a more sustainable future, and that companies exploiting natural resources need to gain a ‘social license to operate’ from local communities to avoid potentially costly conflict and exposure to social risks. For example, Hall et al. (2015) use semi-structured interviews with industry representatives to compare the understanding and application of this concept in four Australian energy industry contexts: mining, wind, CO_2 capture and storage, and geothermal. They argue that “the emergence of the ‘social licence to operate’ concept reflects increasing awareness by industries of the need to negotiate with communities and other stakeholders regarding the costs and benefits associated with industrial development.”

In a Greek study, Dimitropoulos and Kontoleon (2009) use a choice experiment method to assess the determinants of local acceptance of wind energy investment in the Aegean Islands. Inhabitants in two islands were asked to take a local community welfare point of view and assess different wind energy projects. They show that the governance characteristics of the planning procedure, along with the conservation status of the area, are the most important determinants of local community welfare in relation to wind farms. Physical attributes of wind farms appeared to be less important.

In a UK study, Eltham et al. (2008) examine whether the pre-construction opinions held by communities local to a wind farm change after an extended period following commissioning. They asked residents of St. Newlyn East, Cornwall, England to recall their opinions of Carland Cross wind farm in 1991 and 2006. They found statistically significant changes in views on the wind farm's visual attractiveness and the importance of the energy security it provides. These views were positively affected by community engagement early in the project process and national-level debate on the requirement of infrastructure.

Several empirical case studies reveal that centralising important decisions with respect to wind energy development may result in reduced local support for wind farm projects. Fast and Mabee (2015) examine how policy choices affect attitudes toward local wind farms in a comparative case study of five wind farms in Ontario, Canada. More specifically, they assess the impact of differences in approval authority, community benefit arrangements and spatial restrictions of turbine placement on the place-making and trust-building potential of wind projects in the host communities. They conclude that “the policy choice to elevate project approval to a central authority has had the most damaging effect. Without any local backers there are no attempts to envision turbine contributing to a positive sense of place and it removes trusted local planners from siting deliberations.”

The table below provides an overview of literature on procedural justice, distributive justice and/or trust in the WinWind countries.

Table 2.10. Overview of literature on project-specific decision-making and social acceptance in the WinWind countries.

Examples
Liebe et al. (2017) used a factorial survey experiment to explore the influence of context and fairness considerations on community acceptance of wind energy developments in Germany and Poland. Respondents were faced with hypothetical situations, where the opportunity to participate in the planning process (participatory justice), the distribution of turbines across regions (distributive justice), and ownership (as well as other characteristics), varied. The authors found that respondents in both countries were willing to accept new turbines in their vicinity if they could participate in decision making, if the turbines were owned by a group of citizens, and if the generated electricity was consumed in the region rather than being exported. Overall, they found that participatory justice was more important than distributive justice.
Sonnberger and Ruddat (2017) explored how 1) attitudes toward the German energy transition; 2) the perceived fairness of decision-making processes and their outcomes; 3) the perceived risks and benefits of wind energy; and 4) trust in key actors (federal government, local government, large energy companies, and municipal utilities) affect both socio-political acceptance and community acceptance (defined as acceptance of wind energy turbines situated 500 m from the respondents' home) of onshore and offshore wind energy development in Germany. A representative random survey (N = 2009) was conducted, and the findings showed that most of the predictors significantly influence social acceptance. Perceived risks and fairness were most important in explaining both socio-political and community acceptance of onshore wind farms, while the general attitude toward the energy transition was found to be of greater relevance for acceptance of offshore wind farms. The authors found that trust in large energy companies played a mixed role concerning socio-political and community acceptance.
Zoellner et al. (2008) explore social acceptance of renewable energy (grid-connected larger PV ground-installed systems, biomass plants and wind turbines) in Germany. They used an environmental–psychological approach to investigate the social factors relevant to the formation of acceptance of renewable energies. Results showed that economic considerations were most strongly associated with acceptance, but procedural justice criteria such as transparency, early and accurate information and possibilities to participate during the planning and installation process were also important. Qualitative results showed that the developer's commitment on the local level, public participation opportunities and location choice were among the relevant aspects for acceptance in the implementation process.

The above studies show that public involvement is important to ensure local support. But, what are the experience with local participation measures in Europe? Are they effective in preventing or responding to local opposition? A recent survey among 207 individuals, linked to a set of European wind energy projects, aims at answering these questions (Dütschke et al. 2017). They find that although most wind project developers seek to involve the public, few do this systematically and the level of activity is low in early project phases. Thus, earlier and more systematic involvement of the public and stakeholders could reduce negative reactions in many energy development projects, they argue. Aitken et al. (2008) show that local opposition groups' power over wind energy planning processes is very limited when it comes to the decision of whether and how to implement a planned wind energy project, and in fact extends only so far as delaying an outcome. Their conclusion is based on a thematic content analysis of objection letters to one proposed wind power development in the UK. Similar conclusions are reached by Aitken et al. (2016) who examine how community engagement is practiced in onshore wind farms in the UK. They found that a wide range of engagement methods are used, in particular consultation and awareness raising, but developers typically retain considerable control within such engagement processes.

Project ownership

This category includes literature on how ownership models shape social acceptance. Szarka (2007), for instance, argues that the movement in Europe toward increased ownership by multinational companies has negatively affected social acceptance of wind energy development. A major part of current studies focuses on attitudes toward – and experience with – community ownership models, and research suggests that local ownership increases local acceptance of wind energy projects (e.g. Breukers and Wolsink 2007; Enevoldsen and Sovacool 2016; Jobert et al. 2007; Warren and McFadyen 2010).

Toke et al. (2008) explore possible explanations for the different wind energy deployment outcomes in Denmark, Spain, Germany, Scotland, the Netherlands and England/Wales, including the role of local ownership, and find that local ownership is associated with higher rates of deployment than remote, corporate ownership. Warren and McFadyen (2010) present results from a questionnaire-based survey of attitudes toward wind energy development in south-west Scotland, comparing attitudes toward a community-owned project with attitudes toward developer-owned projects. They argue that local ownership can have a positive effect on community acceptance of wind energy projects. Ek and Persson (2014) conducted a choice experiment on Swedish consumers to assess whether project characteristics such as local ownership and project siting make subjects more likely to accept a higher renewable electricity certificate fee. Subjects were asked to choose between two hypothetical projects, and their results suggest that subjects are more likely to accept higher fees if wind energy projects are owned wholly or partially by the community.

Bauwens et al. (2016) study the factors most likely to foster citizen and community participation in wind energy cooperatives in Denmark, Germany, Belgium and the UK, which have different degrees of cooperatives. They focus on four explanatory factors: 1) support instruments for renewables; 2) planning policies; 3) attitudes toward the cooperative model; and 4) local energy activism. They conclude that a double movement is taking place in these countries; on one hand, they observe an increasingly hostile environment for cooperatives, which places cooperatives at a relative disadvantage compared to conventional ownership models. On the other, they observe an emergence of inter-organisational coordinated actions among cooperatives, such as the creation of joint electricity supply or trading companies. These joint initiatives are the result of strategic responses of small players to regulatory changes and enable them to survive in increasingly hostile environments.

Goedkoop et al. (2016) highlight some possibly challenging aspects of community ownership of renewable energy projects. Drawing on qualitative data from 19 UK stakeholders from industry, community and advisory backgrounds, they argue that while there was strong support for shared ownership in principle, challenges were significant in practice, notably a lack of trust between developers and community actors. The authors conclude that "for shared ownership to become conventional practice, it will be necessary to provide mechanisms that facilitate partner identification at an early stage, which can help to build relations of trust between actors, within a more stable and supportive policy context".

The table below provides an overview of literature on wind energy development and project ownership from the WinWind countries.

Table 2.11. Overview of literature on wind energy development and project ownership in the WinWind countries.

Examples
Musall and Kuik (2011) examined whether different approaches to community ownership (co-ownership versus private ownership) affect the degree of social acceptance of wind energy in Germany. The authors conducted a comparative case study, utilising a questionnaire-based survey. The results showed a significant difference in local acceptance between the two ownership models. Specifically, the residents of the community where a co-ownership model exists, were consistently more positive toward local renewable energy and toward renewable energy in general.

Legal framework, support schemes and institutions

National and international laws, procedures and institutions may influence both the efficiency and legitimacy of national wind energy development. Below we present country studies describing these preconditions. Although the focus of these studies is not necessarily on social acceptance, the described differences in legal preconditions will obviously result in differences in attitudes toward wind from various stakeholders.

In an oft-cited study, Breukers and Wolsink (2007) compare the wind energy development in specific regions of the Netherlands, England, and Germany and explain the differences in achievements by referring to differences in institutional design and capacity. The analysis is based on interviews and document analysis. They examine the extent to which wind power has become embedded in existing routines and practices of society and use the concept of "institutional capacity building" to explain the trajectories followed. The authors argue that the German case has been a success, the Netherlands case has been delayed, and the English case has been a disappointment. In Germany, they argue, the early institutionalisation of renewable energy has contributed to the growth in wind power investments. Also, the feed-in tariff system has been an effective tool for providing economic benefits to residents. As a result, many residents are involved in wind projects, which has increased social acceptance and hindered opposition. This has not been the case in the UK and the Netherlands, they argue, where the support schemes have been designed so that most of the revenue accrues to external companies. They find that differences in local acceptance can partly be explained by differences in institutional arrangements. Yet, they admit that pathways are not deterministic and that changes in the broader institutional context can result in unexpected consequences.

In a study of Spain, Denmark and Sweden, Meyer (2007) asks which country has adopted the most efficient national policies for promoting wind power. His answer is Denmark. Meyer explains the successful promotion of Danish wind power in the last two decades of the 20th century because of individual entrepreneurs, early official certification of wind turbines, systematic government support including favourable economic tariff schemes, and cooperative private ownership of wind turbines, which fostered broad public support. Most importantly, long-range national energy policies have created and stabilized the conditions required for the development of more sustainable energy systems. The poorer wind development achievements obtained in Sweden and Spain, he argues, is a result of the lack or delayed development of such a supportive, stable environment.

Faced with ambitious renewable energy targets, governments may believe that local planning processes will not yield sufficient sites for wind power expansion. This was the motivation behind the Welsh practise of superimposing centrally-determined ‘Strategic Search Areas’ for large-scale, onshore wind farm development onto local decision-making processes. Cowell (2007) uses document analysis and semi-structured interviews with consultants, planning authorities, government officials and wind industry representatives, to understand the various responses to this practice. On a more general level, Cowell (2007) tries to explain why some states are inclined to resolve “the planning problem” through strengthened national control. Cowell (2007) concludes that although a centralised planning culture may indeed stabilise the regulatory conditions for large-scale wind investment in the short term, it may face several vulnerabilities in the long term.

While public engagement at the local level may increase the legitimacy of wind energy development processes, this engagement may also reduce the efficiency of reaching renewable energy and climate targets. Two studies from the Nordic countries illustrate how this trade off, legitimacy versus efficiency, is influenced by EU and national laws and institutions. Petterson et al. (2010) analyse and compare institutional and legal preconditions for wind power development in Denmark, Norway and Sweden. Most attention is paid to the various territorial planning procedures. They argue that although public economic support to wind power has been necessary to promote its diffusion in the electricity system, the differences in wind energy development in the three countries is mostly a result of differences in legal preconditions for the location and environmental assessment of wind energy projects. Most importantly, they argue that “in comparison to Sweden the physical planning systems in both Denmark and Norway provide greater scope for implementing a national wind power policy at the local level.” For instance, the Danish planning system involves a top-down designation of areas for wind power purposes in the local plans, while in Sweden the municipalities must consent to the construction of wind turbines at a certain location for the installation to actually take place. The authors warn that "wind power is one of the power-generating technologies that tend to have the most to lose from the uncertainties created by planning regulations that leave much discretion to local authorities."

Liljenfeldt (2015) examines the national planning systems of Finland, Norway and Sweden, and how the national strategies for wind energy planning are perceived by different stakeholders. The EU Renewable Energy Directives set the conditions for national policies, and the authors show how the three countries have chosen different national planning and permitting processes in response to these Directives. They conclude that the development of wind energy has been moving planning procedures away from more inclusive planning methods in favour of more top-down and streamlined ones, favouring efficiency over legitimacy. Such changes in emphasis may reduce the perceived process and distributive equity of wind energy development processes at the local level, a topic we turn to next.

While the two studies just mentioned are concerned with planning and efficiency, the next study is concerned with planning and local acceptance. In a Danish report, Anker and Jørgensen (2015) examine the legal framework for siting decisions and suggest that it may influence local acceptance for wind energy. They argue that the level of complexity in the legal framework, including linkages between the planning procedures, the environmental impact assessment procedures and permit procedures, may challenge local administration in the municipalities. For example, there is a high risk of not meeting all procedural requirements and thereby a risk of development plans being declared invalid by the Nature and Environment Appeals Board. The same complexity may prevent local citizens from actively engaging in the process, and this may reduce local acceptance of wind energy projects. An issue could be the unclear relationship between the authorities and the developer in the procedures, Anker and Jørgensen (2015) argue. And assigning specific areas for wind energy is increasingly being challenged by ad hoc project planning, possibly due to a more proactive developer practice (i.e., buying up properties).

Lobbying and national, regional and local discourses

What arguments are used, heard and valued in the debate for and against wind energy developments will influence the social acceptance of wind energy. Below we present a selection of studies of how effective various groups of stakeholders are in influencing the legislative system or political system on an issue (i.e., lobbying analyses), and how the language is used and what arguments dominate in conflicts on whether to develop wind energy (i.e., discourse analyses). Moreover, we include some framing analyses, that is a multi-disciplinary social science research method used to analyse how people understand situations and activities. For example, this may include studies of how social acceptance of wind energy will depend on how the overriding goals for wind energy are framed and communicated.

Radical changes, like the shift from a fossil energy regime to a renewable source energy regime, require a change in how we view, interpret and discuss society. An interesting analysis on the German Energiewende is given by Strunz (2014) in *Ecological Economics*. Strunz uses a so-called “resilience framework” to interpret Energiewende as a regime shift. He argues that the regime shift comprises several transformations: First, technological, political and economic developments reduced the resilience of the fossil-nuclear energy regime. Second, recent changes in German public discourse and energy policy paved the ground for a shift to the renewable energy regime. Third, to increase the resilience of the renewable energy regime, there are challenges to be solved, in particular, sufficient resilience of the electricity transmission grid appears to be crucial for facilitating the transformation of the whole energy system. The author argues that “the same processes that lowered the fossil-nuclear regime's resilience created the RES-based regime”. The argument, focusing on the “changing hegemony of competing narratives via the interplay of ideas, institutional arrangements and interests”, is presented in the figure below.

Figure 2.1. Changing hegemony of competing narratives as creation of renewable energies feedbacks and erosion of fossil-nuclear feedbacks

RES-support policies introduced (1991, 2000)

Change in technological structure:

RES-share 1996: 4%
2011: 20%

Repercussion on political discourse

Aspects	Creation of the RES-regime	Loss of resilience of the fossil-nuclear regime
Ideas: competing narratives	Vision: "Growth and prosperity without oil and uranium" (Krause et al. 1980)	"Even in the long run, RES like sun, water or wind cannot provide more than 4% of our electricity demand" (German utilities 1993)
Institutional arrangements: energy policy	Effective RES-support: creation of technological–economic feedback favoring decentralized RES	Support for direct competitors of fossil-nuclear energy: erosion of technological-economic feedback
Interests: changing constellations	Growing number of beneficiaries from RES: creation of economic–political feedback	Traditional conservative constituencies leave the fossil-nuclear interest coalition: erosion of economic-political feedback
Ideas: competing narratives	Energy transition towards RES as consensual aim (Federal government 2010a)	Weakening of the old fossil-nuclear narrative, adjustments required: nuclear power as necessary bridging technology – "nuclear and RES are two sides of the same coin" (Federal government 2010b)

Source: Strunz 2014.

Perspectives and arguments differ across stakeholders. Based on a seminar series on planning for wind energy development, Ellis et al. (2009) conclude that "for the most part, academics and practitioners do live in very different worlds, defined not just by their day-to-day activities and the resulting variation in problem-framing, but in the very basic ways in which they appreciate evidence, knowledge and the normative purpose of planning." This conclusion reflects the various perspectives on wind energy planning presented during the seminar, involving researchers, wind energy developers, non-government organizations and policy-makers. In government policy and popular media, planning is often framed and discussed as a problem that must be solved through a discourse of "planning barriers". This discourse is somewhat at odds with the emerging understanding of social acceptance and the role of planning systems being projected by researchers, Ellis et al. (2009) argue. For example, a participant and experienced wind energy developer argued that "researchers and those involved in the policy and practice communities have failed to understand the real problems that arise when schemes are locally disputed" and expressed frustration over the local planning of such nationally important infrastructure. In contrast, another participant, Professor Maarten Wolsink from the University of Amsterdam, argued that planning should not be seen as the key problem facing wind power deployment, "but as a process which channels a broader range of institutional and ideological factors that frustrate the delivery of wind power."

The perspectives of one stakeholder may be misunderstood by another. An example is the UK study by Burningham (2015) who, based on interviews with wind energy developers, conducts a discourse analysis of their descriptions of local opponents. Burningham finds that UK developers believe that local resistance against wind energy is heavily influenced by incomplete knowledge and NIMBY considerations, despite the considerable empirical evidence that other factors such as visual impacts and process and distributive equity are far more important. This finding is important because developers' perceptions of what causes local resistance may shape how the interaction between authorities, developers and local stakeholders evolve.

A discursive approach to wind energy debates can enable a more explanatory analysis of the values and rationalities that influence different groups of stakeholders than a more descriptive approach. A popular research method to study people's viewpoint is the Q methodology, where individuals with shared ways of thinking are grouped together using a form of statistical factor analysis. This method is well suited to deal with the subjectivity and value-basis of social acceptance of wind farm development. Ellis et al. (2007) explore the nature of public acceptance of wind farms by investigating the discourses of support and objection to a proposed offshore wind project. They use an offshore wind farm proposal in Northern Ireland as a case study and use Q methodology to identify the dominant discourses of support and objection, and to explain the differences in expressed values and views. Using a similar approach, Fisher and Brown (2009) explore the nature of support and opposition to wind farm developments on the Isle of Lewis in Scotland. They identify and elaborate five distinct discourses on the Lewis Wind proposal, where each displays a different set of views on the impacts on the economy, landscape, and environment from this development. Knowledge on such differences in views should be incorporated in the planning process. Finally, Jepson et al, (2012) use the Q methodology to identify discourses on wind energy by key actors in wind energy development in Texas. They pay attention to the pro-wind, anti-environmental discourse. They find that for these individuals, environmental scepticism is not overturned even as renewable energy supports the local economy. Wind energy is viewed as an additional economic source that has saved the community from economic oblivion and enriched well-positioned landowner and business owners, but not as a clean power source. The authors name this view "reflexive environmental scepticism", a view that "accepts the economic products, processes, and policy innovations advocated by ecological modernization without accepting the core claim that innovations are required to adapt to environmental change."

Why are some groups better at developing arguments and mobilising people for or against wind energy developments? In a study of two wind energy projects in Norway, on Smøla and Høg-Jæren, Solli et al. (2010) examine how people are recruited and arguments developed and mobilised in the resistance to wind farms. They found that the resistance group developed strategies for making their arguments effective and convincing, continuously searching for arguments that both reflect local concerns and those of national bodies of environment management. The researchers argue that both supporters and opponents "construct hybrid collectives by enrolling humans and non-humans". That is, they employ nature objects and various concepts of nature that may work in favour or against resistance. Anderson (2013) explains through a qualitative case study how a small protest group prevailed during a local windfarm conflict in south-eastern Australia. When the public participation process failed to address the concerns of two communities opposed to the project, a social network of resistance emerged. Using a social capital analytical framework, she finds that the small protest group had high stocks of bridging social capital, which enabled an effective protest and led to the abandonment of the project. The supporters of wind farms (farmers), on the other hand, were unable to act collectively and acted as silent supporters. Thus, the public participation process led to the emergence of a social network of resistance, consequently failing to address the concerns of both supporters and opponents.

Trust in actors and processes

Trust is a key issue when involving the public in wind energy development (e.g. Aitken 2010a; Bronfman et al. 2012; Fast and Mabee 2015; Hill and Knott 2010; Strazzera et al. 2012). Breukers and Wolsink (2007) argue that policy-makers and wind project developers do not sufficiently recognise the nature of tensions at the local level. They suggest: "Facilitating local ownership and institutionalising participation in project planning can help to arrive at a better recognition and involvement of the multiple interests (environmental, economic and landscape) that are relevant at the local level of implementation." Similarly, Wolsink (2007) claims that "planning regimes and decision-making practices that really enhance the implementation processes of renewable energy require 'strong' ecological modernization. This means institutional changes that create involvement and trust of actors at the actual implementation level." In a study of expressed viewpoints on the siting of an off-shore wind farm in Northern Ireland, Barry et al. (2008) warn against "the counter-productive strategy of assuming that objection is based on ignorance (which can be solved by information) or NIMBY thinking (which can be solved by moral arguments about overcoming "free riders")."

The role of trust is confirmed by many country surveys and case studies. For example, in a Canadian study of controversies surrounding wind turbine noise in the province of Ontario, Hill and Knott (2010) found that the opposition toward wind energy development was reinforced by different interpretations of global and local risks, inadequate communication and public engagement, the loss of local government authority over planning matters, and a growing mistrust in the government’s and industry's ability to effectively and fairly manage the risks of wind turbine noise. In an Australian study, Hall et al. (2013) identify trust, process equity, distributive equity and place attachment as most important aspects to address to increase social acceptance for wind energy. They interview stakeholders at seven wind energy cases and use grounded theory to identify themes that form attitudes toward the wind farms. Their analysis shows strong community support for wind farms, but without addressing the four themes through policy development and public engagement approaches, wind energy is unlikely to provide the early and majority of new renewable energy in Australia, and elsewhere, the authors conclude.

In this section, we have reviewed literature on social acceptance and contextual political-administrative factors, including project-specific decision-making; project ownership; legal framework, support schemes and institutions; lobbying and national, regional and local discourses; and trust in actors and processes. Some of the most important political-administrative factors that shape social acceptance are summarised in the table below, taken from Langer et al. (2016). Additionally, as discussed in the previous sub-section, lobbying and argumentation are also found to be important in shaping social acceptance.

Table 2.12. Political-administrative factors and social acceptance of renewable energy development

Factor	Study	Key findings
Legal framework	Wolsink 2007; Breukers and Wolsink 2007; Holburn et al. 2010	Both regulatory policies and governance are important factors concerning the acceptance of wind energy.
Perception of political process	Toke et al 2008; Ek et al. 2013	Political movements related to energy issues may have an influence on the acceptance of wind energy
Transparency	Gross 2007; McLaren 2007; Toke et al. 2008; Jobert et al. 2007; Söderholm et al. 2007; Agterbosch et al. 2007	Numerous authors emphasize that cooperative, conciliatory and transparent decision-making processes are likely to increase the acceptance of renewable energy.
Communication	Wolsink 2007; Swofford and Slattery 2010; Jones and Eiser 2009.	Some authors emphasize to contribute to the prevention of local resistance towards wind energy investments, by an adequate communication between the involved stakeholders.
Information quality and quantity	Jobert et al. 2007; Agterbosch et al. 2007; Walter and Gutscher 2010	How well-informed residents are about wind energy plays an important role concerning acceptance of wind energy.
Timing	Wolsink 2007; Van der Horst 2007; Aitken 2010a; McLaren 2007; Ek et al. 2013; Corscadden et al. 2012; Brohmann et al. 2007; Zoellner et al. 2008	Along with the development of planning and reliability of wind energy projects a U-shaped development of the acceptance towards wind energy is suggested.
Procedural (and distributive justice)	Gross 2007; Wolsink 2007; Wüstenhagen et al. 2007; Ellis et al. 2007; Devine-Wright 2007; Aitken 2010a; Bidwell 2013; Walter and Gutscher 2010; Wells 2009; Bronfman et al. 2012; Van der Horst and Toke 2010; Cohen 2014	The perceived fairness of the decision-making process is connected to the acceptance towards wind energy.
Trust	Gross 2007; Wolsink 2007; Greenberg 2009; Aitken 2010a; Eltham et al. 2008; McLaren 2007; Jobert et al. 2007; Graham et al. 2009; Walter and Gutscher 2010; Bronfman et al. 2012.	Trust in the decision-making authority and project developers is crucial for the acceptance towards wind energy.
Media exposure	Hobman and Ashworth 2013	The extent of media exposure is associated with technology acceptance.
Ownership structure	Devine-Wright 2007; Frantal 2014	Study shows that people who own shares in a wind turbine indicate more acceptances towards wind energy.
Public involvement/ Participation	Firestone et al. 2015; Eltham et al. 2008; McLaren 2007; Toke et al. 2008; Jobert et al. 2007; Longo et al. 2008; Söderholm et al. 2007; Corscadden et al. 2012; Brohmann et al. 2007; Wells 2009; Aitken 2010; Cass et al. 2010; Gamboa and Munda 2007; Warren and McFadyen 2010; Walker and Devine-Wright 2008; Musall and Kuik 2011; Cowell et al. 2012; Lantz and Tegen 2008; Ferguson-Martin and Hill 2011	A sustainable energy development process allowing the residents to participate and to be directly and substantially involved contributes to higher acceptance.
Community conflict	Aitken 2010; Baxter et al. 2013; Frantal and Prousek 2016	Neighbouring communities of wind energy turbines tend to have lower acceptance levels.

Source: Langer et al. 2016. Only studies published since 2007 and written in English are included here. Also excluded are acceptance factors that we have chosen to address under other headings, including energy security and risk/benefit perception.

2.2.2 Individual characteristics

Socio-cultural factors

Large scale wind energy development entails physical environmental impacts. How these are perceived depends on the socially and culturally constructed connection that individuals have with the environment, such as place attachment (e.g. Pasqualetti 2011; Devine-Wright 2009; Devine-Wright and Howes 2010). In this section, we cover the literature on the relationship between wind energy development, socio-cultural values – defined as implicitly or explicitly shared abstract ideas about what is appropriate in a society (Anshelm and Simon 2016) – and social acceptance.

Using a choice experiment approach, Ek and Matti (2015) explore the most important determinants of individual's willingness to pay (WTP) for reducing negative impacts associated with wind energy development. The focus is on a planned, large-scale wind energy project in northern Sweden, and the choice experiments were designed to capture the economic and cultural impacts of the planned project on the Swedish Saami minority's possibilities to continue their traditional practice of reindeer herding (i.e. the experiment included ethical and ethno-political dimensions of protecting the traditional way of life of a minority group). The sample was split into two: respondents were either explicitly told to choose the alternative they thought was the best for themselves (private preferences), or the alternative they consider the best for society (public preferences). Socio-cultural effects, i.e. effects on the opportunities for the Saamis to continue their traditional practice, were considered the most important in the private sample, whereas new job opportunities were valued highest in the public sample. The authors note, however, that the results could be case dependent, since the experiment was set in an area with diminishing population and a considerable demand for economic development. The valuation of the protection of reindeer grazing areas is worth emphasizing, as it suggests that people indeed are willing to make a significant personal monetary trade-off to protect the rights and interests of a small minority group.

In their study of attitudes among individuals residing near a wind turbine toward wind energy in Delaware, US, Firestone et al. (2015) found that 82% liked the look of the turbine. The authors argue that "socially constructed aspects find more resonance than physical ones (e.g., attractiveness)" in explaining this finding; "with the wind turbine being reflective of a transformation to a clean energy future for those residents who like the way the turbine looks". Similarly, in a study of residents' attitudes toward two wind energy projects in South Dakota, US, Fergen and Jacquet (2016) found that respondents viewed nearby turbines as more beautiful when the turbines were in motion, which the authors attribute to notions of economic productivity of turbines in motion.

Pasqualetti (2011) studies opposition toward wind energy development in the US, Mexico and in the Isle of Lewis in Scotland. One of the reasons for opposition in the

Isle of Lewis, according to Pasqualetti (2011, p. 910), was “the worry that they will bring about a weakening of the cultural roots and conservative lifestyles that people have established there. It remains a simple place where livestock until recently commonly slept in the same house as their owners; where residents practice a fundamentalist form of Presbyterianism; and where Gaelic continues in use, alongside English”. Thus, wind energy development was interpreted as entailing challenges to the appearance of the land and to cultural values. Pasqualetti (2011) identifies five similarities across the diverse settings in which opposition to wind energy development was studied, several of which clearly touch upon how wind energy development may be interpreted as a challenge to cultural values, including immutability (an expectation of “landscape permanence”), and place identity (see also Barry et al. 2008; Devine-Wright and Howes 2010). As Pasqualetti (2011, p. 915) concludes, opposition to wind energy development is “more than a reaction just to the landscapes that wind turbines reshape. It is a response to the threat they pose to the way we fashion how we live”, and accordingly “considering more deeply the relationship between landscapes and the people who occupy and value them, in advance, will help smooth the otherwise bumpy road toward a more sustainable future”.

Previous studies of social acceptance suggest that the threat that wind energy development poses to place attachment is important in shaping social acceptance in Europe (e.g. Devine-Wright 2009; Devine-Wright and Howes 2010; Pasqualetti 2011) and in North America (e.g. Bidwell 2013; Fast and Mabee 2015; Pasqualetti 2011). However, studies also exist that question the importance of this factor in shaping acceptance (e.g. Jacquet and Stedman 2013). Hall et al. (2013) note that concerns with the impacts of wind energy development on place attachment are difficult to quantify, and moreover difficult to compensate.

Socio-psychological factors

Personal values and socio-demographic factors can have an impact on social acceptance of wind energy.

To understand how social acceptance is influenced by personal values and socio-demographic factors, two studies are worth mentioning. Batel and Devine-Wright (2015) focus on the gap between positive attitudes toward wind energy at the national level (i.e. socio-political acceptance) and resistance toward specific projects at the local level (i.e. community acceptance). Until recently, this attitude–behaviour gap in people’s responses to large-scale renewable energy technologies has been explained by referring to Not-In-My-Backyard (NIMBY). Batel and Devine-Wright (2015) argue that to understand this gap, the promotion of renewable energy production must rather be understood as a social change process where socio-psychological aspects influence responses to social change. They explain how the theory of social representations may help contribute to a better understanding of responses to renewable energy technologies. Huijts et al. (2012) develop a conceptual framework for understanding how psychological factors influence the social acceptance of sustainable energy technologies. The framework is based on a review of psychological theories and on empirical technology acceptance studies and aims to explain the intention to act in favour or against new sustainable energy technologies. The authors argue that the intention to act is influenced by attitudes, social norms, perceived behavioural control, and personal norms. Attitudes are influenced by the perceived costs, risks and benefits, positive and negative feelings in response to the technology, trust, procedural fairness and distributive fairness. Personal norms are influenced by perceived costs, risks and benefits, outcome efficacy and awareness of adverse consequences of not accepting the new technology. Addressing the factors that influence attitude and personal norms may therefore change the social acceptance for wind power.

Several empirical studies demonstrate how socio-demographic characteristics affect the support for wind energy as a technology (i.e. socio-political acceptance) relative to other energy sources.

In the US, Greenberg (2009) conducts a survey among residents to assess how social acceptance varies across fossil, nuclear and renewable energy sources. Greenberg finds a strong preference for renewable energy sources, while relatively few favour energy sources like coal and oil. The respondents varied substantially in age, ethnicity/race and other demographic characteristics.

In Turkey, Ertör-Akyazı et al. (2012) present an analysis of citizens' preferences toward nuclear and renewable energy sources based on data from a face-to-face survey of 2422 residents in urban Turkey. They find that those who favoured nuclear energy were typically men who were knowledgeable about climate change and engaged in environmental issues, but less concerned about the environment, and optimistic about its future. Nuclear opponents, on the other hand, were found to be concerned about the environment, pessimistic about its future, and not fully relying on technology. Almost two-thirds of the sample endorsed investment in renewable energy sources (such as wind and solar), and only a small minority was opposed to it.

In Australia, Hobman and Ashworth (2013) demonstrate the influence of psychological factors (i.e., pro-environmental beliefs and subjective norms) and information (i.e., on GHG emissions and generation costs) on public support for a range of energy sources and related technologies. A representative sample of 1907 Australians completed an on-line survey that measured perceptions on a range of climate change and energy issues. Results showed that support for renewables is stronger than support for traditional fossil-fuel based energy sources (i.e. coal or gas) and nuclear energy. Both psychological factors and information significantly changed support ratings. Subjective norms, however, were the strongest predictor, and the authors suggest that social mechanisms may be key drivers of support for new and emerging energy sources and related technologies.

Controlled laboratory experiments may give useful and replicable research findings on how socio-psychological factors influence social acceptance for wind energy. In contrast to field studies, the researcher is able to systematically vary project characteristics and context and examine how such variations affect the attitudes of respondents with different values and preferences.

In a recent study by Ribe et al. (2018), respondents were exposed to audio-visual simulations of two wind park sizes in three different settings in Switzerland and were then asked to rate each for visual preference, acceptability and realism. Prior to the first simulation, respondents were given information on the technical characteristics of the wind energy project. Prior to the second simulation, respondents were given information about each project's energy production, bird mortality hazards, scale and setting type and were then asked to answer questions about their experiences, concerns and attitudes. Estimating regression models, Ribe et al. (2018) find that: 1) in isolation, the technical characteristics of wind energy projects is a weak predictor of the relative perceived merit of alternative designs; 2) individuals have strong predispositions, such as good or bad regard for renewable energy or for certain landscapes, and these can substantially affect perceptions of wind energy projects, irrespective of the technical and geographical characteristics, and the energy and environmental impacts; and 3) risks to wildlife strongly affect attitudes. Bird hazard ratings were the most effective factor in explaining informed acceptability ratings.

Bidwell (2013) examines the role of general values and beliefs in shaping attitudes toward the development of commercial wind energy projects in or near respondents' communities. Responses to a survey were analysed using a structural equation model. Bidwell shows that underlying values substantially influence the expected economic outcomes for their community of wind farm development. This insight is important because the belief that one's community will economically gain is a key factor shaping social acceptance of wind energy projects. Altruistic values increase project support, while traditionalist values have the opposite effect. Consequently, support for wind energy was found to be influenced by concern for others, not self-interest. Bidwell (2013) concludes that the role of values in shaping social acceptance for wind energy suggests that more participatory development processes could be fruitful.

The table below summarises the range of personal attributes that have been identified in the literature as influencing social acceptance (from Langer et al. 2016).

Table 2.13. Literature findings concerning "personal characteristics" and acceptance of renewable energy development

Factor	Study	Key findings
Environmental attitude	Wolsink 2007; Devine-Wright 2007; Demski et al. 2014; Greenberg 2009; Spence et al. 2010; Hobman and Ashworth 2013; Ertör-Akyazi et al. 2012	Studies indicate high levels of acceptance for energy policy-making which strengthen the goal of environmental protection.
Socio-demographic status	Devine-Wright 2007; Greenberg 2009; Hobman and Ashworth 2013; Komarek et al. 2011	On the individual level, socio-demographic characteristics such as gender, age and social status can have an influence on the acceptance towards renewable energies.
Place attachment	Van der Horst 2007; Devine-Wright and Howes 2010; Ladenburg 2008; Swofford and Slattery 2010; Jones and Eiser 2009; Firestone et al. 2015	Emotional attachments to places can influence the acceptance of the population.
Experience with renewable energy	Ribeiro et al. 2011; Devine-Wright 2007; Komarek et al. 2011; Aitken 2010; Borchers et al. 2017; Cicia et al. 2012; Ribeiro et al. 2014	Direct experience, such as having personally seen or visited wind farms may have influence on the acceptance towards wind energy.
Knowledge of renewable energy	Ellis et al. 2007; Aitken 2010; Bigerna and Polinori 2011; Bollino 2009	The higher the information level of the person about renewable energy, the more likely the person accepts them.
Normative beliefs	Hobman and Ashworth 2013; Huijts et al. 2012	Studies suggest normative beliefs to be a strong, positive predictor.
Emotions	Hobman and Ashworth 2013	Positive emotions are associated with technology acceptance.
Political beliefs	Devine-Wright 2007; Rave and Goetzke 2016	Empirical findings suggest that political beliefs are correlated with acceptance of different low carbon technologies.
Attitude to traditional energy	Frantal 2009	Acceptance of renewable energy can be related to opposition to nuclear energy.
Conservative attitude	Bidwell 2013; Eltham et al. 2008	A conservative attitude has been a relevant factor with respect to theory of adoption of technology innovation.

Source: Langer et al. 2016. Only studies published since 2007 and written in English are included.

Experience and familiarity with wind energy and wind turbines may affect perceptions (e.g. Eltham et al. 2008). Wilson and Dyke (2016) explore community and affected stakeholders' perceptions of wind energy in Cornwall, UK, where a wind farm is now operational. The authors conducted pre- and post-construction interviews to assess perceptions. Results suggest that opinions changed over time, specifically that "the community have become used to the turbines and that attitudes have generally become more favourable", including perceptions of how wind energy affects landscape. In a review of the literature, Zerrahn (2017) concludes that "evidence on habituation to wind turbines, over time or due to more frequent encounters, is inconclusive"; some studies suggest that acceptance increases as familiarity increases, while others find either a negative effect, or no effect.

2.2.3 Policy and corporate measures to address acceptance related factors

Some of the factors shaping how wind energy projects are perceived and valued are more or less given and cannot easily or without significant additional cost be altered (e.g. sense of place and self-identity, political attitudes). Other factors can be adjusted to increase the positive impacts (e.g. a community fund), reduce the negative impacts (e.g. minimum setback distances) and improve the social acceptance of wind energy projects.

In this report, policy and corporate measures refer to processes and activities specifically related to a wind energy project, targeting a particular acceptance factor or groups of acceptance factors in order to influence community acceptance. As noted in the introduction, community acceptance is mainly influenced by factors such as distributional justice (distribution of costs/risks and benefits), procedural justice (fair and participative decision-making process) and trust (in information and intentions of investors and other actors) (Wüstenhagen et al. 2007; Zoellner et al. 2008; Sovacool and Ratan 2012; IEA 2013; Greenberg 2014; Sovacool et al. 2014).

Examples of policy and corporate measures include the establishment of a benefit sharing scheme (e.g. a community fund, local contracting and local ownership) to enhance distributional justice, and activities aimed at increasing transparency (e.g. sharing of project relevant information) and inclusiveness (e.g. identifying and interacting with all relevant stakeholders) to enhance the perceived procedural justice (see e.g. Aitken et al. 2016). A national, regional or local authority may introduce regulations to ensure a minimum degree of community ownership, and to ensure that relevant stakeholders are heard. Below, we briefly summarise some of the findings from the literature review in sections 2.1 and 2.2 in this report on what measures can be taken to overcome barriers associated with social acceptance, with a focus on distributional justice, procedural justice, and trust.

Policy and corporate measures aimed at enhancing distributional justice, procedural justice, and trust

The reviewed literature on benefit sharing schemes finds that social acceptance is strongly related to local economic benefits. However, the way in which project benefits are distributed and community benefits governed also shape perceptions of the distributional justice and consequently social acceptance (see section 2.1.3.). Relevant factors include which benefit-distribution mechanisms are employed (e.g. community funds versus community (co)-ownership), the share of benefits, how recipients are defined, and how these aspects contribute to a perceived fair distribution of costs and benefits. Fast et al. (2016) argue that measures to ensure a certain degree of local ownership are more likely to create a stronger form of community-based wind energy development than direct financial transfers from developers to landowners, as the latter approach risks creating intra-community conflicts. Strong policy support, including funding for project development, may be required to ensure community ownership. Cass et al. (2010) also argue that direct financial transfers as a measure to compensate communities risks being perceived as bribes, which could serve to reduce rather than enhance social acceptance. Measures to ameliorate such risks include formalising the process of financial transfers, rather than relying on voluntary transfers. The argument that formalising the process of benefits provision is likely to enhance acceptance is also put forward by Aitken (2010b). Specifically, Aitken (2010b) argues that institutionalised guidance (including rules defining the minimum requirements of what developers should provide in terms of community benefits) could serve to reduce conflict and increase trust by 1) providing greater clarity, 2) giving developers greater confidence to discuss community benefits in the early planning stages, and 3) reducing the likelihood of benefits being perceived as bribes.

The reviewed literature in this report suggests that the way in which stakeholders are involved in the process of wind energy development is strongly associated with social acceptance of wind energy (see section 2.2). Relevant factors include how institutions, regulations, organisation of development processes, communication, etc. contribute to a high or low involvement of all stakeholders in the process, from initiating the idea to constructing wind power plants to the actual implementation. Reed (2008) identifies a set of principles for best practice participatory approaches:

- Stakeholder participation should be based on the values of empowerment, equity, trust and learning.
- Participation should be considered as early as possible and throughout the process.
- The process needs to have clear objectives and to be facilitated by a skilled person.
- Local and scientific knowledge can be integrated to provide a more comprehensive understanding of the environmental challenges, and to evaluate the appropriateness of potential technical and local solutions to environmental problems.

Aitken et al. (2016) review practices relating to community engagement in wind energy development. The three main forms of community engagement approaches identified by the authors are summarised in the figure below.

Figure 2.2. Overview of community engagement methods identified in case studies of wind energy projects in the UK.

Source: Aitken et al. 2016.

Recommended practices for wind energy project planners, policymakers and practitioners

IEA (2013) presents recommended practices aimed at planners, policymakers and practitioners of wind energy development, based on strategies that have been successfully used to improve wind power projects "for the benefit of all, and to implement projects that are acceptable to a majority". The report is based on the IEA Wind Task 28 working group, involving experts from the US, Canada, Japan in addition to seven European countries, where the objective was to support the development of wind energy in the participating countries. The recommendations were structured around five key themes that the working group identified as playing a key role in shaping social acceptance:

- Policy and strategy (including planning and support regimes).
- Well-being and quality of life (including property value prices and landscape / ecosystems).
- Distributional design (including costs and benefits for the host communities).
- Procedural design (including processes, consultation and involvement).
- Implementation strategies (e.g., local empowerment).

Although best practices are presented, the authors warn that “there is no common recipe for such a complex and context-specific topic as social acceptance. These good practices have been effective in the past and are expected to facilitate greater support of wind energy; however, it is unlikely that all social opposition and barriers to wind energy projects can be resolved even if all recommendations are observed. Every project is unique and involves specific challenges. Any project is likely to result in many trade-offs and compromises because resources to deal with acceptance may be limited.” Here, we present some illustrations of the main recommendations from IEA (2013), but would like to emphasise that impacts and contextual factors are likely to differ from one project to another (as described in the previous sections of this report).

Table 2.14. Example recommendations for wind energy development and measures to enhance the social acceptance of wind energy

Theme	Recommendations
Policy and strategy	
National and supra-national policy	• Establish stable long-term policy • Ground wind energy policy in a comprehensive energy strategy that includes grid development and expansion • Design policy with provisions to facilitate social acceptance (e.g., explicitly consider provisions that encourage cooperative or community-based projects) • Provide informed guidance for permitting and approval standards and processes
Local, regional and state policy	• Proactively plan for wind energy by identifying specific areas for wind development and, where reasonable, areas to be excluded from wind development; align planning with the broader regional and national planning processes. • Account for local/regional experience and culture when identifying specific areas for wind development and formulating permitting and approval standards and processes. • Create mechanisms to allocate project benefits among the communities and private individuals located in the immediate vicinity of wind energy projects. • Consider including provisions for third-party intermediary to facilitate negotiations between host communities and project developers. • Design policy to facilitate transparent, direct proceedings, public participation, and open exchange of information throughout the development process. For participation to be perceived as “democratic,” participation above and beyond typical regulatory minimums may be required.
Well-being and quality of life	
Standard of living	Provide opportunities for host community residents to access direct project related material benefits, e.g. by facilitating opportunities for low-threshold financial participation by local stakeholders or suggest cooperative models; shares may be offered to non-local-community members, but only after local citizens’ demand is satisfied.
Well-being	Minimise the light intensity of aircraft obstruction markings e.g. by allowing and using demand-oriented navigation lights. Minimise turbine and project related sound emissions, e.g. by evaluating appropriate turbine setbacks and distances from occupied buildings for each project individually.
Valuation of eco-systems	In connection with environmental impact analyses, carry out biological studies of possible sites at the same time as the technical studies, and cooperate with nature conservation experts in detailed analyses. As a general principle, use the newest technology, such as radar detection of bird flocks, or temporarily shut down wind turbines during flying times where appropriate (especially for migratory species).

Costs and benefits: Distributional design	
General	Identify the key interests of the various stakeholder groups (financial, environmental, well-being).
Developers	• Boost the local economy, e.g. by contracting with local companies for basic construction activities such as pouring foundations, building roads, establishing grid interconnection, and transporting equipment. • Allow residents/communities to participate as shareholders (potentially by offering them shares at a special price if otherwise not practicable). • Create a positive link with the wind power production; for example, by setting up a company for the wind power project that is based in the municipality so that the taxes generated by the project flow to the host municipality. • Consider allowing the residents/communities to purchase the locally generated electricity on preferential terms.
Communities/ municipalities	• Create an investment company that holds a majority or minority share in the local project; keep in mind that this entails risk because the project may not be profitable. • Require your local or regional utility to participate in wind power projects or to develop its own wind power plant.
Consultation and involvement: Procedural justice	
Principles for procedural design	At a national or regional level, every stakeholder (including regulators, developers, amenity and environmental groups, and trade representatives, etc.) should discuss and agree to abide by the core principles for procedural justice. These may vary according to cultural and geographic contexts, but wherever possible, these should try to address the following: • Inclusivity and comprehensiveness. • Mutual respect. • Transparency and consistency. • Create adequate space and time for deliberative dialogue. • Sensitivity towards the local context and cultural relationships. • A balanced, evidence-driven discussion. • On-going opportunities for dialogue. • Empowering participants.
Protocols for practice	To translate these principles into operational guidance, it is suggested that stakeholders agree on the areas in which more detailed protocols should be developed to guide the processes and actions of specific decision-making processes. It is anticipated that such protocols should define the following: • The roles and responsibilities of the stakeholders involved. • Aspects of process management, including the availability of third parties to manage and arbitrate the decision-making process. • Opportunities for public participation, including the stages at which community input will be sought, the way in which this will be determined, and how the impact of the process will be reported. • Arrangements for determining and distributing benefits from wind energy project. • Access to information. • Capacity-building measures. • Opportunities for different stakeholders to challenge any decisions made. • Transparency and consistency: Stakeholders should act in an open and consistent way.

Implementation strategy	
Analysing and de-conditioning	Wind energy development should not start with a set project plan, but with an out-of-the box analysis of the area and a de-conditioning of the project: Look out for local developments in a broad social or economic sense. Find the answers to questions such as: what's important for the people of the community, what makes them proud, or with what do they identify themselves? Then they must try to incorporate these aspects into the planning process. This is the starting point for further development based on local empowerment and a cooperative design plan.
Using local empowerment	Try to arrange a transparent definition of the framework of the plan, and define the initial conditions under which other interests can join and in which phase. Start with ideas from the above-mentioned process of "analysing and de-conditioning" and forge them together with local stakeholders into a project-plan that maintains flexibility: • Realise that while the process evolves, other interests and parties might become relevant to the project and could be taken on board to strengthen the developments basis. • Start by bringing local people (citizens, entrepreneurs, and shopkeepers) together to develop the potential local meaning of having wind power in their community—and answer the question, "What can wind power deliver to the local environment and economy?" • Take the subjects and ideas and build one integrated plan, based on local meaning and co-creation among different interests. Arrange for: • Good project-planning and management. • Good process planning and management in which a balance of interests and powers is guaranteed by a neutral third-party who is solely dedicated to the result of the whole. Communicate continuously: • Send information and messages, and listen. • Adapt the message, means, sender, target group, etc., following the stage of the development. • Demonstrate the positive aspects.

Source: IEA 2013. Note that the list of recommendations shown here is incomplete and is only meant to provide examples of possible approaches. See IEA (2013) for a complete list of recommendations.

3 Technical, socio-economic and regulatory conditions for wind energy

In this section we provide a brief description of the natural, technical and political context for wind energy development in each WES target region. We describe the technical conditions for wind energy and technical challenges related to market development and grid connectivity and land use constraints. We also describe relevant policies, support schemes and institutions that govern the development of wind energy. In addition, we provide information about environmental aspects from an LCA-perspective, as this may influence social acceptance (see section 2.1.2.). The conditions that we describe include the following:

Technical conditions

- Basic facts (location, size, population, etc.)
- Wind energy resources, wind energy potential (including average wind speed)
- Local energy resources
- Grid capacity
- Topography/Geography (incl. map of region)
- Infrastructure (e.g. accessibility to the regions)
- Demographic characteristics (sparsely populated vs. congested)
- Restrictions on land use: national park, natural reserve, cultural heritage, indigenous people rights, tourism, military/defence interests, etc.
- LCA analysis (we use national, general LCA analysis when regional data is not available)

Regulatory framework

- Laws and regulations (e.g. Energy Act, Nature Diversity Act, Cultural Heritage Act, Expropriation Act)
- Institutions with jurisdiction
- Renewable energy support schemes
- Tax policies
- Licensing process for wind energy projects (incl. figure depicting the process)
- Impact assessment regulations
- Land use planning
- Impact assessment regulations

Socio-economic conditions

- Statistics/surveys on the perception of wind energy/renewables (incl. acceptance)
- Local knowledge/expertise
- Statistics/record of opposition and/or citizen protest against wind energy projects
- Statistics on number of jobs in renewable energy/wind energy sector
- Statistics on number of jobs in fossil and/or nuclear energy sector
- The economic role of tourism in the region

3.1 Germany

Germany is famous for its Energiewende, the energy transition towards a nuclear-free, low carbon and environmentally sound energy supply. While other European countries have higher shares of renewable energy than Germany, the Energiewende is, among others, famous because Germany is a large industry nation and exporter that has managed to achieve a rapid growth of renewables from 3.6% in 1990 to 36.2% in 2017 (Umweltbundesamt 2018).

The WinWind project focuses on two wind energy scarce regions in Germany: The Free State of Saxony (Saxony) and the Free State of Thuringia (Thuringia). They are two of Germany's 16 federal states. While they share many similarities, being part of the same national politico-administrative system, they show also important differences.

In the following we present the commonalities first, before we describe the conditions in each of the regions.

3.1.1 Technical conditions

Grid capacity. The German grid system is subdivided into a national transmission grid covering far distances at maximum voltage levels (220 kV and 380 kV) and a distribution grid providing power on high-voltage (60 kV – 220 kV), medium-voltage (6 kV – 60 kV) and low voltage levels (< 6 kV) on a regional or local scale. Most of the wind turbines (96 %) feed into the high- or medium-voltage level grid while only wind parks with large installed capacities are connected directly to the transmission grid.

The Renewable Energy Sources Act stipulates that all grid operators must expand their network should the grid capacity not be sufficient for the increasing feed-ins from renewable energy systems. A major challenge at the national level is to improve transport from the northern/eastern regions to the south Germany where wind energy is not as developed and where the shutdown of some nuclear power plants increases demand for power supply from other states.[1]

[1] https://www.bee-ev.de/fileadmin/Publikationen/Studien/100125_BEE-Roadmap_AusbauEE_2020.pdf

LCA analysis. Obligations concerning the dismantling of the wind turbine and restoration of the used land are part of the initial approval process and regulated in the federal building code. Operators must address these steps in advance, e.g. by providing a bank guarantee. They commit to dismantling the complete turbine and removing the foundations up to a minimum of 1 meter into the ground so that future agricultural land-use is made possible.

After the dismantling, steel and copper are usually sold according to raw material prices; concrete and glass fibres are cut up and used, for example, as backfills in road construction. The most challenging and controversial part of the recycling process are the rotor blades. Because of the high percentage of resins, fillers and sandwich materials, they cannot be disposed of conventionally. For this reason, they are recycled thermally which is only possible in highly specialized plants and with extensive preparatory work.

Saxony

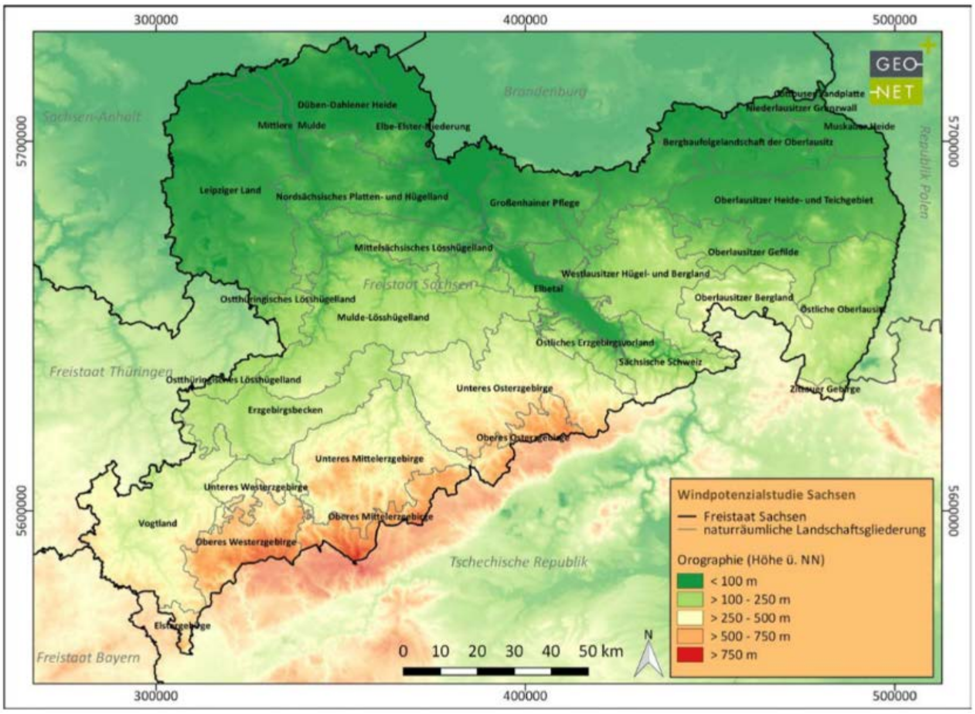
Saxony is a landlocked state situated in the eastern part of Germany bordering with Poland and the Czech Republic and is subdivided into ten districts. It has a population of 4.081.783 (2016) and an area of 18,450 km2. Saxony is the 10th largest and 4th most populated state in Germany with a population density of 221 inhabitants per square kilometre.[2]

Figure 3.1.1. Geographical location of the Free State of Saxony in Germany

Topography. Saxony's landscape can be classified into three major zones: the lowlands, loam regions and central mountain zone. These zones create a dominant north-south structure that is crossed by the Elbe valley.[3]

[2] https://www.statistik.sachsen.de/html/426.htm
[3] http://www.energieportal-sachsen.de/SAENA/SAXWIND_SMWA_Abschlussbericht_WPS.pdf

Figure 3.1.2. Landscapes in the Free State of Saxony



Local energy resources. In 2015 Saxony's gross electricity production amounted to over 42.4 billion kilowatt hours. The most important energy source, lignite (brown coal), is responsible for about three quarters of the gross electricity production. Renewables make up 13.5% of the energy mix of which 4.6% is produced by wind energy plants. Natural gas accounts for 8.8%.[45]

Wind energy resources, wind energy potential (incl. average wind speed). To date, 891 wind turbines have been installed and produce 1,199 MW. As far as the number of newly built plants, Saxony was ranked number 14 out of 16 federal states with 16 newly built wind turbines in 2017 (representing 0.9% of national newly built gross capacity).[6]

This comparatively slow development does not correlate to the available wind potential since large parts of Saxony have a considerable wind harvest potential. According to a recent wind potential study, almost all areas of Saxony have an average wind speed of more than 5.5 m/s in a height of 140 m above ground. Only small areas in deeply cut valleys are unfeasible for wind turbines.[7]

Furthermore, a study published in 2012 by the German Wind Energy Association (Bundesverband WindEnergie e.V.) examines the potential electricity yield from wind energy based on the geographical preconditions: land cover, settlement areas and

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[4] https://www.statistik.sachsen.de/download/200_MI-2017/MI-75-2017.pdf
[5] https://www.statistik.sachsen.de/html/503.htm
[6]http://www.windguard.de/_Resources/Persistent/23f0cbcd629af2a24f59e562abbf0d2a936d3abb/Factsheet-Status-Windenergieausbau-an-Land-2017.pdf
[7] http://www.energieportal-sachsen.de/SAENA/SAXWIND_SMWA_Abschlussbericht_WPS.pdf

infrastructure. Questions concerning topography, property or regulation were not addressed. The results of the study reveal that 4.9% of Saxony's area outside forests and protected areas would be geographically suitable for wind turbines. Considering forests and protected areas would increase the capacity to 14.3% thus making approximately 20 TWh of production potential per year possible. This implies that the wind energy potential could cover about 75% of the gross electricity consumption of 26.5 TWh as of 2015.[8][9][10] The Saxon spatial planning regulations state that the use of forest areas for wind energy production is generally to be avoided.[11] A later study emphasized that based on the assumption that only 2% of the total territory is used for wind energy, Saxony is only realizing 9.7% of the available potential.

Infrastructure. Potential sites can normally be reached using the existing road network.

Thuringia

Thuringia is situated in the centre of Germany and therefore landlocked and bordering with five other federal states. Thuringia has 2,164,421 (2016) inhabitants and covers an area of 16,171 square kilometres with a population density of 133 inhabitants per square kilometre. The state is organized in 17 rural districts (Landkreise) and six urban districts (kreisfreie Städte), i.e. cities constituting a district in their own right, with Erfurt being the state capital.

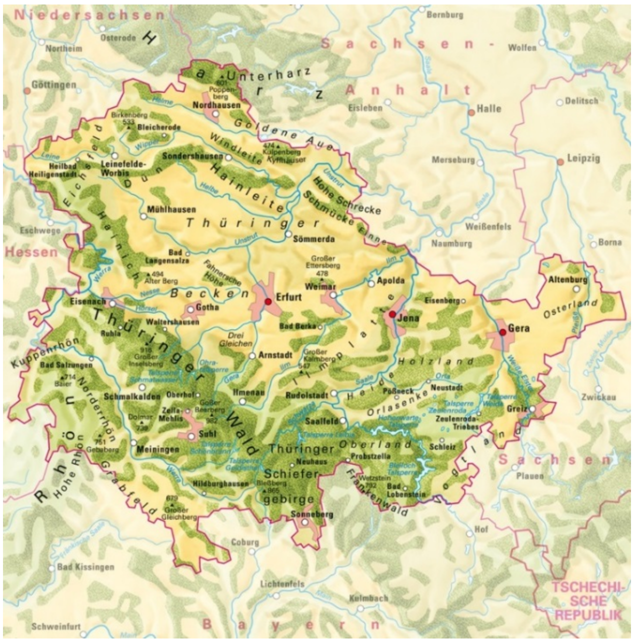
Figure 3.1.3. Location of the Free State of Thuringia in Germany

Topography. Many parts of Thuringia are characterized by the Thuringian Basin, which is flat, fertile and surrounded by smaller mountains. The Thuringian Forest is in the south, the largest mountain range in the state that merges into the Thüringer

[8] https://www.wind-energie.de/sites/default/files/attachments/region/sachsen/sachsen-potenzial.pdf
[9] https://www.wind-energie.de/sites/default/files/download/publication/studie-zum-potenzial-der-windenergienutzung-land/bwe_potenzialstudie_kurzfassung_2012-03.pdf
[10] https://www.statistik.sachsen.de/download/200_MI-2017/MI-75-2017.pdf
[11] https://www.fachagentur-windenergie.de/fileadmin/files/Veroeffentlichungen/FA-Wind_Analyse_Wind_im_Wald_06-2016.pdfv

Schiefergebirge, with another mountain range in the east. The Harz Mountains are in the north and also reach the neighbouring states of Saxony-Anhalt and Lower Saxony. The major rivers forming valleys are the Saale in the west and the Weiße Elster in the east.

Figure 3.1.4. Landscapes and topography of the Free State of Thuringia in Germany



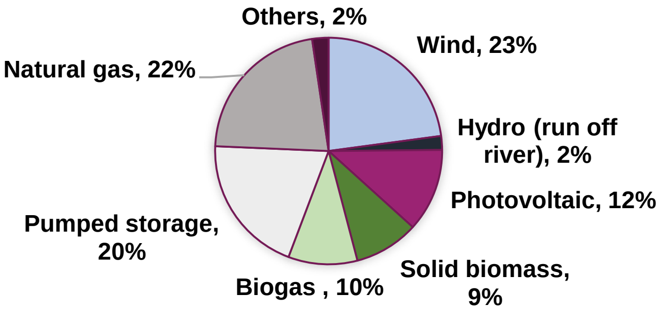
Wind energy resources, wind energy potential (incl. average wind speed). There are currently 834 wind turbines in operation in Thuringia with an installed power of 1,295 MW representing 3% of Germany's total wind energy capacity. In 2017, 45 new wind turbines were installed with a power of 138.82 MW representing 2.6% of the newly built gross capacity at a national level.[12]

A study on wind energy potential in Thuringia found that merely 0.56% of the state's area fulfils the necessary criteria for the potential use of wind energy production. Apart from the area suitability (see the section on restrictions) the study also states that potential areas need to reach an average wind capacity of 200 W/m^2 which corresponds to a wind speed of 5.3-5.5 m/s. The 0.56% share is equivalent to 9.108 ha and represents a potential wind yield of 7,134 GWh per year. If Thuringia were to fully exploit its wind potential, this could cover approximately 50% of its total electricity demand.[13] Another study highlighted that, based on the assumption that 2% of the total area were used for wind energy, Thuringia is only realizing 14.6% of the available potential.[14]

[12] https://www.thega.de/wind-gewinnt/
[13] https://www.thueringen.de/mam/th9/tmblv/rolp/windstudie_zusammenfassung.pdf
[14] BDEW 2016, LAK 2018, Statistical Offices 2017

Local energy resources. Thuringia covers about 50% of its electricity demand through imports from other states. The electricity generation mix is rather unique compared to other German states: In 2016, around 22% of electricity production was supplied by natural gas, 20% by pumped storage hydro power, 22% by wind energy, 12% by PV and 19% by biomass and biogas (cf. Fig. 3). According to this mix, electricity from renewable energy sources covers approximately 57% of the electricity generation.

Figure 3.1.5. Electricity generation mix in Thuringia, 2016



Source: Statistical Office of Thuringia 2017 [15]

Infrastructure. Potential sites can normally be reached using the existing road network. Access to projects in forested areas is rather difficult, but possible.

Restrictions on land use. According to a state-wide study[16] commissioned by the Thuringian Ministry of Infrastructure and Agriculture, approximately 30% of the area has been classified as a “taboo zone” due to the dominance of nature conservation areas that cannot be used for wind energy production. Additionally, other areas have been ruled out due to their “high sensitivity landscape” significance. These make up about 28% of the Thuringia territory but have large intersections with the aforementioned nature conservation areas. Nearly 60% of Thuringia’s area is excluded from potential use for wind turbines because of settlements and minimum distance requirements between these and the turbines.

3.1.2 Regulatory framework

The following table provides an overview of important *laws and regulations* at the national level including provisions for planning, environment, support mechanisms for renewables and technology.

[15] http://statistik.thueringen.de/datenbank/TabAnzeige.asp?tabelle=LD000640%7C%7C
[16] https://www.thueringen.de/mam/th9/tmblv/rolp/windstudie_zusammenfassung.pdf

Table 3.1.1. Overview of selected laws and regulations at national level

Renewable Energy Sources Act [17]	The Act includes long-term targets for RES based electricity and provisions for grid connection and represents the key support scheme for RES generated electricity (RES-E). RES-E is mainly supported through a market premium scheme. Since 2017, for most RES installations, the award and the level of the market premium is determined through auctions. Onshore and offshore wind projects <750 kW are exempted from auctions and still supported by feed-in tariffs (see also below).
Federal Spatial Planning Act[18]	Regulatory framework and provisions for spatial planning at federal, federal-state and regional levels: Regarding wind power development, *priority areas* are defined as sites where the installation of wind turbines takes priority over other types of land uses, while *suitability areas* are defined as sites where wind power development is feasible and then, prohibited in other parts of the region. Combining both types of regulations leads to the designation of areas, which, on the one hand, guarantee that the installation of WTs takes priority over other types of land uses but, on the other hand, installation of WTs outside these areas are prohibited.
Federal Building Code[19]	Provisions for planning and building at a local level. General rules for the permitting of wind turbines in the open countryside.
Federal Pollution Control Act[20]	Provisions for licensing of wind turbines with a size > 50 meters (see below)
Federal Nature Conservation Act[21]	Provisions for landscape planning, designation of reserve areas and protection of endangered species and habitats.
Environmental Impact Assessment Act[22]	Rules for environmental assessment of plans and projects including wind power plants (see below)
Technical Instructions on Noise Abatement[23]	Methods for the determination and the assessment of noise generated from industrial or commercial installations, including wind turbines. They contain binding emission values for emission points outside buildings. If binding emission values are exceeded, measures to reduce noise are required.

The following table provides an overview of key strategies, programmes and related concepts at national level.

[17] Erneuerbare-Energien-Gesetz – EEG.
[18] Bundesraumordnungsgesetz – ROG.
[19] Baugesetzbuch – BauGB.
[20] Bundes-Immissionsschutzgesetz – BImschG.
[21] Bundes-Naturschutzgesetz – BNatSchG.
[22] Gesetz über die Umweltverträglichkeitsprüfung – UVPG.
[23] Technische Anleitung TA Lärm.

Table 3.1.2. Energy strategies, programmes and related concepts at national level

Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply (2010 /2011)[24]	In September 2010, the Federal Government adopted the Energy Concept which sets out Germany's energy policy until 2050 and specifically lays down measures for the development of RES, power grids and energy efficiency. Following the Fukushima accident, the role assigned to nuclear power in the energy concept was reassessed and the seven oldest nuclear power plants and the plan at Krümmel were shut down permanently. Further to this, a decision was made to phase out the remaining nine nuclear power plants by 2022. On June 6, 2011 the Federal Government adopted the energy package which supplements the measures of the energy concept and speeds up its implementation. The Energy Concept describes specific targets and development paths through the year 2050: 1. Reduction of GHG emissions by 40% until 2020, by 55% until 2030, by 70% until 2040 and by 80-95% until 2050 (compared to 1990 levels) 2. The share of RES in final energy consumption is to be increased from roughly 10% today to 60% by 2050. 3. Compared to 2008 levels, there is to be a 20% reduction in primary energy consumption by 2020, and a 50% reduction by 2050. 4. The annual rate of building renovation to upgrade energy performance is to be doubled from current levels, passing from 1% to 2% per year. The Energy Concept contains specific measures to meet these targets.
Federal Climate Action Plan 2050 (2016)[25]	The Climate Action Plan builds upon the targets of the Energy Concept for GHG reductions and specifies sector specific interim targets up to 2030. The Federal government adopted the Climate Action Plan in November 2016. The Plan provides guidance to all areas of action to achieve the climate targets in line with the Paris Agreement and includes energy, buildings, transport, trade and industry, agriculture and forestry. Key elements of the Plan are: • Long-term target: based on the guiding principle of extensive GHG neutrality by mid of the century. • Guiding principles and transformative pathways as a basis for all areas of action by 2050. • Milestones and targets as a framework for all sectors up to 2030. • Strategic measures for every area of action.

The Renewable Energy Sources Act (mentioned in Table 3.1.1) is the *main support scheme* for wind energy in Germany. This federal law was passed in 2000 and has been amended in 2004, 2009, 2012, 2014 and 2016. On July 8, 2016 the (new) German Renewable Energy Act 2017 was adopted.

Up to 2017, the Renewable Energy Sources Act has promoted the use of electricity from RES via feed-in tariffs and feed-in premiums by requiring the grid operators to connect renewable energy installations and remunerate the electricity fed into the power grid. The difference between the wholesale market price on the electricity

[24] Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung der Bundesregierung.
[25] Klimaschutzplan 2050.

exchange and the higher remuneration rate for renewable energy is generally borne by the electricity customers via a surcharge included in the electricity price.

The latest amendments of 2016, which entered into force on 1 January 2017, mark a fundamental change from legally defined, guaranteed feed-in tariffs and feed-in premiums to competitive bidding and market-based auctions. As of 2017, remuneration rates for RES based electricity are no longer fixed by the federal government but are determined through an auctioning scheme, complying with the corresponding EU Guidelines on State Aid for Environmental Protection and Energy 2014-2020 (2014/C 200/01). The auction design is based on a price only selection process, i.e. the only award criterion is the support level for the renewable electricity. The auctions are expected to stabilize the costs for renewable energy and to provide the mechanism for adhering to specific growth corridors by auctioning a specific amount of capacity volume each year. Under the new system, a market premium is paid only to successful bidders in addition to the electricity market price prevailing at the relevant time.

The Act also sets targets for the share of electricity generated from RES in annual gross electricity consumption from the current 33% to 40-45% in 2025, to 55-60% in 2035 and to at least 80% in 2050.

For onshore wind installations > 750 kW, the following provisions, *inter alia*, apply under the EEG 2017:

- The pay as bid principle applies. This rule grants bidders the prices they have offered. The EEG offers a guaranteed price for 20 years.
- The Act provides for special reference values to compensate for differences in wind speeds.
- As a rule, onshore wind projects may only participate in the auctions if they have received a permit under the Federal Pollution Control Act (*Bundesimmissionsschutzgesetz*) at least three weeks before the auction date.
- The first auction was held on 1 May 2017 (800 MW), with two further auctions following on 1 August (1,000 MW) and 1 November (1,000 MW). In 2018 and 2019, four auctions will be held with a capacity of 700 MW each; as of 2020, three auctions will be held per year.
- To preserve the diversity of market participants, special rules apply for community energy companies including citizens' wind farms (*Bürgerwindparks*). Such projects may participate in the auctions without having to obtain the mandatory permit beforehand. Furthermore, these projects are eligible for the highest successful bid rate (uniform pricing). The Act also grants them a longer implementation period, i.e. 54 months rather than 30 months.
- To benefit from those privileges, citizens´ energy companies have to comply with certain eligibility criteria, e.g. with regard to shareholder structure. In general, the respective municipality has been granted or at least offered a 10% financial participation in the company.

- The federal states may enact further specific legislation regarding citizens' participation.

During the three auctions organized in 2017, average remuneration rates for wind energy decreased considerably from 5.71 €ct/kWh (May 2017) to 3.8 €ct/kWh (November 2017).

The special rules and privileges applying for community energy/citizen energy companies has helped render this actor group the "big winner" in the first three rounds of auctions. 2,730.4 MW of the 2,820.4 MW of onshore wind projects allocated support at the three auctions in 2017 are owned by enterprises that fulfil the legal definition of a citizens' wind projects. In the third auction round held in November 2017, these companies covered 98 % of the tendered volume. [26]

However, one of the drawbacks of the Act is that the eligibility rules for community/citizen energy were flawed and prone to misuse. There is evidence that several traditional project developers artificially created citizen energy companies to benefit from the privileges. In some cases, it was reported that the local citizens were employees of the companies. Hence it turned out that at least a part of the successful citizen projects seems to be “dummy organizations” of private-sector developers.[27]

The Federal Government supports wind energy also through other policies and measures. For instance, onshore wind farms are privileged projects according to §35 No. 5 of the Federal Building Code (Baugesetzbuch, BauGB). In addition, the federal state governments at the level of the *Länder* provide complementary support for renewable energy including wind energy (e.g. seed-money, tax incentives for community energy development, capacity-building etc.)

Tax policies. Local business taxes (*Gewerbesteuer*) are charged for profits from wind turbines, which means that wind farms can provide a stable source of revenue for local governments. On January 1, 2009, the federal government amended its local business tax law. Regarding the allocation of business tax revenues from wind energy projects, at least 70 % of the tax revenues is transferred to the local community where the wind project is sited, with the remaining 30 % paid to the municipality where the operating company has its headquarters. In addition, local communities can apply to retain up to 100 % of the tax. In the case of community-owned wind farms, which are managed by a local company, 100 % of the business tax remains within that community.

Spatial planning. § 35 Federal Building Code (*Baugesetzbuch, BauGB*) stipulates that wind turbines are privileged projects outside built-up areas of municipalities if there are

[26] For a detailed description of the auctioning system under the new Renewable Energy Sources Act, see https://www.fachagentur-windenergie.de/fileadmin/files/EEG/FA_Wind_RES_Act_2017_New_auction_system.pdf

[27] Morris, Craig (2017): Why no one seems happy with 96% citizen wind power. Available at https://energytransition.org/2017/08/why-no-one-seems-happy-with-96-citizen-wind-power/; Wehrmann, Benjamin (2017): Booming German wind power sector fears 2019 cliff. Available at: https://www.cleanenergywire.org/news/booming-german-wind-power-sector-fears-2019-cliff; see also http://www.klimaretter.info/energie/hintergrund/23527-zweifelhafte-buergerenergie; and http://www.klimaretter.info/energie/hintergrund/23913-windkraft-droht-der-absturz

no conflicting public interests. However, exceptions apply if, for instance, priority/suitability areas for wind energy have been designated in a regional plan or in a (municipal) preparatory land-use plan.

Considering the jurisdiction of the Federal Administrative Court regarding § 35 BauGB, several criteria have to be observed for effective spatial planning of wind turbines. Designation of priority/suitability areas needs to be based on a coherent planning concept. Furthermore, the bodies being responsible for the spatial/regional planning and designation of priority/suitability zones should in their plans ensure that wind energy is provided space in a “substantial manner”.

Whereas the basic political decisions about the *Energiewende* and the financial support for RES are made at the federal level, identification and designation of sites for onshore wind energy developments is normally the responsibility of the federal states. Siting is strongly based on regional and partly municipal spatial planning processes and on the designation of suitability or priority areas in regional plans or by designation of concentration zones on the level of municipal preparatory land use plans (*Flächennutzungspläne*).

Designation of suitability/priority areas generally follow a consecutive, three step process:

1. Mapping and elimination of categorical “no-go areas” where the installation of wind turbines is absolutely ruled out for factual or legal reasons (“hard taboo zones”, e.g. nature conservation areas, areas with high sensitivity of landscape scenery, residential and industrial areas etc.) and corresponding buffer zones.
2. Mapping and elimination of “soft” taboo zones where the construction and operation of wind power plants is factually and legally possible, but where no wind power plants are to be set up according to the priorities of the federal state governments (e.g. additional buffer zones, biodiversity)
3. The remaining areas (“potential areas”) are subject to a process of careful balancing of wind energy use with competing public interests. This will lead to further elimination of areas and finally to an identification of priority/suitability areas.

The criteria for no-go areas, particularly the soft no go areas and buffer zones in detail differ among federal states. Most states have enacted rules guiding the designation of priority/suitability areas, which must be followed by regional planning organizations.

Public involvement in spatial planning. There are special provisions ensuring the consultation of authorities, stakeholders and the general public. Planning procedures take at least several months and may take several years. The organizational setup of regional planning bodies varies among the 16 federal states of Germany.

Strategic Environmental Assessments. A Strategic Environmental Assessment (SEA) is conducted at the level of regional / land use planning to designate priority and concentration zones. This assessment helps ensuring that significant environmental effects potentially arising from plans and programmes are considered even before a project is actually implemented. As these plans and programmes are further developed, public information and participation is part of the procedure.

Permitting of wind energy projects. Wind turbines with a size of > 50 m are subject to licensing pursuant to the German Federal Pollution Control Act (*Bundesimmissionsschutzgesetz, BImSchG*). Permitting shall ensure that no harmful effects on the environment are caused by wind turbines. Permits are usually granted by environmental authorities. The permit for a wind farm according to the Federal Pollution Control Act concentrates all other necessary permits and approvals. Hence, the permitting procedure comprises all relevant assessments of the project – no other permissions are required. The permitting authority allots the application documents to all concerned authorities ("*Träger öffentlicher Belange*") and obtains their reasoned opinions. In case of a public consultation, documents are disclosed at least for one month.

Environmental Impact Assessment regulations. Legislation regarding the EIA is based on the European guidelines for such assessments. The EIA of wind farms is regulated at the federal level according to the EIA Act. Wind farm development requires a mandatory EIA for large projects with 20 turbines or more and a conditional EIA depending on the results of an initial screening process for projects with 3 to 19 turbines. The EIA provides a framework for assessing the effects of a project on environmental aspects that require protection and includes an evaluation of possible alternatives.

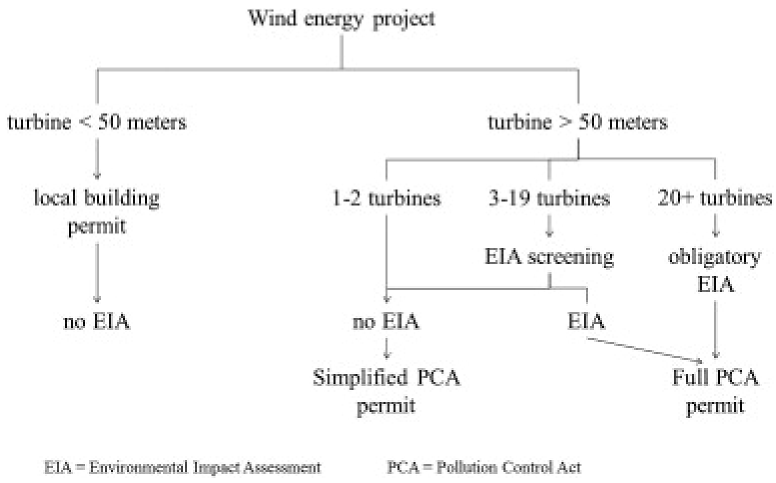
- *Projects with 20 or more turbines:* Full procedure including public consultation and environmental impact assessment.
- *Projects with 3 to 19 turbines:* Full procedure is required only when an environmental pre-assessment ("scoping") leads to the conclusion that significant negative effects for the environment could be expected. In other cases, a simplified procedure without public consultation and without EIA is sufficient.
- *Projects with 1 or 2 turbines:* Simplified procedure

Table 3.1.3. Environmental impact assessment requirements

	< 3 wind turbines	3-5 wind turbines		6-19 wind turbines		>19 wind turbines
EIA	No EIA	Site-specific preliminary assessment:		General preliminary assessment		Mandatory EIA
		No EIA	Mandatory EIA	No EIA	Mandatory EIA	
Participation of the public	Simplified process (§ 19 Federal Pollution Control Act)	Simplified process (§ 19 Federal Pollution Control Act)	Formal process (§ 10 Federal Pollution Control Act)	Simplified process (§ 19 Federal Pollution Control Act)	Formal process (§ 10 Federal Pollution Control Act)	Formal process (§ 10 Federal Pollution Control Act)

Source: Umweltbundesamt

Figure 3.1.6. Permission regime and environmental impact assessment for wind energy projects



Source: Geißler et al[28].

Public involvement in permitting. Public participation is required during the EIA procedures. This condition is legally defined in the EIA Act and the opportunity to consult and comment on the proposed project/plan and the accompanying environmental study must be granted. In practice, most projects and plans do not go beyond these formal requirements. Thus, frequently, the public becomes involved when the plan or project is in an advanced stage. For projects that do not require an

[28] Geißler, Gesa et al. (2013): Wind energy and environmental assessments – A hard look at two forerunners' approaches: Germany and the United States, Renewable Energy, Volume 51, 2013, Pages 71-78, ISSN 0960-1481, https://doi.org/10.1016/j.renene.2012.08.083.

EIA, or where the initial screening results in the finding that no full EIA is necessary, public participation is not formally required and thus rarely occurs.

Saxony

In addition to the national level strategies, the states have their own energy policy targets, strategies and related programmes. The following table gives an overview of such policies in Saxony.

Table 3.1.4. Energy policy targets, energy strategies and related programmes in Saxony

Energy and Climate Programme (2012)[29]	Saxony's energy and climate programme was adopted by the previous state government in Saxony (comprising the conservative Christian Democratic Union (CDU) and the liberal Free Democratic Party (FDP)). The programme defines the energy and climate policy objectives up to 2022. It is accompanied by an action plan. The programme formulates a target of 28% RES in gross electricity consumption to be reached by 2022. In the programme, the government considered possible to increase annual electricity production from wind energy from 1,700 GWh in 2012 to 2,200 GWh/a by 2022. This should be achieved by securing respective areas in spatial plans at a regional level. The programme has not been updated since its inception.
Coalition Agreement of the state government (2014)	After the parliamentary elections in the federal state of Saxony of 2014, a new government coalition was formed by the Christian Democratic Union and the Social Democratic Party. The corresponding coalition agreement stipulates that the state government is oriented to achieving the RES targets of the federal government (40-45% until 2025 and 55-60% until 2035). These targets, however, have not been translated so far into any new energy and climate programme.

Spatial planning in Saxony. Saxony also has its own spatial planning rules. Whereas fundamental political decisions about the *Energiewende* are made at the federal level, the identification and designation of sites for wind energy developments is the responsibility of the federal states, regional bodies or municipalities. In Saxony, there are four planning regions responsible for spatial planning. There have been established corresponding public bodies called "regional planning associations" (*Regionale Planungsverbände*), each with a regional planning office staffed by professional planning officials and a decision-making body, an assembly of elected political representatives. The four planning regions are as follows: Region Chemnitz, Region Oberlausitz–Niederschlesien, Region Oberes Elbtal – Osterzgebirge, Region Leipzig – Westsachsen. The planning bodies are in charge of elaborating and implementing the regional plans. The Saxon state government has defined political

[29] Energie- und Klimaprogramm Sachsen 2012, vom 12. März 2013

targets for the use of wind energy in its energy and climate programme of 2012[30], which have been broken down proportionally to the four planning regions. According to the Saxon state development plan of 2013, all four planning associations are required to designate corresponding priority and suitability zones for wind energy.[31] Construction of wind energy plants is only possible within these areas but excluded outside them. When designating corresponding areas, the planning associations need to differentiate between "hard taboo zones" and "soft taboo zones" (see above). According to the recent Saxon State Development Plan (*Landesentwicklungsplan*) of 2013, the regional planning associations have to revise their regional plans by 2017. This process is ongoing. The situation is further complicated by the fact that the wind energy related provisions of two regional plans have been declared ineffective by court decisions. Presently, 0.18% of the state territory are available for wind energy.[32]

Table 3.1.5. Spatial planning: Selected decrees and guidelines in Saxony

State Development Plan 2012 (of 12.07.2013)[33]	The plan emphasizes that designation of new priority areas/ should always refer to the energy policy targets of the corresponding state government. This means that regional plans should be based on the existing and actual energy policy targets defined in the Energy and Climate Programme 2012 (which was adopted by the previous government). The designation of priority and suitability zones should, inter alia, consider the following issues: • Available wind potential • Existing strain (e.g. from highways, other infrastructure, lignite mining) • Possibility to feed electricity into the grid • The special interest to replace older plants by new ones (repowering) • The local acceptance of wind energy, also regarding sufficient distances to residential areas. The plan also stipulates that the use of wind energy in forest areas should be generally avoided (particularly in protected forests and other forest types).

30 SMWA (Sächsisches Staatsministerium für Wirtschaft, Arbeit und Verkehr), SMUL (Sächsisches Staatsministerium für Umwelt und Landwirtschaft) (2013): Energie- und Klimaprogramm Sachsen 2012, vom 13. März 2013, available at https://www.umwelt.sachsen.de/umwelt/download/Energie-_und_Klimaprogramm_Sachsen_2012.pdf
31 SMI (Sächsisches Staatsministerium des Innern) (2013): Landesentwicklungsplan 2013, available at http://www.landesentwicklung.sachsen.de/download/ Landesentwicklung/LEP_2013.pdf.
32 SMI (Sächsisches Staatsministerium des Innern) (2017): Landesentwicklungsbericht 2015 (incl. Korrekturblatt Windenergie vom 3.Februar 2017. Available at http://www.landesentwicklung.sachsen.de/download/Landesentwicklung/LEB2015.pdf
33 Landesentwicklungsplan 2012.

Decree on minimum setback distances between residential areas and priority/suitability zones for wind energy (2015)[34]	The decree addresses the regional planning associations responsible for regional planning and designation of priority/suitability zones for wind energy. The decree refers to minimum setback distances between those zones and residential areas. In contrast to the previous government, which favoured fixed set back distances between wind turbines and residential areas (1,000 meters), the new government favours flexible setback distances and gives the regional planning bodies discretion in defining those distances.
Recommendations on the permission of wind energy plants (2011)[35]	The recommendations provide an overview of existing regulations for the permission of wind energy turbines.

Permitting process in Saxony (including EIA). The permitting process is determined by federal legislation. However, the lower pollution control authorities, which are part of the rural district administrations and the district-free cities are responsible for the granting of permits.

Thuringia

Thuringia has a draft of a climate protection act, which is relevant for wind energy as it highlights the aim to cover the primary energy demand by locally available renewable energy sources.

Table 3.1.6. Laws and regulations in Thuringia

Draft Climate Protection Act[36]	With this law, the state government transposes climate and energy policy targets included in the Coalition Agreement. The agreement was concluded by the coalition partners forming the new government after the state elections in Thuringia in 2014 (Left Party, Social Democratic Party, Green Party). The new state government aims to cover the total primary energy demand by a mix of locally available RES. The area dedicated to the development of wind energy is planned to be increased from 0.3 to 1% of the total area of Thuringia.

Like Saxony, Thuringia also has relevant energy strategies. See the table below.

[34] Gemeinsamer Erlass des Sächsischen Staatsministeriums des Innern und des Sächsischen Staatsministeriums für Wirtschaft, Arbeit und Verkehr über Mindestabstände zwischen Wohngebieten und Vorrang- und Eignungsgebieten zur Nutzung der Windenergie (VREG) vom 20. November 2015.

[35] Gemeinsame Handlungsempfehlung des Sächsischen Staatsministeriums des Innern und des Sächsischen Staatsministeriums für Umwelt und Landwirtschaft zur Zulassung von Windenergieanlagen
Dresden, 7.9.2011, Aktenzeichen: 53-458 I 66 I 4I - 4581 54.

[36] Entwurf eines Thüringer Gesetzes zum Klimaschutz und zur Anpassung an die Folgen des Klimawandels (Thüringer Klimagesetz) vom 19.12.2017.

Table 3.1.7. Energy policy targets, energy strategies and related programmes in Thuringia

Energy and Climate Protection Strategy 2040 (2011)[37]	This strategy defines quantitative targets for RES, includes and analyses individual sectors, and includes a comprehensive set of measures how to reach the targets
Draft Integrated Energy and Climate Protection Strategy (planned to be adopted in 2018)	

Spatial planning in Thuringia. Whereas the fundamental political decisions about the *Energiewende* are made at the federal level, the identification and designation of appropriate sites for wind energy developments is the responsibility of the federal states. In Thuringia, four planning regions have been established as public bodies being called “regional planning communities” (*Regionale Planungsgemeinschaften).* *E*ach of them has a regional planning office staffed with professional planning officials and a decision-making body, the assembly of elected political representative from the district/counties. The planning communities are in charge of elaborating and implementing regional plans, including the designation of priority zones for wind energy. These four regional planning communities are: Nordthüringen, Mittelthüringen, Südwestthüringen and Ostthüringen. Two of the existing regional plans have been declared ineffective by court decisions. Presently, approximately 0.3% of the state territory is available for wind energy.

Table 3.1.8. Spatial planning. Selected decrees and guidelines in Thuringia

State Development Programme 2025[38]	The programme aims to increase the share of renewable energy in final energy consumption to 30% and in net electricity consumption to 45% by 2020. It also specifies quantitative targets for RES-E for each of the four planning regions. The regional planning regions are to designate priority zones for wind energy having the effect of suitability areas. This planning instrument enables the planning bodies to concentrate wind energy developments on suitable sites by simultaneously excluding them outside those areas. The programme also stipulates that it is possible to limit the height for wind turbines in the regional plans. Furthermore, the regional planning communities are to determine priority areas for repowering projects by replacing old and less efficient wind turbines with larger and more efficient ones at sites with minor conflict potential. In addition, the regional planning communities can initiate informal concepts, e.g. regional energy concepts, or participate in the development of such concepts and strategies of local authorities or other bodies.

[37] Energie- und Klimaschutzstrategie 2040.
[38] Landesentwicklungsprogramm Thüringen 2025. Thüringer Ministerium für Bau, Landesentwicklung und Verkehr (2014): Landesentwicklungsprogramm Thüringen 2025 (LEP 2025) – Thüringen im Wandel, 05.07.2014.

Wind Energy Decree 2016[39]	The decree specifies the framework for designating priority zones for wind energy via regional planning. It takes into account the current legal framework and important administrative court decisions. It seeks to guide the planning communities in designating priority zones for wind energy. The goal is to increase the land area for wind energy developments to reach a share of 1% of the total state area. The decree includes a detailed description of 19 hard and 22 soft "taboo zones". Soft "taboo zones" include, inter alia, buffer zones around nature protection areas or national parks, sets setback distances/buffer zones around residential areas, or NATURA 2000 habitats. According to the decree, wind energy developments in forest areas are not generally excluded. They have been excluded only for specified types of forests (e.g. protection forests, recreational forests).

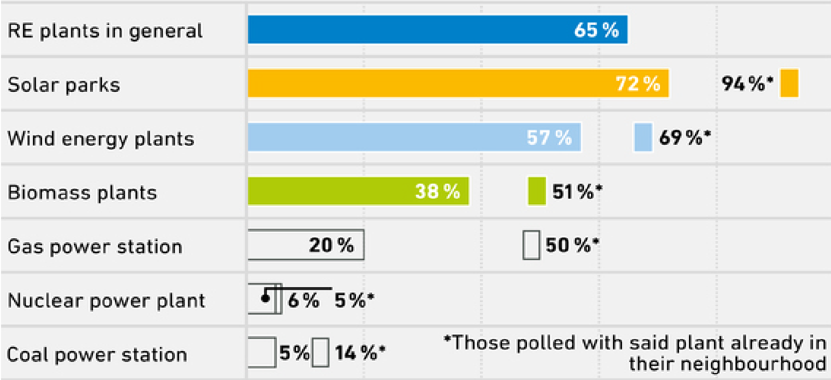
Permitting process in Thuringia (including EIA). The permitting process is very much determined by federal legislation. Several guidance documents and recommendations for the permitting of wind energy plants exist, e.g. referring to nature protection requirements for birds[40] or bats[41].

3.1.3 Socio-economic conditions

Statistics/surveys on the perception of wind energy/renewables (incl. acceptance). There have been numerous surveys and studies examining the social acceptance of the *Energiewende* in general, and of the local acceptance of renewable energy plants including wind energy plants. One of the recent studies conducted by TNS Emnid[42] and commissioned by the Germany Renewable Energies Agency illustrates that the growth of renewable energy continues to be of great importance to the German population. According to the results, 95% of those surveyed consider further expanding renewable energy "important" or "extremely important". 1,000 persons took part in the representative survey in July 2017. 57% of the respondents consider wind turbines in the neighbourhood as good or very good, with those living already near wind turbines showing even higher approval rate (69%) (cf. Fig. 4). An older survey shows from 2012 that in most of the federal states being formerly parts of the GDR (particularly i.e. federal states of Brandenburg, Thuringia, Saxony and Saxony-Anhalt) support rates for wind energy are generally at a lower level than in the rest of the country.

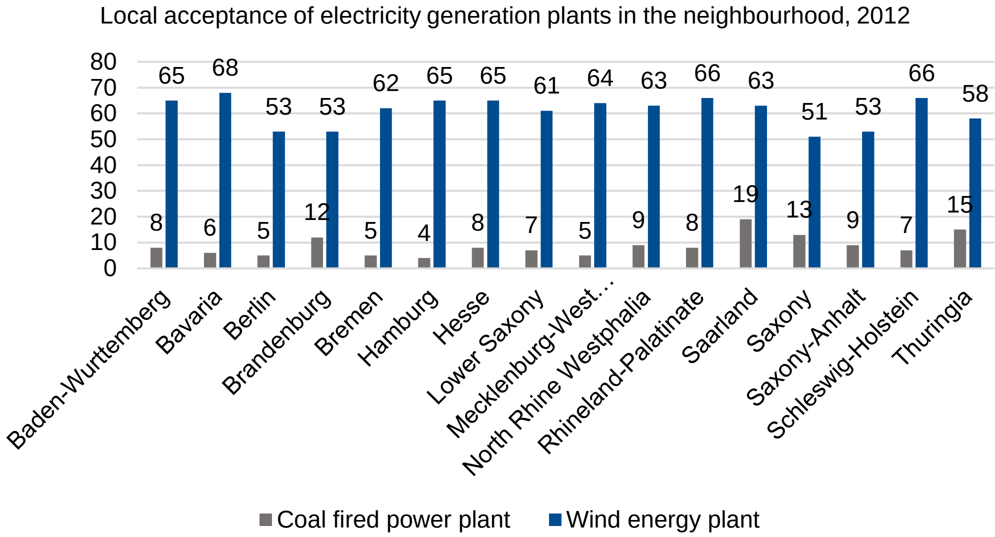
[39] Windenergieerlass 2016. Thüringer Ministerium für Infrastruktur und Landwirtschaft (2016): Erlass zur Planung von Vorranggebieten „Windenergie", die zugleich die Wirkung von Eignungsgebieten haben (Windenergieerlass) vom 21. Juni 2016, available at www.thueringen.de/mam/th9/tmblv/landesentwicklung/windenergie/windenergieerlass_vom_21.6.2016_1_.pdf.
[40] Thüringer Landesanstalt für Umwelt und Geologie (TLUG): Avifaunistischer Fachbeitrag zur Genehmigung von Windenergieanlagen (WEA) in Thüringen (30.08.2017).
[41] Institut für Tierökologie und Naturbildung im Auftrag der Thüringer Landesanstalt für Umwelt und Geologie (2015): Arbeitshilfe zur Berücksichtigung des Fledermausschutzes bei der Genehmigung von Windenergieanlagen (WEA) in Thüringen (Dezember 2015).
[42] https://www.unendlich-viel-energie.de/akzeptanzumfrage2017

Figure 3.1.7. Local acceptance of electricity generation plants, 2017*



* power generation in the neighbourhood is considered good or very good. *Source: Kantar Emnid/Agentur für Erneuerbare Energien 2017*

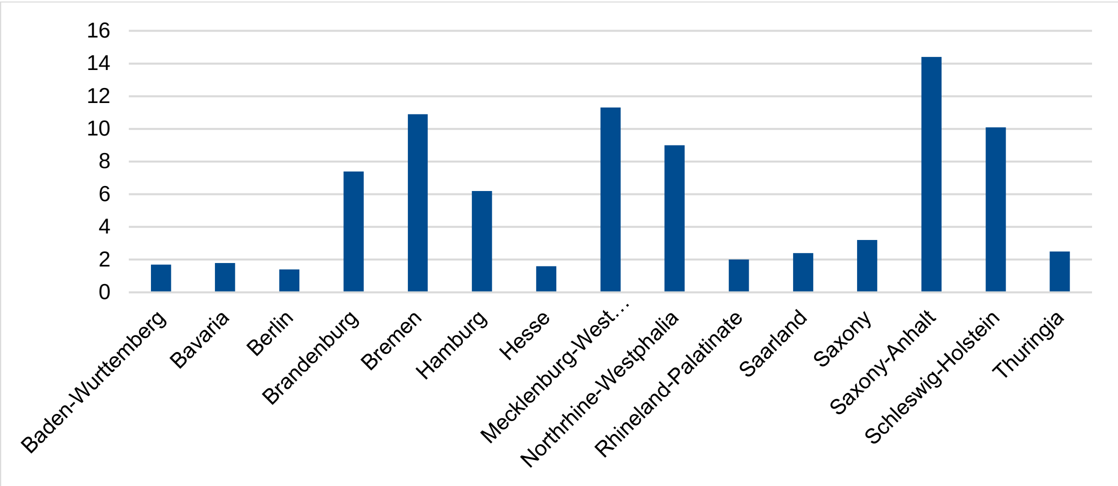
Figure 3.1.8. Local acceptance of electricity generation plants in the 16 federal states, 2012*



* power generation in the neighbourhood is considered good or very good by the respondents. *Source. Emnid, TNS Agentur für Erneuerbare Energien*

Statistics on the number of jobs in the renewable energy/wind energy sector also provides information about the socio-economic conditions.

Figure 3.1.9. Total number of jobs in the wind energy sector, per 1,000 persons employed, 2015



Sources: Agentur für Erneuerbare Energien, GWS 2017, Statistical Offices 2017, VGRdL 2017

Source: GWS 2017[43]

Table 3.1.9. Total number of jobs in the wind industry (onshore and offshore)

Federal state	2012	2013	2014	2015
Baden-Württemberg	8,140	9,210	9,520	9,490
Bavaria	9,960	11,450	12,140	11,820
Berlin	1,980	2,360	2,490	2,330
Brandenburg	6,080	6,540	7,350	7,060
Bremen	4,890	5,110	4,840	4,220
Hamburg	4,860	6,300	7,110	6,770
Hesse	4,070	4,910	5,070	4,870
Mecklenburg-Western Pomerania	6,140	7,290	7,670	7,520
Lower Saxony	28,290	31,470	34,370	32,300
North Rhine-Westphalia	16,300	18,400	19,130	18,490
Rhineland-Palatinate	3,990	4,100	4,150	3,580
Saarland	830	1,050	1,130	1,160
Saxony	5,040	5,660	6,000	5,710

[43] Gesellschaft für Wirtschaftliche Strukturforschung (GWS) mbH: Beschäftigung durch Erneuerbare Energien in den Bundesländern. Analyse und Ausarbeitung im Auftrag eines Konsortiums aus acht Bundesländern (Berlin, Hamburg, Hessen, Mecklenburg-Vorpommern, Niedersachsen, Sachsen-Anhalt, Schleswig-Holstein). Osnabrück, März 2017, Daten abgerufen über das Internetportal "Föderal Erneuerbar" der Agentur für Erneuerbare Energien (https://www.foederal-erneuerbar.de)

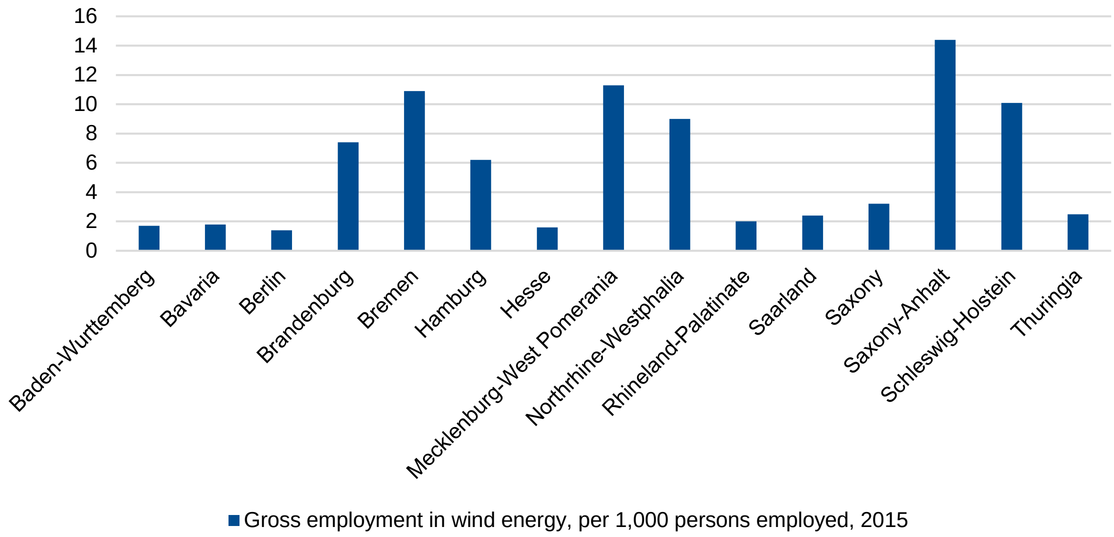
Saxony-Anhalt	10,990	12,450	13,440	13,120
Schleswig-Holstein	8,110	9,150	12,260	12,150
Thuringia	2,130	2,350	2,530	2,310
Germany	**121,800**	**137,800**	**149,200**	**142,900**

Sources: BWE/VDMA/OWIA (2017)[44], GWS

Saxony

As the following figure shows, Saxony is among the German states with a relatively low share of gross employment in the wind energy sector.

Figure 3.1.10. Gross employment in the wind energy sector 2015



Sources: Agentur für Erneuerbare Energien, GWS 2017, Statistical Offices 2017, VGRdL 2017

Local knowledge and expertise. Saxony have several companies and associations with wind expertise. See the table below.

[44] BWE/VDMA/OWIA (2017): The Wind Industry Is a Strong Employer in Germany. Available at https://agwind.vdma.org/documents/106078/16262656/1491380194390_VDMA%20PS%20BWE%20OWIE%20Ent-PM-GWS%20BeschAnaly%202017-03-22-final%20E.pdf/73dc4b40-2fd4-4971-a615-51472ea135b8

Table 3.1.10. Local knowledge and expertise

Saxon Energy Agency SAENA[45]	SAENA GmbH[46] is a company owned by the Free State of Saxony and the Development Bank of the State of Saxony (*Sächsische Aufbaubank*). It is an independent advisor to citizens, businesses, municipalities, schools and churches in the fields of renewable energies, sustainable energy supply and a conscious and efficient use of energy.
German Wind Energy Association–Saxony[47]	The German Wind Energy Association[48] promotes the further expansion of wind energy use on a national level. It has 20,000 members and experts working in international associations like the European Wind Energy Association or the Global Wind Energy Council.
Regional Planning Associations[49]	The Regional Planning Associations[50] are public corporations responsible for the implementation of regional plans according to the Saxon state planning act. Every association is obligated to draw up a regional plan for the respective region thereby determining potential wind energy sites.
Association to promote the use of renewable energies Saxony[51]	VEE Sachsen[52] is a non-profit organization with the goal of promoting education, science and research in the fields of using renewable energies and thereby supporting the environmental protection.

Statistics/record of opposition and/or citizen protest against wind energy projects. Wind projects experiences opposition. One of the key networks opposing wind energy in Saxony is the network of citizen initiatives for landscape conservation (*Netzwerk der Bürgerinitiativen des Landesverbandes Sachsen des Bundesverbandes Landschaftsschutz e.V.*). On its website the network lists presently 43 local citizen initiatives in Saxony opposing wind energy[53]. There is no information about the number of citizen initiatives not being members of this network.

Job opportunities in renewable energy/wind energy sector. The total number of persons employed in the Saxon wind energy sector has been recently estimated at roughly 5,900[54]. Although none of the leading wind turbine manufacturers has production sites in Saxony, there are several important component suppliers located there (e.g. VEM Sachsenwerk, SIAG Tube & Towers und Eickhoff Wind Power). In addition, there are several project developers, operators and service enterprises (e.g. WSB/VSB, BOREAS, UKA Meißen, Stadtwerke Dresden etc.). However, the relative

[45] Sächsische Energieagentur e.V.
[46] http://www.saena.de
[47] Bundesverband WindEnergie - Landesverband Sachsen
[48] https://www.wind-energie.de/en
[49] Regionale Planungsverbände Leipzig-Westsachsen, Region Chemnitz, Oberes Elbtal/Osterzgebirge, Oberlausitz-Niederschlesien
[50] http://www.landesentwicklung.sachsen.de/2378.htm
[51] VEE Sachsen e.V. Vereinigung zur Förderung der Nutzung Erneuerbarer Energien
[52] www.vee-sachsen.de
[53] http://www.sachsen-gegenwind.de/website/index.php
[54] Ulrich, Philip, Lehr, Ulrike Lehr (2017): Windenergie in Sachsen – Ausbau und Beschäftigung. September 2017, available at https://www.wind-energie.de/sites/default/files/attachments/region/sachsen/20171012-windenergie-sachsen.pdf.

importance of wind energy related employment is low, which can be partly attributed to the low overall wind energy plant installation rates in Saxony.

Statistics on number of jobs in fossil and/or nuclear energy sector. With its shares in the Lusatian and Central German lignite-mining district, the Free State of Saxony is one of the main lignite mining states in Germany. The approximately 30 million tons of lignite mined annually makes up around 18% of the total volume mined across Germany. Representing about 3.5% of the lignite produced worldwide, this quantity is also substantial at an international level. The volume mined annually in Saxony is equal to that of countries such as Serbia, Canada, Romania and India, which rank tenth to thirteenth among the world's top lignite producers. In Saxony, lignite is used primarily for power generation for industry and the transportation sectors.

Table 3.1.11. Share of persons employed in the lignite sector of all employed persons

	Total number of employed persons	**Number of persons employed in lignite based electric power stations**		**Number of persons employed in lignite mining and other parts of the supply chain**	
		Absolute number	Relative share	Absolute number	Relative share
Germany	32,009,204	5,740	0.02%	13,680	0.04%
North-Rhine-Westphalia	6,673,474	2,350	0.04%	6,610	0.10%
Brandenburg	829,429	2,700	0.33%	5,170	0.62%
Saxony	1,579,639	320	0.02%	1,590	0.10%
Saxony-Anhalt	796,886	370	0.05%	320	0.04%

Source: Bundesagentur für Arbeit. Status: September 2016, DEBRIV 2017a, DEBRIV 2017c, calculations by Wörlen et al. 2016.

The economic role of tourism in the region. Saxony has a moderately important tourism industry focused on the Ore Mountains, Leipzig, the scenic Elbe River valley and Saxon Switzerland, and Dresden.

Thuringia

Thuringia has some *local knowledge/expertise*, as shown in the table below.

Table 3.1.12. Local knowledge and expertise in Thuringia

Thuringian Energy and GreenTech Agency ThEGA [55]	On behalf of the state government, the Thuringian Energy and GreenTech Agency[56] established a service centre for wind energy which promotes and supports the further development of wind energy in Thuringia. It offers information and consulting to citizens, municipalities, associations and owners of potential wind energy sites.
Thuringian Renewable Energies Network ThEEN[57]	The Thuringian Renewable Energies Network (ThEEN e.V.)[58] was founded in 2013 as an umbrella organization for renewable energy, energy storage, energy efficiency and sector coupling, based in Erfurt. The expert network has more than 70 members from economic, scientific and public institutions and can count on the expertise of more than 300 companies through its sector associations.[1]
German Wind Energy Association Thuringia[59]	The German Wind Energy Association[60] promotes the further expansion of wind energy use on a national level. It has 20,000 members and experts working in international associations like the European Wind Energy Association or the Global Wind Energy Council
4 Regional Planning Associations: Northern Central, Southwest and East Thuringia[61]	The Regional Planning Associations[62] are public bodies responsible for the implementation of regional plans according to the Thuringian state planning act. Every association is obligated to draw up a regional plan for the respective region thereby determining priority zones for wind energy.

Statistics/record of opposition and/or citizen protest against wind energy projects. As of 4 October 2016, the *Thüringer Landesverband Energiewende mit Vernunft e.V." – Bündnis Thüringer Bürgerinitiativen – (THLEmV)*, the regional association of citizen initiatives in favour of a reasonable energy transition in Thuringia, listed a total number of 39 local citizen initiatives as member opposing wind energy developments in Thuringia.[63] There is no information about citizen initiatives not being members of this association.

[55] Thüringer Energie- und GreenTech-Agentur.
[56] www.thega.de
[57] - Thüringer Erneuerbare Energien Netzwerk.
[58] www.theen-ev.de/en/
[59] Bundesverband WindEnergie - Landesverband Thüringen.
[60] https://www.wind-energie.de/en
[61] 4 Regionale Planungsverbände: Nord-, Mittel-, Südwest- und Ost-Thüringen.
[62] www.regionalplanung.thueringen.de
[63] https://www.thlemv.de/index.php/buergerinitiativen.html

Table 3.1.13. Gross employment in renewable energy sector in Thuringia, 2015

Sector	Number of jobs
Wind energy	2,310
Photovoltaics	1,950
Solar thermal	250
Hydro	90
Bioenergy	4,160
Geothermal	290
Total	**9,050**

The economic role of tourism in the region. There is a modest tourist industry in Thuringia that largely serves German travellers, and which is focused on cultural activities and historical sites in towns like Eisenach or Weimar and on the scenic beauties of the Harz mountains and the Thuringian Forest.

3.2 Italy

In Italy a combination of government and market incentives has resulted in the rapid expansion of wind power capacity since 1998 and there is still a large potential. Two wind-scarce regions in Italy that WinWind focuses on are Lazio and Abruzzo.

3.2.1 Technical conditions

Energy resources. In Italy cumulative installed wind capacity at the end of 2016 reached 9,410 MW, distributed in 3.598 wind plants, the majority (89%) of which were small in size (< 1 MW). During 2016, wind energy accounted for roughly 16.8% of the total renewable electricity production, a value equal to 17.689 GWh. Of this, only 3% was produced by small size plants (< 1 MW) and 6% by medium size plants (> 1 MW and < 10 MW) while the remaining 91% was produced by large size plants (> 10 MW).

Grid Capacity. Terna is the sole transmission system operator (TSO) of the national high-voltage grid (380 kV - 220 kV - 150 kV), also responsible for planning and developing the National Transmission Grid (NTG). The company approves and carries out development measures on the NTG based on a ten-year plan approved each year by the Ministry for Economic Development “the Grid Development Plan”. In the long run, there will be nearly 4,600 km new electricity lines and 111 new transforming stations built. The overall Grid transformation capacity will increase by 22,458 Mega VoltAmpers (MVA).

Wind power has been important for the need for more grid capacity in Italy. For example, from 1998-2008 more than 90% of requests for connection to the national grid were associated with new turbine arrays (Oles and Hammarlund, 2011).

Lazio

Basic facts (location, size, population). Lazio is the second most populated and ninth largest region of Italy, with a population of 5,898,124 (2017), mostly concentrated in the Metropolitan City of Rome (4,353,738), an area of 17 242,29 km² and a population density of roughly 342 ab./km². It is divided into 5 provinces and located in the centre of Italy and it has borders with Tuscany, Umbria and Marche (N), Abruzzo, Molise (E), Campania (S) and it faces the Tyrrhenian Sea (W). The Region also includes the Pontine Islands off the southern coast.

Figure 3.2.1. Geographical location of Lazio Region

Topography. Most of Lazio's landscape is flat or hilly with some mountainous areas found in its most eastern and southern parts. Next to the border with Abruzzo, the Appennino Laziale contains the highest peaks of Lazio (> 2000 m). The coast of the Region is mainly characterized by sandy beaches occasionally interrupted by headlands (< 600 m).

Figure 3.2.2. Topography of Lazio

Local Energy Resources. The regional energy balance report[64] suggests that in 2014 Lazio was characterised by an almost fully dependent on imports (91,7% of Gross Internal Consumption, GIC) and in the same year the most important energy sources were oil products (45.3%), solid combustibles (21,6%), and gas (20,3%), all imported. Primary production (8.9% of GIC) almost exclusively concerned renewable energy (92,5%), which is also the only source exported.

Table 3.2.1. Energy Balance (ktep) 2014, Lazio[65]

	Tot (ktep)	Solid Combustibles	Oil	Oil Products (derivates)	Gas	Renewable Energy*	Non-renewable Waste	Electric Energy
Primary production	1.230	0	0	0	0	**1.138**	92	0
Import balance	11.675	2.747	0	5.806	2.591	**132**	50	349
Export balance	136	0	0	0	0	**136**	0	0
Gross Internal Consumption	12.729	2.747	0	5.766	2.591	**1.134**	142	349

In 2016, solar energy accounted for most of the total renewable energy production (65.2%), followed by hydraulic energy (21.3%) and bioenergy (10.7%), with wind energy being the least developed (2.7%).

[64] RAEE Energy Efficiency Report ENEA, 2017
[65] http://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/raee-2017.pdf

Table 3.2.2. Number and power of RES plants in Lazio at the end of 2016.

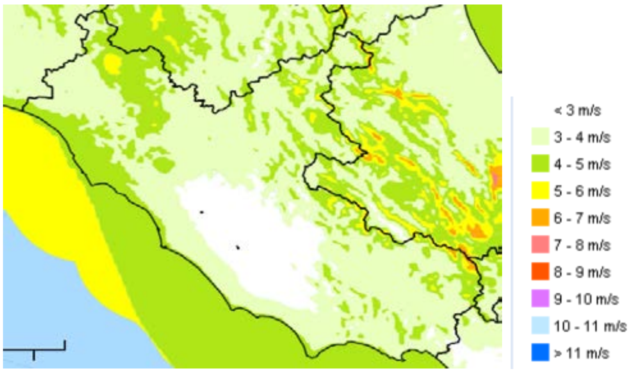
	Hydraulic	Wind	Solar	Geothermic	Bioenergy	Total
N° of plants	83	**46**	46.718	-	109	
MW	405,7	**52,2**	1.238,8	-	203,8	1900,6

Source: GSE, Terna

Wind Energy Resources and Potential. In 2016, Lazio had a total installed wind energy capacity of 52.2 MW distributed in 46 plants with which it produced 97.4 GWh (Terna). ANEV (Associazione Nazionale Energia del Vento) estimates a total installed capacity of 750 MW by 2030, with relative production of 1.58 TWh. This corresponds to the generation of up to 3400 additional jobs in the region. The GSE (Gestore Servizi Energetici) provides a conservative estimate in the increase of installed capacity of 65 MW by 2020 and of 100 MW by 2050, which results in a techno-economic potential for total installed capacity in Lazio of 170-190 MW, translating in 330 GWh/year of electric producibility. If we add the conservative estimates of off-shore potential (325 GWh/year) these figures reach 250 MW and 650 GWh/year.

To assess the potential for wind energy development in Lazio, it is useful to refer to the 'Atlante Eolico Interattivo' produced by RSE (Ricerca Sistema Energetico), which reveals the macro-areas with higher estimates of average wind speed per year and specific producibility at the regional level (Fig. 3 and 4). The overall wind energy potential is thus the sum of the specific producibility of each regional cell with a producibility value higher than 1500 MWh/MW, subtracting all areas that are interested by restrictions.

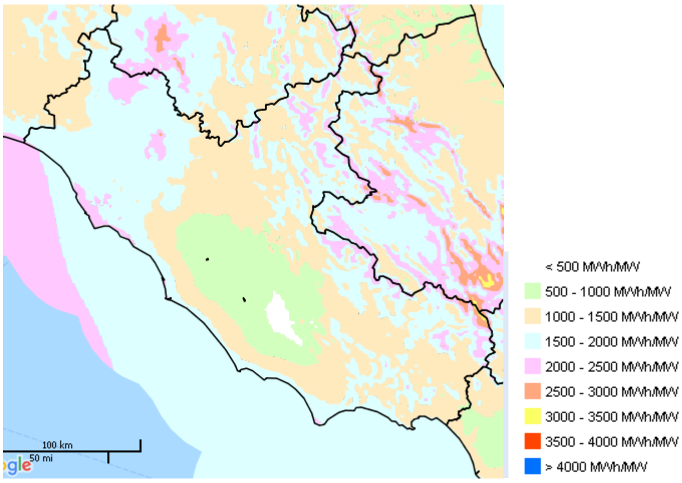
Figure 3.2.2. Average yearly wind speed at 75 s.l.t/s.l.m – Lazio.



Source: ATLAEOLICO[66]

[66] http://atlanteeolico.rse-web.it/

Figure 3.2.3. Specific producibility at 75 s.l.t/s.l.m – Lazio.



Source: ATLAEOLICO[67]

Restrictions on Land Use. Plant installation is forbidden in the following areas:

- Urban areas;
- Regional and National Parks;
- ZPS (Zone di Protezione Speciale)
- Appennine areas > 1200 m

These land use restrictions have been considered in the mentioned estimates for wind energy potential.[68]

Abruzzo

Basic facts (location, size, population). Abruzzo is the thirteenth largest region of Italy with an area of 10 831,84 km², it has a population of 1,322,247 with a relatively low density of roughly 121 ab./km². It is located in the centre-east of the peninsula, has borders with Marche (N), Lazio (W), Molise (S) and faces the Adriatic Sea (E). It is divided into 4 provinces.

[67] http://atlanteeolico.rse-web.it/
[68] www.regione.lazio.it

Figure 3.2.4. Geographical location of Abruzzo Region

Topography. The landscape of Abruzzo is mainly characterised by mountainous (65.1%) and hilly (34.9%) areas gradually downgrading towards the coast. The Appennino Abruzzese hosts the highest peaks of the whole mountain range, well above 2500 m.

Figure 3.2.5. Topography of Abruzzo

Local Energy Resources. The regional energy balance report[69] suggests that in 2014 the primary production in Abruzzo covered only 24% of gross internal consumption. The region was capable of producing the majority of renewable energy it consumed (75.2%) as well as a relevant portion of gas (16.9%), since it holds a considerable number of gas deposits.

[69] RAEE Energy Efficiency Annual Report ENEA, 2017

Imports are crucial as they covered 76.1% of Gross Internal Consumption, mainly in the form of gas (38.2%) and oil products (43.8%), but also renewable energy (8.85%).

Table 3.2.3. Energy Balance (ktep) 2014 – Abruzzo[70]

	Tot (ktep)	Solid Combustibles	Oil	Oil Products (derivates)	Gas	Renewable Energy*	Non-renewable Waste	Electric Energy
Primary production	663	0	0	0	160	491	12	0
Import balance	2.046	1	0	897	783	181	8	175
Export balance	19	0	0	0	0	19	0	0
Gross Internal Consumption	2.689	1	0	897	943	653	20	175

In 2016, of total renewable energy production, hydraulic energy accounted for more than half (50.4%), followed by solar energy (35.6%) and wind energy (11.6%), with a limited contribution being given by bioenergy (1.6%).

Table 3.2.4. Number and Power of RES plants in Abruzzo at the end of 2016. Sources: GSE, Terna

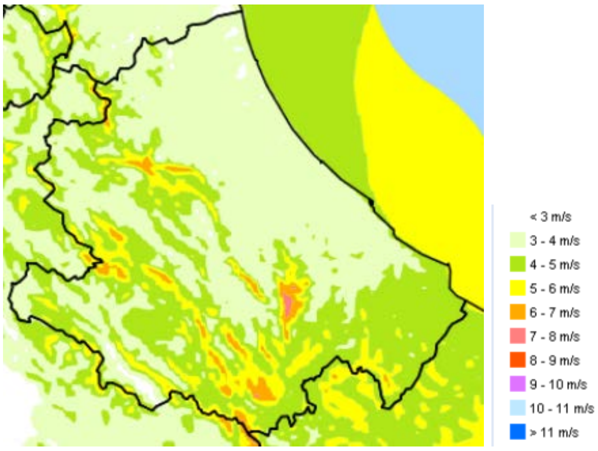
	Hydraulic	**Wind**	**Solar**	**Geothermic**	**Bioenergy**	**Total**
N° of plants	66	40	18.315	-	38	17.438
MW	1.011,3	232,0	714,5	-	31,7	2.005,4

Wind Energy Resources and Potential. In 2016, Abruzzo had a total installed wind energy capacity of 232.0 MW distributed in 40 plants with which it produced 372.4 GWh (Terna).

To assess the potential for wind energy development in Abruzzo, it is useful to refer to the 'Atlante Eolico Interattivo' produced by RSE (Ricerca Sistema Energetico), which reveals the macro-areas with higher estimates of average wind speed per year and specific producibility at the regional level (Fig. 3 and 4). The overall wind energy potential is thus the sum of the specific producibility of each regional cell with a producibility value higher than 1500 MWh/MW, subtracting all areas that are interested by restrictions.

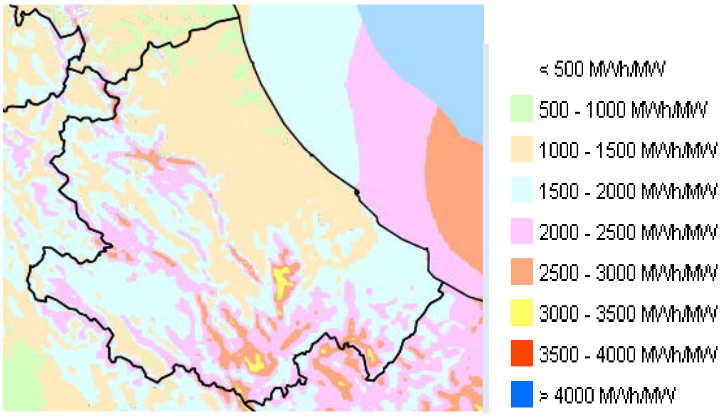
[70] http://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/raee-2017.pdf

Figure 3.2.6. Average yearly wind speed at 75 s.l.t/s.l.m – Abruzzo.



Source: ATLAEOLICO[71]

Figure 3.2.7. Specific producibility at 75 s.l.t/s.l.m – Lazio.



Source: ATLAEOLICO[72]

Restrictions on Land Use. Installation of wind turbines in 'Off-limits Areas' is completely forbidden. These include:

- natural reserves,
- national or regional parks,
- areas located on migratory routes,
- archaeological areas,
- urban areas.

[71] http://atlanteeolico.rse-web.it/
[72] http://atlanteeolico.rse-web.it/

In Critical Areas, installation is subjected to specific conditions such as extensive studies on the existing fauna and impact analyses of wind turbines. These areas again mainly coincide with natural reserves and national or regional parks.[73]

3.2.2 Regulatory framework

Laws and Regulations. The following table gives an overview of important *laws and regulations* at the national level in Italy.

Table 3.2.5. Overview of selected laws and regulations at national level

Laws and regulations concerning authorisation procedures	
Legislative Decree No 387 of 29 December 2003 (transposition of Directive No 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market)	It regulates the construction and operation of plants producing electricity fuelled by renewable sources, interventions for their modification, development, total or partial reconstruction reactivation and associated works and infrastructures. It establishes that the construction and operation of said installations shall be the subject of a single authorisation issued by the region or another institutional body delegated by the region, in accordance with the regulations in force concerning the protection of the environment, the countryside and historical and artistic heritage. For this purpose, the Conference of Services* shall be convened by the region within thirty days from receipt of the application for authorisation. This single authorisation automatically constitutes a variant of all urban planning instruments and title of expropriation. * Decision Conference ex art. 14, c. 2 L. 241/90, as modified by D.Lgs. n. 127/2016.
Ministerial Decree 10 September 2010 "Guidelines for the authorization of plants powered by renewable sources".	The National guidelines approved by the Ministry of Economic Development clarifies the authorization procedures to be applied to renewable energy plants which represent a reference in the formulation of regional scale guidelines. Referring primarily to wind farms, the guidelines set out the criteria by which Regions should identified measures to delimit areas for specific plant types and to define compensatory measures.
Legislative Decree No 28, 3 March 2011 (transposition of Directive 2009/28 / EC on the promotion of energy from renewable sources and amending and subsequently repealing Directives 2001/77 / EC and 2003/ 30 / EC)	This Decree introduces further simplification for the authorisation of renewable energy producing plants.

[73] www.regione.abruzzo.it

Laws and regulations concerning authorisation procedures englobed in the Single authorization of the Legislative Decree 283/2003	
Legislative Decree Law 152/2006 „Code on the Environment “	This Legislative Decree approves the Code on the Environment which sets out the legislative framework applicable to all matters concerning environmental protection.
Cultural Heritage and Landscape Code, Law 42/2004 and Amendments. Presidential Decree n. 327 of 8 June 2001	The “Unified law on cultural and landscape heritage”, known as the “Code on cultural and landscape heritage sets the objectives of protecting, conserving and valorising the architectural and landscape heritage in the Italian territory. The Code protects landscape assets, defined as territory that is expressive of the Italian identity and whose character derives from both natural and man-made factors. The Code lists landscape areas that are to receive legal protection as cultural property in Italy.
Presidential Decree No. 32 on 8 June 2001	Single Text on the laws and regulations with regards to expropriation for public convenience.
Energy policy targets and strategies	
National Renewable Energy Action Plan (NREAP) 2010	According to Directive 2009/28/EC, 17% of Italy’s final energy consumption must be supplied by renewable sources by 2020. In June 2010, in compliance with the directive, Italy submitted its National Renewable Energy Action Plan (NREAP) to the European Commission. The plan identified sectoral targets and measures for achieving them.
National Energy Strategy (NES) 2017	NES 2017 lays down the targets to be achieved by 2030, in accordance with the long-term scenario drawn up: strengthening supply security; narrowing the energy price gap; furthering sustainable public mobility and eco-friendly fuels. A major role is reserved for renewable energies, and new targets are fixed for 2030: reaching a 28% share of renewables in total energy consumption and a 55% share of renewables in electricity consumption.
Recent renewable energy support schemes	
Ministerial Decree (MD) of 6 July 2012 Feed-in premium for renewable energy sources other than photovoltaic	This Ministerial Decree introduced a support mechanism to replace all other types of support for non-solar RES- such as the Green Certificates. For each technology, there is a feed-in tariff for small installations and a sliding-scale feed-in premium system for larger installations.
Ministerial Decree (MD) of 30 June 2016: Feed-in premium for renewable energy sources other than photovoltaic	This Decree updates the support mechanism for supporting electricity generation by RES-E plants (other than photovoltaic ones) that were grated through the previous Ministerial Decree of 6 July 2012.

Institutions with jurisdiction. The Ministry of Economic Development (MSE) is responsible for formulating and implementing Italy's energy policy. The Ministry for the Environment, Land and Sea (MATTM) is responsible for co-ordinating climate policy issues. It co-signs policy measures promoting renewable energy and energy efficiency with the MSE.

The responsibility for energy policy is shared between the Government and the Regions. Legislative Decree No 112/1998 made the Regions responsible for the administrative duties relating to energy, including renewable sources, electricity, oil and gas, which were not reserved for the state or assigned to local authorities. Under Constitutional Law No 3/2001, the state has legislative power within the renewable energy sector, while the Regions have administrative power.

MATTM is also responsible for issuing some permits (including the IPPC permit) and undertaking Environmental Impact Assessment (EIA) and SEA assessments in relation to plants, installations and projects falling under the government's competence. It is also responsible for bringing environmental damage claims.

The Ministry of Cultural and Landscape Heritage provides feedback in administrative proceedings concerning cultural and landscape aspects and impacts. Together with MATTM, it is responsible for the performance of some EIAs falling under state competence.

The Regulatory Authority for Energy, Networks and Environment (ARERA) has a number of responsibilities regarding renewable energy, such as ensuring fair grid access conditions or allocating support to face renewable energy costs to different consumer groups.

Gestore Servizi Energetici (GSE) promotes the development of RES, manages payments of economic incentives, forecasts and aggregates the production of renewable energy power plants. This also includes the sale of renewable power on the electricity market and supporting policy makers with analysis. GSE is organised as a private company with a sole shareholder, the Ministry of the Economy and Finance (MEF), which exercises its shareholder rights together with the MSE that is responsible for operational guidelines.

Terna is responsible for high-voltage electricity transmission and dispatching throughout the national territory and the realization of ten years "Grid Development Plan".

Renewable energy support schemes. On 30 June 2016, a new Ministerial Decree that established the mechanism for achieving renewable energy goals entered into force. It provides incentives for electricity production from renewable energy sources other than photovoltaic (PV). The new incentives are estimated to amount to approximately €9 billion for the next 30 years. Similar to the previous decree, the new Decree provides for three different methods to access the incentives, depending on the type and size of the RES project:

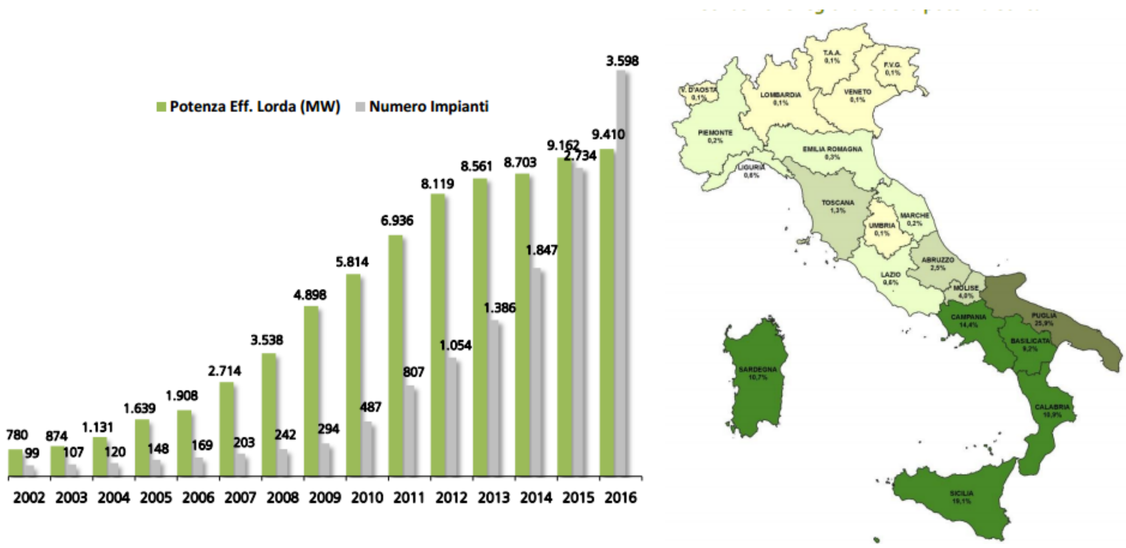
- Direct access for micro plants.
- Access through a register and a ranking system based on priority criteria.
- A reverse auction process.

While the allocation of incentives for micro plants with direct access is made on a first-come-first-served basis irrespective of the type of RES plant, the new decree provides for capacity caps on incentives accessed through the register and reverse auction process, showing a clear preference for onshore wind projects > 5 MWp.

Between 2009 and 2012, the growth of RES in the electricity sector has been supported by different support mechanisms. Italy previously had a tradable Green Certificates scheme, which required utilities that did not produce sufficient energy from renewable sources to purchase certificates from those that do. Italy has also had a high feed-in tariff scheme for all RES other than PV and with a capacity up to 1.0 megawatt (MW) and 200 kilowatts (kW) for wind. Most of these schemes have expired and been replaced by the feed-in tariff and feed-in premium system (MD of 6 July 2012 and MD of June 2016).

The effects of the different support schemes are shown in following figure. The Wind Energy Sector is the most incentivised renewable energy source (1,49 billion €), with incentivised plants accounting for 92% of total operating capacity at the end of 2016.

Figure 3.2.8. Evolution of wind energy plants and capacity in Italy and regional distribution of installed capacity in 2016.



Source: GSE

The evolution highlights the progressive growth of the wind energy sector, with a diminishing average plant size from 2015 to 2016.

Tax policies. A "parafiscal" system, the so-called "system charges" (component A3 of the electricity bill), is used to finance policies concerning renewable energy. Their annual amount is not identified in a financial law nor is it subject to parliamentary procedure, but it is managed outside the state budget by GSE under the control of ARERA. In the last two years, the annual amount for promoting renewable energy sources was about 15 MLD euro.

Licensing process for wind energy projects. Authorization regimes for installations producing electric energy from RES are regulated under Legislative Decrees 387/2003, Ministerial Decree 10 September 2010 and Legislative Decrees 3 March 28/2011. No concessions for electric production have been established since the beginning of the process of liberalization of the energy market.

The authorisation procedure is followed by the Regional Authority competent in the energy sector. For simplified authorization regimes (PAS and Communication) the body holding authority is the Municipalities (Comune). Opinions and authorizations concerning all other interests (landscape, health, territorial and environmental protection) converge, subordinately, into the single authorization procedure (Conference of Services procedure). For renewables plants the single authorization operates in exemption of urban plans, it is a variation of all urban instruments and also constitutes title of expropriation.

In the general procedure (Legislative Decrees 387/2003), the public is not involved. Where a VIA procedure is requested for the installation of the plant, the public is involved following the rules described in the procedure itself. Nevertheless, the regions can establish procedures for public consultation.

Land use planning. No land use planning for what concerns wind plants localization is envisaged in Italy. Although Regions can identify areas not suitable for the installation of wind turbines (Regional guidelines), such identification is not legally binding.

Impact assessment regulations. Legislation regarding the Environmental Impact Assessment (EIA) is based on the European guidelines for such assessments. The EIA praxis is regulated by the Legislative Decree n. 152/2006. For installations generating electricity from renewable sources which are subject to an EIA, the administrative competences for almost any type of plants are conferred to the Regions or Provinces delegated by the Regions.

3.2.3 Socio-economic conditions

Statistics/surveys on the perception of wind energy/renewables. The following table shows that the degree of trust of Italian people in energy source (source preferences) is prevalently oriented to the solar and wind energy sectors.

Table 3.2.6. Degree of trust of Italian people in energy[74]

Year 2017	**%**
Solar	86
Wind	66
Hydropower	33
Nuclear	5
Biomass	15
Gas	6
Geothermal	25
Oil	2

Statistics/record of opposition and/or citizen protest against wind energy projects. The *Osservatorio Media Permanente del Nimby Forum* has collected useful data on the number of plants that have been contested in Italy. The Observatory, having analysed news articles from 2004 onwards, find that contestation is particularly concentrated in two sectors: the energy sector and the waste sector. The energy sector includes plants for the production of electric power from conventional and renewable sources, electric and gas storage infrastructure, transport infrastructure and hydrocarbon research and extraction projects. The waste sector includes waste-to-energy plants, incinerators, composting plants, solid urban waste landfills and special waste landfills. The following table includes data from all 342 electric generation plants that have been registered as contested in 2015.

Table 3.2.7. Contested Electric Energy Production plants.

Electric Energy production plants	N°	%
Renewable Energy plants	189	77.5%
Conventional plants	55	22.5%
Total	244	100%

Source: Osservatorio Media Permanente Del Nimby Forum

Regarding renewable energy, the absence of contestation related to PV plants is absent, while contestations of hydro and wind energy plants are quite significant.

The rapid expansion of wind energy helps to explain such contestation. Politicians and citizens have had heated discussions about the role of wind power in Italy's renewable energy strategy (Oles and Hammarlund 2011). The environmental and preservation movements disagree about the need for wind power: To meet climate targets the largest environmental advocacy group (Legambiente) supports further development of wind power. In contrast, heritage groups (e.g. Italia Nostra, Comitato Nazionale del Paesaggio) have organised national campaigns to ban wind energy projects,

[74] Univerde-IPR Marketing Report (XV Report "Italians, solar energy and green economy" 2017)

frequently quoting the Constitution’s Article 9 (Oles and Hammarlund 2011). This Article enshrines protection of the landscape and the historical and artistic patrimony of the nation as a fundamental responsibility of the state.

Another issue is the series of investigations and arrests for corruption in the wind energy sector. Wind turbines have become symbols of political and economic corruption and regional and local officials have called for a stop in wind power development to combat corruption (Oles and Hammarlund 2011). Organised crime in the wind sector has been particularly prevalent in Sicily, where the Mafia has bribed local officials to circumvent planning processes and environmental review (Oles and Hammarlund 2011). International energy companies (e.g. International Power, E.ON and EDF) have bought most of the turbines that are related to issues with the Mafia (Oles and Hammarlund 2011).

Statistics on number of jobs in renewable energy/wind energy sector. In Italy cumulative installed wind capacity at the end of 2016 reached 9,410 MW, distributed in 3.598 wind plants, the majority (89%) were small in size (< 1 MW). During 2016, wind energy accounted for roughly 16.8% of the total renewable electricity production, a value equal to 17.689 GWh. Of this, only 3% was produced by small plants (< 1 MW) and 6% by medium size plants (> 1 MW and < 10 MW) while the remaining 91% was produced by large size plants (> 10 MW).

In 2016, the economic impact of wind energy in Italy was an estimated 3.7 billion EUR (3.9 billion USD). This value represents the overall contribution of three different business areas: new installations, operation and maintenance (O&M) of the online plants, and energy production and commercialization. ANEV reports that the number of jobs in the wind energy sector totalled 26,000 units (including direct and indirect involvement).[75]

In Abruzzo, ANEV (Associazione Nazionale Energia del Vento) estimates a total installed capacity of 700 MW by 2030, with relative production of 1.47 TWh, which would generate up to 2500 additional jobs in the region.

Economic role of tourism. Tourism is a significant sector in Italy’s national economy. The government has focused efforts on this sector in its government policy for economic development. Many of Italy’s major tourist destinations are historic places, often protected as world heritage sites. In 2015, the value-added produced by tourism-related industries was 87.823 million euros, 6.0% of total value-added of the economy. Internal tourist consumption was equal to 143.334 million euros. The majority, 43.9%, was generated by Italian tourists whereas foreign tourism accounted for 32.9%. In 2015, foreign tourists spent more than 48 billion euros in Italy, whereas Italians spent roughly 24 billion euros in travels abroad.

[75] IEA Wind TCP Annual Report, 2016

3.3 Latvia

With the exception of a few coastal communities situated in the Kurzeme region, the whole Latvia can be considered almost entirely as a wind energy scarce region (WESR). The total supply of electricity in Latvia in 2016 was 6958 GWh and wind energy contributed less than 2% of this figure. Currently, only 70 MW on-shore wind energy capacities operated in 2016 (data from the Central Statistical Bureau of Latvia; CSBL).

3.3.1 Technical conditions

The following table provides basic facts about location, size and population in Latvia.

Table 3.3.1. Basic facts on Latvia

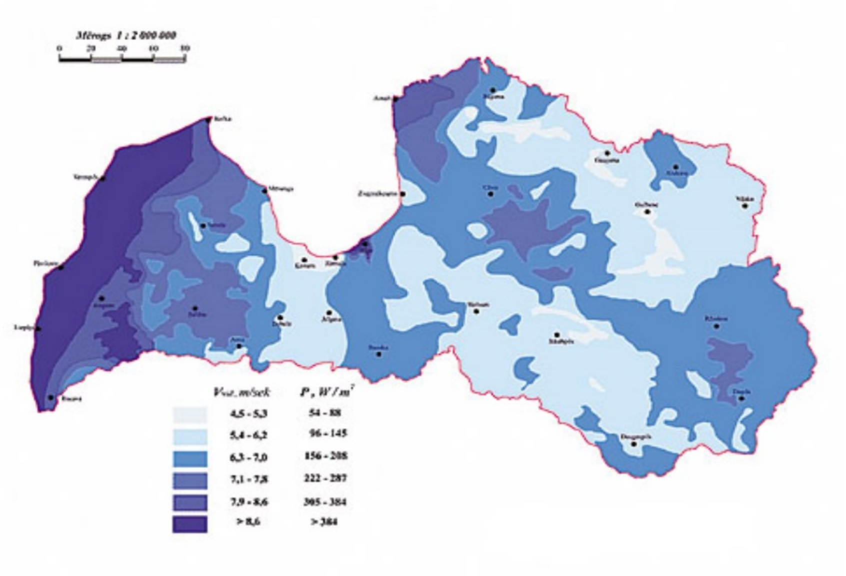
Area, in km^2		**Population, number on 01.01.2017**	
Total	64573	**Total**	1950116
Land	62113	**Urban**	1332546 (68.3%)
agriculture land	23358	*in cities (9 cities including capital)*	*1009446*
forest land	30662	*in towns – regional development centers (21 centers)*	*197801*
inland water	2460	*in other towns (46 towns)*	*125299*
naturally protected areas	12790	**Rural**	617570 (31.7%)
Regions			
Area	**km2**	**Population, number and shares of total Latvia, on 01.01.2017**	
		in capital city Riga	641423 (32.9%)
Riga planning region (PR)	10439	In Riga PR (without capital city)	364954 (18.7%)
Kurzeme PR	13607	In Kurzeme PR	246317 (12.6%)
Zemgale PR	10732	In Zemgale PR	235417 (12.1%)
Vidzeme PR	15245	In Vidzeme PR	191794 (9.8%)
Latgale PR	14550	In Latgale PR	270211 (13.9%)

Demographic characteristics. At the beginning of 2017 the population density in Latvia was 30 people per km^2. The population density fluctuated between around 4 persons per km^2 (*Rucava* municipality in South Kurzeme and *Rugāji* municipality in Latgale region) up to 2110 people per km^2 (capital city *Rīga*), but in the municipalities near *Rīga* (*Stopiņi* municipality) it was 194 people per km^2. We also calculated population density for rural inhabitants only: when not taking into account inhabitants in towns and cities, the rural population density varies from 6.6 rural inhabitants per km^2 (in Kurzeme region) up to 18 rural inhabitants per km^2 (in the Riga planning region). The average for Latvia is 9.6 rural inhabitants per km^2. Thus, Latvia may be considered as a sparsely populated country. There is a change of population over last decade: population increases in the capital city Riga and in the municipalities of its vicinity (50-70 km) but decrease in other municipalities[76].

One of Latvia's characteristics is the large number of farmsteads/country homes. Thus, the wide placement of farmsteads limits the areas in which wind stations and wind parks might be placed considering the normative regulations on wind stations and wind parks distances (see Table 3.3.3 below) from rural buildings.

Wind energy resources and wind energy potential. The coast of the Kurzeme region can be considered as large enough to be an active wind zone and is sparsely populated. However, certain restrictions due to the Natural Protection Areas as well as potential contradictions with tourism sector interests should be noted. Also, particular zones in other regions can be considered as suitable for wind energy, taking into account up-to-date on-shore wind technologies. Analysis of data, provided by the national CSB indicates that there has been 1946 hours of full load annual average produced (generated electricity *versus* installed capacity) for the last 5 years, 2012-2016.

Figure 3.3.1. Latvia wind speed, annual average at 100 metres high[77]

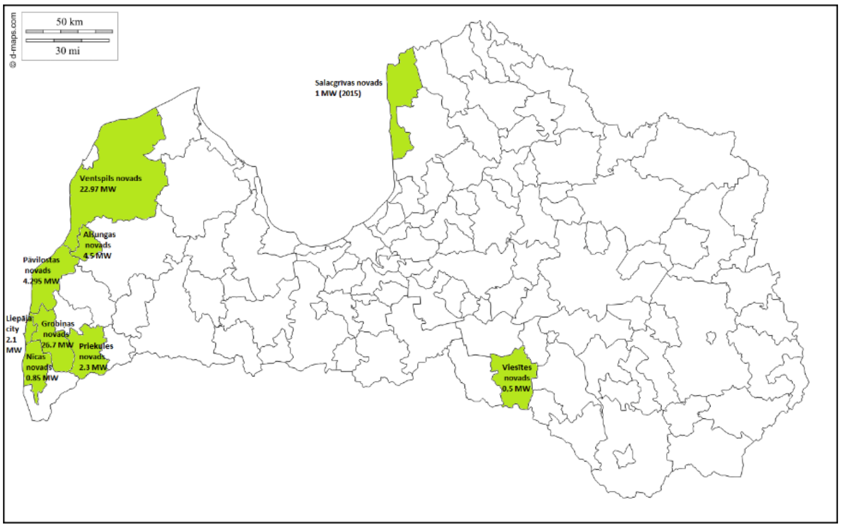


[76] Source: Ex-post evaluation of Rural Development Programme 2007-2013, report done in December 2016, submitted by Elita Benga, Head of Division of Rural Development Evaluation of AREI EPC).

[77] http://www.windenergy.lv, figure from national Energy Policy Strategy 2016-2020, p.20.

Wind power in Latvian regions and municipalities. Only 10% of the 119 Latvian municipalities have at least some installation of wind energy with the dominating areas of the Latvian wind energy capacities situated in only two municipalities of the Kurzeme region: Ventspils novads (~23 MW) and Grobiņas novads (26.7 MW), see Figure 3.3.2. in which the capacities receiving feed-in payments are presented based on data provided by the Ministry of Economics

Figure 3.3.2. Wind energy capacities in Latvian municipalities, 2016



Local energy resources. Latvia's target, according the Renewable Energy Directive 2009/28/EC is to reach 40% renewable energy in gross final energy consumption by 2020. The share of RES continues to grow to reach this target and in 2016 renewable energy sources constituted ~37 % in primary energy supply (respectively 68 PJ renewables and 185 PJ total). The shares of renewable sources in 2016 were as follows: solid biomass – 79.4%, hydropower – 13.4%, biogas – 5.5%, biofuels – 0.7%, wind energy – 0.7%, straw – 0.2%.

The most important local energy resource in Latvia is wood**.** In 2016, wood contributed approximately 29% of the total primary energy supply in Latvia. Forest coverage in Latvia is on average 49.5%. In Kurzeme and Vidzeme, as well as the Riga planning region, the forest coverage is greater than 50%. Despite potential availability of peat resources, peat currently plays a minor role in the energy supply and, due to the high environmental pressure from peat combustion, the peat utilisation wide programme is currently not under discussion.

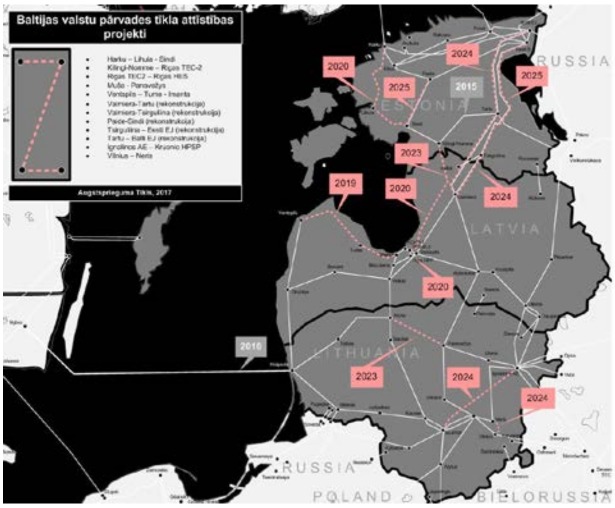
Table 3.3.2 presents the use of local resources for electricity generation. High importance source is large hydropower (hydro power plants cascade on the Daugava river).

Table 3.3.2. Use of resources for electricity production in Latvia in 2016

Resource	Electrical capacity, MW	Gross Electricity Production, GWh
Wind	70	128
Large hydro, above 10 MWel	1536	2467*
Small hydro	29	63
Solid biomass	81	427
Biogas	62	397
TOTAL RES	**1778**	**3482**
Natural gas (imported resource)	around 1150	2944
Electricity net import		1033
Data source: CSBL, Energy sector databases, http://data.csb.gov.lv/pxweb/en/vide/vide__ikgad__energetika/?tablelist=true&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0 Note: * - average long-term annual production is 2.7 TWh (Latvia TSO Report, 2017)		

Grid capacity. The power system of each of the Baltic States is small, thus they are strongly interconnected and historically have been integrated with the larger system – IPS/UPS of Russia and Belarus. Due to step-by-step developing of interconnections with European power network, the closing of interconnections (de-synchronisation) with Russian power system is under investigations. Synchronisation with European network might not be possible before 2025 (Latvian TSO report, 2017).

Figure 3.3.3. Development of the Baltic States' power network (according to the plans of the Baltic States' TSOs)



Source: Latvian TSO report, 2017, p.45

The backbone of the Baltic IPS is formed by 330 kV high-voltage power lines. The regional transmission network of the Baltic IPS consists primarily of 110 kV lines, with the exception of the Estonian power system, where 220 kV lines are also present.

Great efforts are paid to provide interconnection with Scandinavia and Germany (through Poland) power networks. Currently, the three Baltic States are interconnected with the Western European countries through four (plus one interconnector planned for 2020) electricity interconnectors.

Future strengthening of the electricity grid between Estonia and Latvia is planned. The capacity of Latvia-Lithuania interconnections is adequate in the interim.

The on-going development of the Latvian transmission network, namely the line “Kurzeme Circle” (“*Kurzemes loks”),* is one important factor in the development of wind energy in Latvia*.* It will provide the necessary infrastructure for the development of wind parks in the Kurzeme region, will connect the largest (central and western) power production-demand regions in Latvia and promote the increase of transit flow by “NordBalt” (Klaipeda – Nibo) interconnector.

According to the information provided by the Latvian Transmission System Operator (TSO), integration into Latvia’s power network of up to 800-1000 MW of wind capacity might be available in the near future. In its 2017 report forecasting the power production capacities development for the next decade, the Latvian TSO anticipates in its “optimistic scenario” the development of 455 MW wind power (both on-shore and off-shore) in 2027. Thus, grid capacity is not a limiting factor for on-shore wind development in Latvia. Also, adequate balancing capacities (CHP and hydro PP) are available.

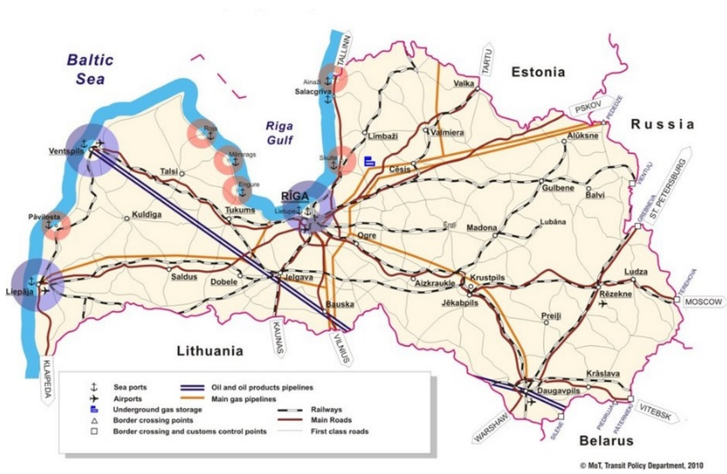
Topography/Geography. Latvia is a typical flat state (see Figure 3.3.4), located in the west of the great Eastern European plain, near the Baltic Sea. The highest relief point is 311.94 meters high Gaiziņkalns (in Vidzeme region). There are more than 12,000 rivers and more than 2,000 lakes in Latvia. Latvia is situated in the temperate zone and its climate is influenced by the proximity of the sea and the masses of air from the Atlantic Ocean, therefore Latvia has a mild and humid climate and a marked change of four seasons.

Figure 3.3.4. Physiographic map of Latvia

Infrastructure. Historically Latvia has a good density of road infrastructure**.** The road network provides connections of any settlement to the nearest administrative centre, connects amongst administrative centres and connects administrative centres with the capital city Riga. The most intensively loaded are state roads, particularly, state main roads. However, in general, the technical condition of both state roads and, particularly, municipal roads are non-satisfactory.

Historically, the Latvian rail road system was built to connect inner regions of Russia (USSR) with Latvian harbours. A common rail system with a track width of 1520 mm and a unified system for the organization of rail freight transport provide today the CIS, as well as Asian countries, with direct access to Latvian ports in the European Union.

*Figure 3.3.5. Latvia infrastructure map**



**Map is indicating the rail road between Liepāja – Ventspils cities; however, this infrastructure was disassembled in 1996.*

Thus, regarding Kurzeme region where the greatest wind energy potential is indicated, the railroad infrastructure is available among the capital city Riga and regional cities: Rīga - Liepāja and Rīga – Ventspils, and also from regional cities to the eastern border of Latvia passing round Riga. However, there is no rail available along the coast that connects both regional cities Liepāja – Ventspils

The transit and logistics sector is well developed in Latvia and efficient and competitive package of services are provided by ports, railway, road haulage, customs warehouses and brokers, logistics centers as well as ship agents, freight forwarders and oil and oil product pipelines.

LCA analysis. There are no data available on CO_2 emissions intensity based on LCA calculations in Latvia. CO_2 emissions intensity is therefore calculated based on only those emissions that occur during a specific process, i.e. just the combustion of a fuel, without considering the upstream and downstream emissions. Thus, below the indicator "CO_2 emissions intensity" is understood as the absolute amount of CO_2 emissions per unit of energy and we provide the values of this indicator for both primary energy consumption and electricity production in Latvia.

Wider utilisation of renewable energy sources has contributed in the increase of renewables' relative share in the primary energy consumption thus resulting in the decrease of CO_2 emissions intensity of primary energy. During last 5 years the noted indicator has decreased by 12% and in 2015 constituted 0.14 tons of CO_2 emissions per MWh of primary energy.

Considering the large contribution of hydropower, Latvia has historically low CO_2 emissions intensities from electricity production in comparison to many other states. During last 10 years the average CO_2 emissions intensity of electricity production in Latvia is 0.101 tons of CO_2 emissions per MWh of produced electricity.

3.3.2 Regulatory framework

Institutions with jurisdiction. There is a national and a municipal level (since 1 July 2009). There are 110 municipalities (*Latvian: novadi, plural*), with 9 metropolitan areas, which has the status of republican cities (*republikas pilsētas*) with their own city council and administration. There are currently no regional self-governments in Latvia**.** However, there are special regional authorities, planning regions (*Latvian – plānošanas reģioni),* which have the status of a derived public person. The planning region ensures regional development planning, coordination, cooperation between the local governments and other state/public administration institutions. There are five planning regions in Latvia.

Figure 3.3.6. Territory of Latvia Planning Regions

Relevant institutions with jurisdiction are included in the following table.

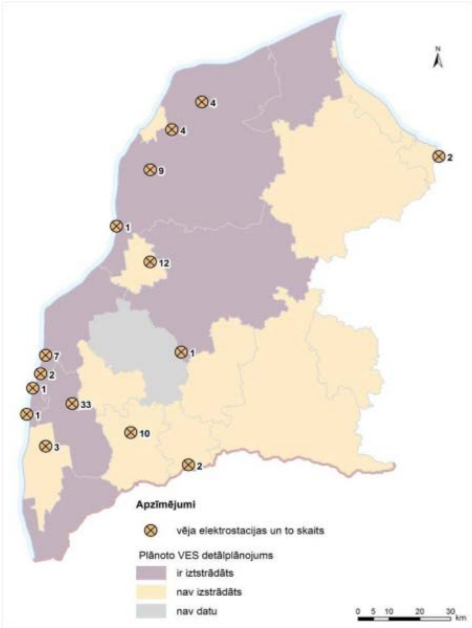
Table 3.3.3. Institutions with jurisdiction

Ministry of Environmental Protection and Regional Development (MEPRD)	Ministerial departments most related to onshore wind energy development: Climate Change Department, Environmental Protection Department (includes responsibility for EIA legislation), Nature Protection Department, Spatial Planning Department, Regional Policy Department Institutions supervised by MEPRD: State Environmental Bureau (including performing EIA of intended activities according to the legislative requirements); State Environmental Service (structural units: Central Unit and 8 regional Environmental Boards, the areas of Regional Boards do not comply with the area of planning regions); Nature Conservation Agency; Consultative councils of the MEPRD (particularly Environmental Consultative Council involving the NGOs related to environment)
Ministry of Economics (ME)	Ministerial departments: Sustainable Energy Policy Department; Energy Market and Infrastructure Department; Energy Policy Administration Department Supervised by ME: Investment and Development Agency of Latvia (among others, the Agency implements state tourism policy and promotes development of tourism as a sector of national economy)
Ministry of Culture, National Heritage Inspection	

Public Utilities Commission (PUC)	The PUC is a government institution – regulator. Electricity producers, which have received the permit for electricity production, after starting the service shall mandatory register in the Electricity Producers Register and regularly provide information to the Regulator in accordance with normative regulations.
State Construction Control Office	Ensures among others performing control of construction work and acceptance for services of those structures for the construction of which the EIA procedure has been applied
Power Transmission and Distribution	National Transmission system operator SC "Augstsprieguma tīkls" and distribution system operator JSC "Sadales tīkls"
Latvian Association of Local and Regional Governments	The LALRG functions as a representative, advocate and advisor of the local governments in Latvia and Europe. Organisation contributes to the development of municipal policies, solve common problems and defend interests of local governments.
Other relevant organisations (NGOs)	Association of Latvian coastal self-governments; Latvian Country Tourism Association "Lauku ceļotāj"
Local level	City or municipal councils composed of elected councillors; Construction management authority (*Latvian – būvvalde*) - is a local government authority or unit or an authority established by several local governments.

Land use planning. The local governments develop, approve, coordinate and monitor the implementation of the municipal sustainable development strategies, development programs, spatial plans, local planning, detailed plans and thematic plans. Local municipalities draft proposals for the development of national and regional development planning documents.

Figure 3.3.7. Map of the municipalities that have developed a RES local planning document



4.3.1.attēls. **Pašvaldības, kurās izstrādāts plānoto VES detālplānojums** (izstrādājusi autore, izmantojot veiktās aptaujas datus; 2. pielikumu; GIS Latvija 10.2 telpiskos datus)

Information from Maija Bumbiere, bachelor thesis "Wind power stations in Latvia: discourses and practice in the Kurzeme Planning region", 2016 Riga. (ir izstrādāts – developed, nav izstrādāts – not developed, nav datu – no data)

Territory planning includes land use planning, urban planning, transport planning, landscape planning, detail planning, etc. It refers to activities that directly affect and plan the physical structure and environment of populated areas and local communities (and thus are different from economic and social planning activities). The zoning of renewable energy areas could be developed as one of the thematic plans, however such a plan, as well as a separate energy sector development plan, is not mandatory.

Figure 3.3.7 shows in which municipalities of the Kurzeme region the zoning of potential sites for wind power plants was done in Spring 2016.

Restrictions on land use include considerations related to national parks, natural reserves, cultural heritage, tourism, military/defence interests, etc.

One important regulation is the Cabinet of Ministers Regulations No 240 (adopted 30 April 2013, in force 22 May 2015) “General Regulations for the Planning, Use and Building of the Territory” (issued pursuant to the *Spatial Development Planning Law).* Two important articles are Article 161 and 162:

- Article 161: It shall be allowed to place wind power stations, the power of which is more than 20 kW, in an industrial building territory, technical building territory and agricultural territory or in the places indicated in the spatial plan and local plan.

- Article 162: The territories where construction of wind power stations is prohibited may be laid down in the spatial plan or local plan.

One important aspect is the location distances for wind power stations, which affect all on-shore wind energy sector development.

- Article 163: Upon planning, the layout of such wind power stations whose power is more than 20 kW, the following provisions shall be conformed to the distances, as presented in Table 3.3.4. The regulation specifies differentiated distances for wind power stations and wind parks.

Table 3.3.4. Normative defined minimal distances for wind power stations and wind parks

Wind power stations shall be placed no closer than within the distance. *The distance of the wind power station shall be determined from the wind power station tower*	
Type of distance	**Distance**
from each other	of three rotor diameters
to the residential houses of the rural area	500 metres
to a dense residential building and public building existing or planned in the territories of villages and towns	1000 metres
to *NATURA 2000* territories and micro-reserves which have been set for the protection of bird species	2000 metres
to other *NATURA 2000* territories;	500 metres
a wind farm shall be placed not closer than within the distance *a border of the wind farm shall be determined from the outside projection of the wind power station tower*	
to the residential houses of the rural area	five times larger than the maximum height of the wind power station
to a dense residential building and public building existing or planned in the territories of villages and towns	2000 metres
from a health resort territory	2000 metres

Laws and regulations. See the following tables for an overview.

Table 3.3.5. Overview of selected laws and regulations at national level

Energy sector	
The Energy Act	It includes among other provisions on Licensing and Registration of Energy Supply Merchants and Operation thereof
Law on Regulators of Public Utilities	
Electricity Market Law	Cabinet of Ministers Regulations (CMR) No 86 (14.02.2017) "Procedures regarding the Receipt of Electricity Origin Certification" CMR No 262 (16.03.2010, latest amendments 16.03.2016) "Regulations Regarding the Production of Electricity Using Renewable Energy Sources and the Procedures for the Determination of the Price" Decision of the Board of Public Utilities Commission (BPUC) 1/36 (21.12.2017) "Regulations for information provision in the energy sector" Decision of BPUC 1/10 (11.06.2014, latest amendments 19.10.2016) "Regulations regarding Registration of Energy Producers and Traders), Decision of BPUC 1/30 (23.11.2011, amendments 19.10.2016) "General Authorisation Regulations in the Field of Energy" Decision of BPUC 1/4 (26.06.2013, amendments 14.12.2017 and 07.02.2018) "Network (Grid) Code" Decision of BPUC 1/6 (22.02.2012) "Regulations regarding System Connection for Electricity Producers"
Electricity Tax Law	Electricity produced by RES is taxed from 01.01.2017
Subsidised Electricity Tax Law	The tax shall be applied to the taxable income obtained within the feed-in system in the period from 1 January 2014 until 31 December 2017

Regional development and spatial planning, construction	
Development Planning System Law	CMR No 970 (25.08.2009, Amendments 30.04.2013) “Procedures for the Public Participation in the Development Planning Process”
Spatial Development Planning Law	CMR No 628 (14.10.2014) “Regulations on Local Government Territorial Development Planning Documents” CMR No 240 (30.04.2013) “General Regulations for the Planning, Use and Building of the Territory”
Regional Development Law	
Protection Zone Law	
Land Management Law	
Construction Law	CMR No 500 (19.08.2014, latest amendments 22.12.2017) “General Construction Regulations”: power station structures with capacity over 20 kW, including wind power stations (wind parks) are included in the third – the highest – group of constructions CMR No 573 (30.09.2014) “Construction Regulations regarding Power Production, Transmission and Distribution Constructions”.
Environment, nature and cultural heritage	
Tourism Law	
Environmental Protection Law	
Law on Environmental Impact Assessment	
Law on the Conservation of Species and Biotopes	
Law on Specially Protected Nature Territories	
Law on Protection of Cultural Monuments	
Society organization	
Co-operative Societies Law	
Law on Savings and Loan Associations	
The Law on Alienation of Real Estate Required to the Public	

Renewable energy support schemes. The existing feed-in tariff system relates only to the existing utilities, which had received feed-in rights before 26 May 2011, and thus will continue for the particular period for which these rights had been received by each of particular utility. However, this support instrument has been phased-out: currently there is no feed-in/feed-in premium support scheme for new RES power plants in Latvia.

Tax policies. There are a number of relevant tax policies. See the following table.

Table 3.3.6. Overview of selected laws and regulations at national level

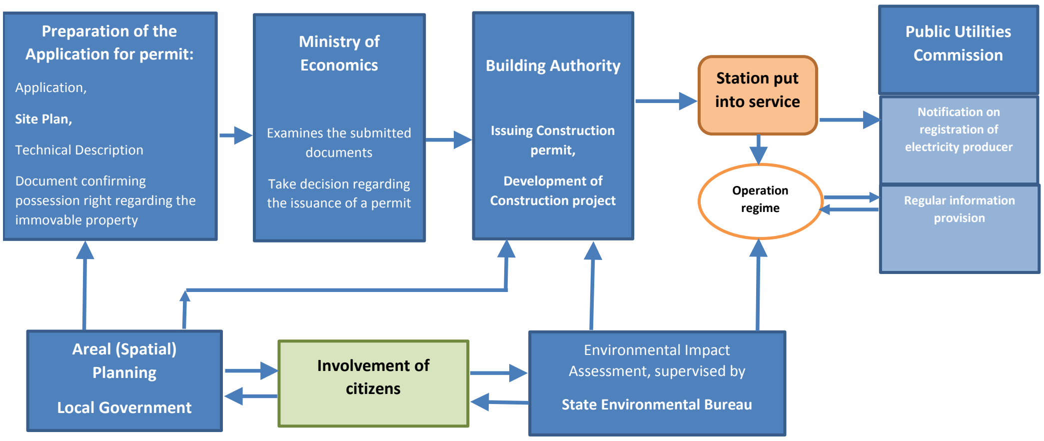
Taxation of electricity	Electricity consumed is taxed by electricity tax (current exemptions apply to household users, the carriage of goods and public carriage of passengers, including on rail transport and in public carriage of passengers in towns, for the provision of street lighting services). Currently (starting from 01.01.2017) electricity produced by utilizing renewable energy sources is taxed at 1.01 EUR per MWh.
VAT	General VAT rate in Latvia currently is 21%. No reduced rate for electricity.
Taxation incentives which may promote non-combustible renewables utilisation	
Taxation of CO_2 emissions from stationary sources (prescribed by the Natural Resources Tax Law)	The subject of CO2 taxation is CO2 emitting activities (installations) for which a GHG emission permit could be required - if the amount of the activity (installation) is below the limit defined for inclusion in EU Emissions Trading Scheme. Important to note is that the CO2 tax shall not be paid (section 10 of the Law) for the emission of CO2 which emerges from the installations participating in the EU Emissions Trading Scheme. The CO2 tax shall not be paid for the emission of CO2 which emerges while using renewable energy resources and local fuel - peat. Current CO2 tax rate is 4.5 EUR per ton of CO2 emissions.
Noxious air pollutants taxation (prescribed by the Natural Resources Tax Law)	Dominating fuels for energy production in Latvia are natural gas and wood. Thus, we indicate here the current rates for the emissions particularly relevant for these fuels: (i) PM10 emissions – 75 EUR/ton, (ii) NOX emissions – 85.37 EUR/ton.
Excise duty for natural gas	Energy utilities, utilising natural gas, shall pay an excise duty. The current rate is 1.65 EUR/MWh (the highest calorific value).
Taxes paid by company	
New Enterprise (corporate) Income Tax (EIT) Law has come into force 01.01.2018.	According the new Law, if an enterprise income will be re-invested the EIT does not apply. General rate of EIT is 20%.
Taxation related to employed persons	Personal income tax and Social Insurance have to be considered determining salary for employed.

Annual Immovable Property Tax	The Immovable property tax rate is 1.5% of the cadastral value of the engineering structures. The two taxes, Personal Income Tax and Annual Immovable Property Tax, are particularly relevant for municipalities as these are only taxes' revenues which go to municipality budget. Personal income tax is transferred to the municipality in which a particular person is declared, thus municipalities are very interested in creation of such job places in which local inhabitants may work.
Vehicle operational tax and Company car tax	Applies for vehicles owned by the company. Transport fuels are taxed by Excise duty.
Natural resource tax	Wind power stations with the total capacity more than 125 kV shall register for the polluting activity requiring a Category "C" certification. According legislation, if it is not possible to calculate the amount of polluting substances, the tax amount shall be ~71 EUR per year per each certificate of "C" category.

Licensing process for wind energy projects. The licensing process consists of the following steps:

1. The applicant completes and appends the application to receive the permit for introduction of new electricity production capacities, submits the application to Ministry of Economics
2. The Ministry of Economics examines the submitted documents, verifies the veracity of the information indicated therein and makes a decision regarding the issuance of a permit.
3. The Building Authority issues the Construction permit. Development of construction projects shall correspond to the by-laws of local government, spatial plan/zoning, and shall incorporate the provisions of EIA, stated by the competent authority, according to which the intended activity is to be implemented.
4. The construction process is controlled by the municipal building authority or, in case an EIA procedure has been applied, by the State Construction Control Office
5. The station is put into service and the registration is added to the list of electricity producers. Information to Public Utilities Commission (PUC) shall be provided regularly. The PUC provides the control of the station according the legislative/normative documents. In addition, the operator of the new wind station shall register the activity with the Regional Environmental Board as a category "C" pollutant (if capacity is above 125 kW).
6. Particular requirements regarding the operation regime of the wind power stations can be stated in the EIA.

Figure 3.3.8. Licensing process for new electricity production capacities development, construction and operation



Impact Assessment Regulations. The Law on Environmental Impact Assessment lays out the rules for impact assessments. See the following table. Impact assessment regulations are not applicable for municipal level institutions functions.

Table 3.3.7. Impact Assessment Regulations

Law on Environmental Impact Assessment	The Annex 1 “Objects requiring Impact Assessment” Section 26[1] of this Annex states the objects requiring Impact Assessment are the Construction of wind farms, if their: 1) number is 15 power stations and more; and 2) total capacity is 15 megawatts and more The Annex 2 “Activities requiring an Initial Assessment”. Section 3.8 of this Annex states the activities requiring an Initial Assessment are the Construction of wind power stations (farms) if: a) their number is 5 power plants and more, b) their capacity is 5 megawatts and more, c) it is intended within the distance of less than 500 metres from residential houses, except cases when a wind power station is intended for the supply of electricity to a residential house and its capacity is 20 kilowatts and more, d) the height of the construction exceeds 30 metres and it is intended in a specially protected nature territory or within the distance of less than 1 kilometre from a specially protected nature territory (except the territory of natural monuments – protected stones (secular stones) and protected trees (secular trees)) or from a micro-reserve established for the protection of specially protected bird species. Installation or construction of wind power plants (of any height) is the activity requiring Technical Regulations (Cabinet of Ministers Regulations No30 (2015) “Procedures by Which the State Environmental Service Shall Issue Technical Regulations for the Intended Activity”, issued pursuant to the Law on Environmental Impact Assessment). In addition, the Cabinet of Ministers Regulations No 240 (2013) “General Regulations for the Planning, Use and Building of the Territory”, Article 163.6 states: the impact of wind power stations on the landscape shall be assessed in the visual perceptibility area of State protected cultural monuments, considering the particular situation and the specific character of the cultural monument.

3.3.3 Socio-economic conditions

Statistics/surveys on the perception of wind energy/renewables. Currently there is no available survey on actual perception of RES in Latvia.

Two surveys were performed in 2016 (the survey commissioned by Baltic Environmental Forum (BEF) and the survey commissioned by DNB Bank, so called DNB Barometer) had indicated the following:

- 68% respondents (BEF survey) indicated that there is a need to work towards solutions to mitigate the effects of climate change,
- Both surveys indicated rather positive attitudes to RES. Generalising, around a half of respondents supported the development of RES/alternative energy sources,
- At the same time, the DNB survey indicated the majority (61%) of respondents would not be willing to pay more for energy if more renewables would be used.

However, the societal attitude to RES electricity may have significantly changed during 2017. This conclusion is one based on publications in mass media and society representatives' reflections in media and internet platforms. Unfortunately, the development and implementation of feed-in payment systems was done with significant shortcomings. The particular problems which caused this negative attitude from society are as follows: (1) an increase in electricity tariffs, due to the number of supported by feed-in capacities has grown, (2) a lack of communication, particularly no adequate communication on the feed-in support received by different types of capacities (different types of RES, decentralised natural gas CHP, large CHP)[78], (3) illegal actions of producers, included in the feed-in payments system, have been particularly discovered in autumn 2017 which caused very negative attitudes in society.

Thus, currently the societal environment for RES electricity in Latvia is rather unclear. It may be concluded that the overall attitude is trending negatively and that there is a lack of willingness to pay more for RES electricity.

Local knowledge/expertise

- Universities (higher education institutions). Important, regional cities host the higher education institutions
- Competence centres
- Business incubators
- High IT expertise in Latvia
- Expertise on wind energy in Latvia: experience of operators of existing wind parks, Wind Energy Association, recognized in Europe construction company with experience in wind parks construction "Arsava" Ltd (established in 1998 in Latvia).

[78] This information is publicly available on the web-site of Ministry of Economics for each individual station – feed-in receiver, however in non-interactive way for the user.

3.4 Norway

Despite a long history of producing electricity from renewable energy, the development of wind power in Norway in general is slow. One key reason is the fact that there is an oversupply of cheap electricity, which is based on renewable energy. The share of renewable energy in the electricity generation is 98 %, of which only 1.4 % is wind power (IEA no date). Extensive hydropower resources explain this high share of renewables and also why wind power historically has not been a priority.

In the 1990s there was a low rate of construction of renewable energy plants. However, in 1999 the government set a goal to produce three TWh wind power annually by 2010 (Hager 2014). In the early 2000s, the electricity demand was expected to increase, and the electricity industry was interested in constructing new plants (Boasson 2015). There was political agreement on preserving (i.e. not damming or regulating) the country's remaining major streams and waterfalls, and gas power gave rise to major political disputes. Therefore, new renewable energy sources gained considerable attention around year 2000 (Boasson 2015). Large-scale wind power seemed particularly well-suited, and an increasing number of small hydro investors showed an interest. This resulted in a sudden growth in produced wind power at the beginning of the 2000s (Hager 2014).

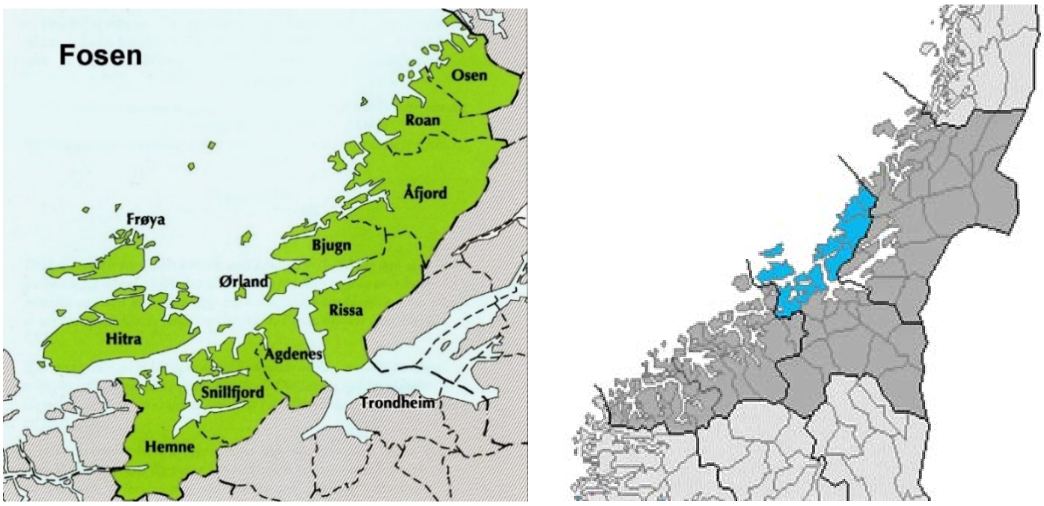
However, public debate about wind power development has been characterised by the existing high share of renewable energy production and concerns related to local environmental impacts.

3.4.1 Technical conditions

Basic facts about location, size and population. Norway has a population of about 5.2 billion people. The country covers an area of approximately 385,000 km^2. It has a large latitudinal range, stretching over 1,750 km from the north to the south. The average density is low with 14 inhabitants per km2. In general Norway has many sparsely populated areas and small municipalities. There are 428 municipalities located within 19 counties. The population is clustered unevenly in few relatively large municipalities and many small municipalities. There are substantial differences between the 428 Norwegian municipalities in terms of number of citizens, physical size and geographical location. There are five key regions in Norway: The Northern, Mid, Western, Eastern and Southern region. The majority of the municipalities are located in the Western and Eastern part of Norway where the majority of the people live. These areas are more densely populated than the other areas. On average, the Northern part and Mid Norway have the largest municipalities in terms of km^2, while Western and Southern Norway have more of the relatively small municipalities. While four of the five largest municipalities are located in Western and Eastern Norway, most of the small municipalities are located in Northern and Mid Norway

The region Fosen is situated in Mid Norway, on the coastline, and consists of eleven municipalities. The Fosen region includes a large peninsula, a fjord, two islands and an area south of the fjord.

Figure 3.4.1. Maps of the Mid-Norway region Fosen



Fosen is a sparsely populated region, with some 25,000 inhabitants and just one urban centre with some 2,000 inhabitants. Most jobs are found in the following economic sectors: agriculture, fish farming, service industries, the Royal Airforce base in Ørland, and in public welfare services.

Topography. Norway is dominated by mountain masses and the average altitude is 500 m. Fjords and bays characterize the long coast line. There are also chains of islands along the coast.

The Fosen Region has low-lying coastal areas, roaming hills, forests, and agricultural land dominate the topography. There are no high mountains in the area, but some hills are quite steep hence restricting area available for wind parks.

Wind energy resources and wind energy potential. Wind energy resources in the Mid Norway region are excellent, with an estimated wind power potential among the best in Europe. Calculations show that the Mid Norway region (i.e. Trøndelag) has a potential for ca. 105 TWh per year for average wind speeds of 6 m/s, ca. 78 TWh p.a. for average wind speeds above 7 m/s, and ca. 28 TWh p.a. for average wind speeds above 8 m/s (Kjeller Vindteknikk 2008).

Local energy resources. Many of the hydroelectric plants in Norway are easily adjustable and can adapt well to variations in demand and therefore price. However, frequency stability is not satisfactory. Norway often imports power when the price is low at night-time, while exporting at daytime when the price is higher. In 2016 there was a net electricity export of 16.4 TWh (IEA no date). The electricity consumption in the country was 133.1 TWh in total that year.

The country has five price zones. Mid-Norway (or 'Central Norway') is one such price zone. This region has experienced power shortage,[79] in particular related to dry seasons, meaning that the electricity prices have gone up due to lack of water in the magazines.

Grid capacity. The transmission system operator in the Norwegian energy system is Statnett, which operates 11,000 km of high-voltage power lines and 150 stations all over Norway. Statnett is a state enterprise, established under the Act of state-owned enterprises and owned by the Norwegian state through the Ministry of Petroleum and Energy. One national control centre and three regional centres monitor the operations. Statnett is also responsible for the interconnections to Sweden, Finland, Russia, Denmark and the Netherlands.[80] Together with National Grid in the United Kingdom, Statnett is building an interconnector to the United Kingdom, the North Sea Link.[81] Statnett is also building an interconnector to Germany, called NordLink, together with TenneT and the German Investment Bank (KfW).[82]

In the Mid-Norway region (or Central Norway), where Fosen is located, Statnett is in the process of upgrading the voltage (i.e. increase the grid voltage into and throughout this region from 300 to 420 kV), in order to improve security of supply and increase the capacity in the grid.[83] Statnett will convert existing 300 kV power lines and substations or replace old low-capacity power lines with new ones. As a result, the capacity of each line can be increased, with very limited reservation of new land along the route. The increased transmission capacity is necessary to ensure stable power supply in the region and to facilitate the construction of new renewable power. It will also contribute to decrease the transmission loss in the power grid.

The harsh climate makes maintenance of the grid challenging and outages occur. A large part of Norway's grid is without grounding.

It should also be mentioned that Norway has an open electric market, integrated with the other Nordic countries. The market is part of NASDAQ OMX Commodities Europe and Nord Pool Spot.

Infrastructure. Development of wind energy typically results in large infrastructure interventions. This is because wind energy is usually established in areas that are sparsely populated and there might be a lack of for example, roads or the existing roads are small. In such areas background noise levels are lower and expectations of quietness higher than in urban areas (Klæboe and Sundfør 2016). Wind development increases traffic and noise in such quiet areas.

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[79]http://www.statnett.no/en/Sustainability/Our-social-mandate/building-the-next-generation-main-grid/what-do-we-build-where/grid-development-in-central-norway/
[80] http://www.statnett.no/en/About-Statnett/
[81] http://www.statnett.no/Nettutvikling/Kabel-til-england/
[82] http://www.statnett.no/Nettutvikling/NORDLINK/
[83] http://www.statnett.no/en/Projects/Oppgradering-Midt-Norge/

Demographic characteristics. Norway has an indigenous population, the Sami. There is no registration of the Sami population, therefore it is not known how many Sami there are in Norway today.[84] They live all over the country, but the most concentrated Sami settlement areas are in Northern Norway (on a mountain range on the Arctic Circle) and Mid Norway. The Sami are fighting to protect ancient reindeer grazing land from development.

Restrictions on land use (national park, natural reserve, cultural heritage, indigenous people rights, tourism, military/defence interests, etc.).

One key restriction that should be highlighted is the demarcation of areas that are national wildlife areas for reindeers. The intention is to ensure that wild reindeer have access to sufficiently large areas for grazing and can move and use different areas as they need. Regional plans and demarcation of areas for reindeers are being assessed annually. The borders of such areas are political decisions. These areas are particularly important during winter when the ground freezes to ice, making the reindeers seek the forests for grazing. With climate changes, it is expected that such icing will increase. These areas are typically in the highlands, but there are continuous concerns that the areas are not large enough.

There are no rules about distance from buildings etc. in Norway. It means that wind development projects may be placed closer to where people live than in many other countries, where such rules exist.

A new mapping of possible wind resource areas in Norway is under development, called the *National Frame for Wind*. The Ministry of Petroleum and Energy (OED) has commissioned the Water Resources and Energy Directorate to prepare a proposal for a Norwegian framework for wind power on land[85]. The aim is to facilitate for long-term development of profitable wind power in Norway. One issue is that more concessions for wind power have been granted than what has been built. The framework is supposed to be a management tool. It is meant to create an overview of the best wind power locations. One intention is to mitigate conflicts. The framework consists of two parts: (1) an updated knowledge base about the existing knowledge of wind power in Norway, specifying what knowledge is lacking. This work will consist of a number of subprojects, aiming to reach a wide agreement on what we actually know about Norwegian wind power. (2) Maps that define larger areas where it is possible to develop wind power. The map is based on a method for designating defined areas that are suitable for wind power. Exclusion of sites is used, initially, as a methodological step to remove areas from further analysis. Hard exclusion removes 60 % of Norway's land area (i.e. 60 % of the land area is considered as not being suitable). This is for example, due to lack of wind resources. It is also a discussion going on about to what extent national parks and wildlife should be included in the hard exclusion criteria. A map that shows production costs (purely economic) based on wind conditions, slopes

[84] https://www.ssb.no/en/befolkning/statistikker/samisk/hvert-2-aar/2014-02-06
[85] https://www.nve.no/Media/6596/bestilling-nasjonal-ramme-for-vindkraft.pdf

and turbines will also be developed. In the case of soft exclusions, there will be discussions with different professionals. The maps for exclusion and production will be placed on top of each other. According to Fauchald (2018), it is uncertain whether and how the national framework will be followed up in local and regional planning processes.

LCA analysis. Energy Payback Ratio values for wind power in Norway vary between 3 and 30, which in comparison to other technologies is second-best after hydro power (Raadal et al 2012). The same finding goes for the Net Energy Ratio, where the values for wind are from 0.71 to 0.90 (Raadal et al 2012). Hydro power and wind also represent the best energy performance according to the Cumulative Energy Demand indicator (Raadal et al 2012). There are studies of LCA of offshore wind parks in Norway (e.g. Birkeland 2011). There is no regional LCA analysis available.

One important question is the duration of effects. Today there are no guarantees about recovery of nature to its original state, if for example a developer goes bankrupt.

3.4.2 Regulatory conditions

In 2016, the Norwegian government published a “White Paper” about Norway’s future energy intentions through 2030[86]. It highlighted four key goals: (1) improving security in the power supply, (2) facilitate for profitable production of renewable energy, (3) making energy consumption more efficient and climate friendly, (4) and fostering economic development and value creation through the effective use of profitable renewable resources.

Being a member of the European Economic Area, Norway is required to implement EU laws related to the internal market. One such law is the Renewable Energy Directive. Norway’s target for renewable energy is in line with the EU’s 2011 Renewable Energy Directive. Norway has reached its target, which is 67.5% of the total energy production by 2020 (Øvrebø 2016). There is no specific target for different renewable energy sources in Norway; there is for example no explicit wind target.

The following table gives an overview of important *laws and regulations* at the national level, including provisions for concessions, planning and impact assessments, environment and support instruments.

[86] https://www.regjeringen.no/no/dokumenter/meld.-st.-25-20152016/id2482952/

Table 3.4.1. Overview of selected laws and regulations at national level

The Energy Act	The purpose of the Energy Act is to ensure that production, conversion, transfer, trade, allocation and consumption of energy happens in a societally rational way and considers public and private affected interests (§ 2). The Energy Act lays the primary rules for allowing investors to establish and operate wind power projects (i.e. concessions) and prescribes centralized proceedings when it comes to making decisions about wind power development. Onshore wind power projects do not need concessions when the installed effect is up to 1MW, unless the construction includes more than five wind turbines (§ 3-1). The responsible ministry is the Ministry of Petroleum and Energy.
The Planning and Building Act	The Planning Act is intended to promote sustainable development in the best way for individuals, society and future generations, coordinate national, regional and municipal tasks and provide a basis for decisions on protection of resources, as well as securing transparency, predictability, participation and complicity for all affected interests and authorities (§ 1-1). The Planning Act includes basic rules on the design of land use plans, which indicate what kind of activities can be established in a certain area and about the investigation of impacts of the such activities. It gives considerable responsibilities to municipal and regional authorities. The Ministry of Local Government and Modernisation administers the act. In cooperation with the Ministry of Climate and Environment it is responsible for the impact assessments.
El-Certificate Act	This act regulates the green certificate scheme and applies to wind power projects that have had their construction start or permanently increased the energy production after 7 September 2009 and will apply until the end of 2035.
Nature Diversity Act	This act recognizes the use of local knowledge in addition to scientific knowledge. In particular §§ 8-12 create the basis for the exercise of public authority and include expectations about popular contributions.
Pollution Act	Wind power projects may imply demands for pollution permit in line with the Pollution Act due to noise (§ 6, 7 and 11).

In addition to the laws in the table above there are guidelines that are supposed to contribute to an effective implementation of the laws.

The legislation and management practices on wind power developments involve a significant centralization of decision-making power to the Ministry of Petroleum and Energy and the Water Resources and Energy Directorate. The legislation for wind power developments has over time become more detailed, but much discretion is still left to management practices, especially under the Energy Act (Fauchwald 2018). The Planning Act from 2009 states that energy measures are not subject to legal proceedings by the traditional planning authorities. However, municipalities, counties, the Sami Parliament and state agencies have the right to object to submitted applications. Private individuals and organizations do not have the same right to object; but they should be included in traditional hearings and may claim compensation. The Act's Chapter 14 points out that plans and development measures that have significant consequences for the environment and society must be carefully assessed. The assessment should be presented in the form of an impact assessment related to an application and include consultations with private individuals and organizations (Ruud Wold and Aas 2016). The relationship between concession decisions under the Energy

Act and planning decisions under the Planning and Building Act remains somewhat unclear (Fauchwald 2018). Administrative guidelines are of great importance in the wind power sector.

In Mid Norway there is one relevant regional plan: Sør-Trøndelag's plan 2008-2020 facilitates for wind power constructions with installed effect at about 1000 MW by 2025.[87]

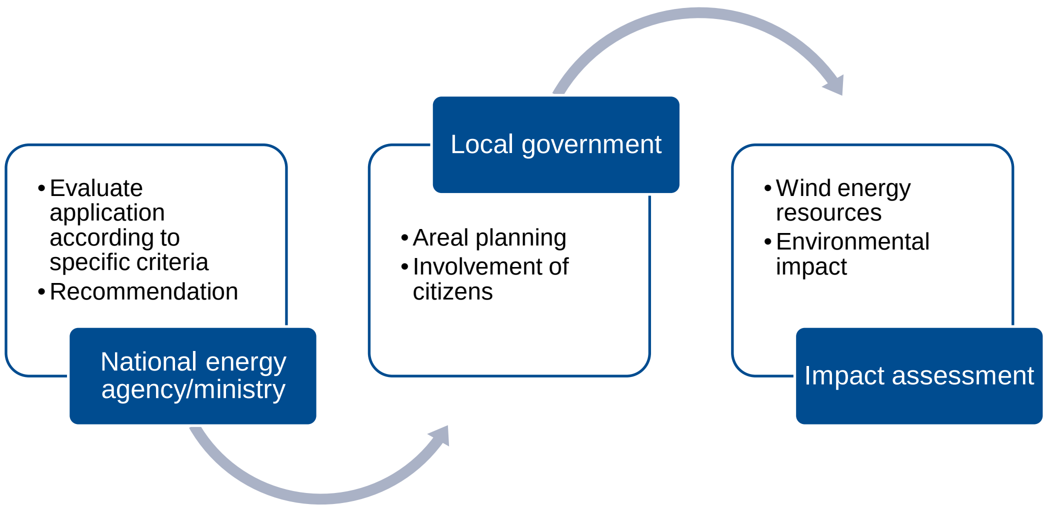
Institutions with jurisdiction. There are three administrative levels that are relevant for wind energy projects:

- The Water Resources and Energy Directorate, which is located under the Petroleum Energy Ministry at the national level
- The County Governor, which represents the state at the regional level
- Municipal councils

The responsibility for energy projects is located at the national level. The Water Resources and Energy Directorate gives advice to the Petroleum Energy Ministry and is responsible for the licencing process and coordination with other central authorities.

Licensing process for wind energy projects. The Energy Act and the Planning and Building Act regulate the concession process for wind power developments in Norway. The following figure depicts the process.

Figure 3.4.2. Licensing process for wind energy projects in Norway



The licensing procedure is in line with the EU regulations. It includes public consultation and asks for feedback concerning what the next step in development should be. After such consultations impact assessments follow. There is a new round of public consultations after the impact assessments have been carried out. The Water Resources and Energy Directorate makes the licencing decision, i.e. grants the

[87] https://www.stfk.no/Tjenester/Plan_klima_og_Miljo/Vindkraft/

licence. However, because there is considerable conflict related to wind energy development in Norway, there are many appeals. When appeals occur, the case goes from the regulator and to the Petroleum and Energy Ministry, which makes the final decision. Even small projects typically end up being such a political decision. In Norway there has always been a lot of discussion related to the scope of impact assessments related to wind power infrastructure (Bevanger et al. 2017).

The process follows these steps (Ruud, Wold and Aas 2016): First, the developer gives a notification of a planned project. The notification is supposed to provide information to every affected party. It should include a programme for investigation of topics that, in the opinion of the developer, should be further elaborated on. The aim of the notification is to provide a provisional assessment of possible effects on the surroundings. The Water Resources and Energy Directorate recommends that the developer should distribute a brochure with a short version of the notification to all households and landowners in the area. The Water Resources and Energy Directorate initiates a hearing among the relevant municipalities, counties, county governors and relevant state agencies based on the notification. Usually the Directorate organises a local public meeting during the period of the hearing. Based on the statements, investigation proposals and own assessments, the Directorate determines a programme for an impact assessment. The developer chooses who will carry out the impact assessment. The Water Resources and Energy Directorate initiates a hearing of the application and the impact assessment and announces the hearing in local newspapers. The Directorate organises meetings with local authorities and open public meetings about the application. The Directorate may request additional assessments. If the Directorate is of the opinion that the measure is satisfactorily addressed, it makes a decision or a recommendation to the Ministry of Petroleum and Energy.

The Water Resources and Energy Directorate allows the developers to take advantage of the best technology available at time of implementation. It means that the developer can exploit the newest technology and is not restricted to use technology at the time of application. The Directorate therefore approves the detailed layout, micro-siting and turbine size technology later in the process.

Impact assessment regulations. Wind power projects have an impact assessment duty (i.e. impact assessments have to be carried out). As a member of the European Economic Area, Norway is subject to the EU Environmental Impact Assessment Directive. The demands for data collection are important not only for assessing the consequences but also in relation to participation and transparency in the concession process. Environmental impact assessments have been supplemented by thematic conflict assessments, and the latter have been the subject of substantial criticism from the Directorate for Nature Management and the National Heritage Board.

Renewable energy support schemes. Norway has a green certificate scheme in cooperation with Sweden since 2010. It was implemented in 2012. A quota obligation (i.e. a certain amount of the electricity that users consume has to be renewable) creates the demand for certificates, which are traded on a market. Approved power plants receive one certificate for every generated MWh from renewable energy sources for 15 years. By the end of 2020, it is expected that the support instrument will contribute to develop a combined 28.4 TWh/yr of new renewable power production in the two countries, of which Norwegian power consumers are expected to finance 13.2 TWh.

In 2016, the Norwegian government decided to phase-out the green certificate scheme: it will only last until the end of 2021. The Norwegian government reached an agreement with the Swedish government about this in 2017. In contrast to Norway, Swedish politicians have decided to prolong their certificate scheme until 2030.

In Norway there is no plan to subsidise new wind power after 2021. The Norwegian regulator expects the wind technology to be profitable without support around 2025. One consequence of the phase-out is that the Norwegian regulator currently receives a lot of applications from investors who want to develop projects before the support ends. To receive support, the projects have to be commissioned by 31 December 2021. While previously Norwegian electricity utilities used to be the ones interested in investing, today the investors are primarily foreign investors, who are satisfied with lower margins than the Norwegian investors.

Before the green certificate instrument was introduced, from 2001-2010, there was a possibility to get support for wind power projects via Enova, which is a state-owned organisation that funds projects on a case-by-case basis to make them commercially viable. Enova still exists but is in future supposed to provide support to innovation and development of new energy and climate solutions rather than well-known production technologies.[88]

Tax policies. 19 June 2015 the national parliament decided to amend the depreciation rules for wind turbines.[89] According to the new rules, most investments in wind power plants can be depreciated on a linear basis over five years. When the national budget was revised for 2016, certain adjustments were made to the depreciation rules, inter alia, the time of impact was postponed from 1 January 2015 to 19 June 2015. 6 July 2016, EFTA Surveillance Authority approved the depreciation rules as legal state aid.[90] The rules apply to operating assets acquired during the period 19 June 2015 until the end of the 2021.

Land use planning. Under the Plan and Building Act local land use planning is a municipal responsibility. At the regional level, the County is important, because of its role as a regional planner. The local and regional plans are not "energy plans" but include information about land use that is important for the national energy plans. The Water Resources and Energy Directorate may provide advice and guidance to the planning authorities about energy measures.

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[88] https://www.regjeringen.no/no/dokumenter/meld.-st.-25-20152016/id2482952/
[89]https://www.regjeringen.no/no/aktuelt/esa-godkjenner-avskrivningsregler-for-vindkraftverk/id2507375/
[90]http://www.vindportalen.no/Vindportalen-informasjonssiden-om-vindkraft/OEkonomi/Avskrivningsregler

3.4.3. Socio-economic conditions

Local knowledge/expertise. TrønderEnergi is a local company with shares in three wind power projects. It generates annual sales of approximately NOK 1.7 billion and employs around 450 staff. The aim is to “create value through environmentally friendly production and distribution of energy for the benefit of the local region”.[91]

Statistics/surveys on the perception of wind energy/renewables (incl. acceptance). It is a common claim that Norway does not need more production of renewable energy as the country is more or less self-sufficient with hydropower. Financial support to increase the electricity production of renewables is considered to be subsidisation of other countries in Europe for them to reach their targets (Bye et al. 1999). Given nature conservation, this has not been popular. In 2001, the Norwegian prime minister (Labour) declared the end of the era of large hydropower projects in Norway (Stoltenberg, 2001). However, with increased focus on climate change, hydropower production, and production of energy from other renewable sources, became a question not only about nature conservation, but also about climate-friendly renewable energy versus nature conservation. The Norwegian public is in general more positive towards wind power production than towards hydro power production. In the Norwegian election survey, the public was asked about their attitudes towards wind power. About 80% public agreed that wind power should be further developed in Norway, both in the 2009 survey and in the 2013 survey (NSD 2018). The election survey also asks about the Norwegian public support for hydro power development. About 50% of the Norwegian population were positive to develop more rivers for hydropower in 2009 and 2013 (NSD 2018).

In the literature political party preference (i.e. an industrialist versus environmental protectionist blocs) is highlighted as important for public attitudes towards renewable energy technologies in Norway. Karlstrøm and Ryghaug (2014) argue that there is a clear correlation between people's preferences for parties that emphasize environmental values and their attitudes towards energy technologies. Younger people are in general more positive towards onshore and offshore wind than people of older age. People older than 60 years are significantly negative to renewables. Women are more negative towards hydropower than men, which the authors assume is related to environmental concerns and the impact on nature.

Other studies have focused on the perceptions of people in areas where there have been considerable neighbourhood complaints. In a study about how people are affected by noise from a wind energy development in the South of Norway, Klæboe and Sundfør (2016) found that about 60 per cent of the respondents opined that windmills degrade the landscape aesthetically. The study confirms earlier findings that the existing large hydropower resources in Norway makes people question the desirability for land-based windmills.

[91] https://tronderenergi.no/om-tronderenergi/english

Statistics/record of opposition and/or citizen protest against wind energy projects. The Norwegian environmental movement was created in response to the proposals of developing new hydropower constructions in the 1970s (Ruud, Wold and Aas 2016). Major energy developments occurred from 1920-1970 to ensure the supply of electricity to households and industry. The extensive development of hydropower raised the concerns about conservation. Since then there have been many conflicts about energy-related projects, primarily related to environmental concerns.

Nature conservation is not the only challenge to increase in renewable energy export. Frequent protests against high electricity prices have made Norwegian politicians highly aware of voter sensitivity to electricity prices. This was an important reason when the centre-left majority government decided not to introduce a green certificate scheme to boost renewable energy investments in 2006 (Gullberg and Bang 2015).

Statistics on number of jobs in renewable energy/wind energy sector. In 2013, the Norwegian-based renewal industry employed approximately 20,000 man-years in total (Multiconsult and Analyse&Strategi 2016). This corresponds to approximately 20% of the total number of man-years in the oil and gas industry in 2013. Hydropower and power grids have the highest numbers of employees related to renewables, with a share in total of approximately 76 percent (Multiconsult and Analyse&Strategi 2016). The other renewable energy technologies employ about 4-5% of the total number of employees in renewables. Because of expected major investments in hydropower, power grid and other renewable energy technologies, the outlook for the renewable industry is estimated to be positive in the short term (0-5 years) (Multiconsult and Analyse&Strategi 2016).

In Fosen, wind energy is considered a new and important job provider since the largest wind energy project in Europe is now under construction, with €1,1 billion invested in six wind parks of in total 1000 MW. Construction started in April 2016 and will be complete in 2020, when the wind parks will produce 3,4 TWh of renewable energy per year.

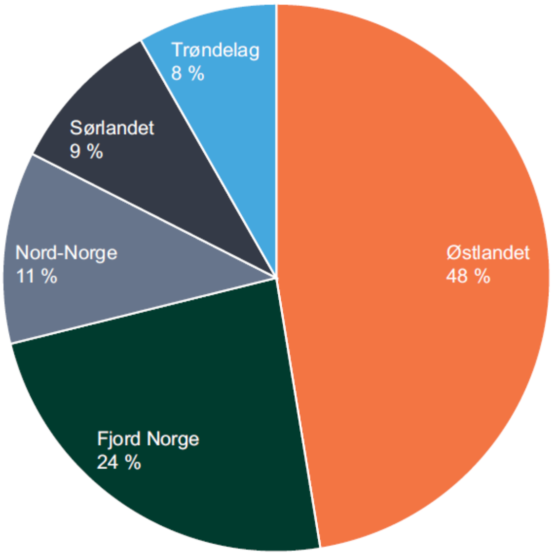
Statistics on number of jobs in fossil and/or nuclear energy sector. While there is no nuclear power plant in Norway (and never has been), the petroleum sector is important. In 2016, 185,300 were directly or indirectly employed in the petroleum sector in Norway (Norwegian petroleum, no date). Compared to 2013, there has been a decline of nearly 47,000 employees (-20%). This is due to the industry's adaptation to a lower activity level domestically and internationally.

However, prior to the recession, in 2014, Statnett expected increased electricity consumption in Mid-Norway among others due to increased activities in the petroleum sector.

The economic role of tourism in the region. In Norway as a whole tourism (in Norway) creates value for 100 billion NOK a year and make up 5.3% of the mainland industries' value creation. The share of commercial guest nights in the region Trøndelag was 8% in 2016 (Ministry of Trade, Industry and Fisheries 2017). In 2013 the value creation in

Trøndelag was 4.9, employment was 11,280, the tourism's share of business value creation was 11.9 and value creation per capita was 21,125 (Menon 2015). The turnover for Norwegian incoming operators in the region Trøndelag was 29 MNOK in 2016, which is a decrease since 2012 (Heyerdahl Refsum 2017).

Figure 3.4.3. The regions' share of commercial guest nights in Norway in 2016.



Source: Ministry of Trade, Industry and Fisheries (2017)

Figure 3.4.4. Value creation (verdiskaping), employment (sysselsetting), tourism's share of business value creation (reislivsandel av fastlandsnæringslivet) and value creation per capita (VS pr. Innbygger) at county level 2004–2013.

	Verdiskaping (mrd. kr.)		Sysselsetting		Reiselivsandel av fastlands-næringslivet	VS pr. innbygger
	2005	2013	2005	2013	2013	2013
Østfold	0,7	1,5	3 321	4 436	3,5 %	5 386
Akershus	5,9	10,2	12 084	14 307	6,2 %	17 993
Oslo	10,6	16,7	28 489	32 119	4,9 %	26 744
Hedmark	0,7	1,2	2 451	2 939	4,1 %	6 323
Oppland	1,2	1,7	3 964	4 206	6,8 %	9 309
Buskerud	1,7	2,8	5 655	6 682	4,8 %	10 280
Vestfold	1,1	2,2	3 842	4 176	5,2 %	9 213
Telemark	0,8	1,2	2 857	3 275	4,8 %	7 304
Aust-Agder	0,5	0,8	1 786	2 017	4,5 %	6 745
Vest-Agder	1,1	2,0	3 254	3 825	4,9 %	11 062
Rogaland	3,4	5,8	11 476	12 693	4,1 %	12 870
Hordaland	3,1	5,2	10 402	12 095	4,0 %	10 424
Sogn og Fj.	1,0	2,7	2 779	4 238	13,3 %	24 695
Møre og R.	1,7	2,2	5 438	4 827	3,3 %	8 668
Sør-Trønd.	2,2	3,7	7 429	8 713	5,3 %	12 307
Nord-Trønd.	0,7	1,2	2 217	2 567	6,6 %	8 818
Nordland	2,5	3,6	6 733	5 839	10,4 %	15 173
Troms	1,8	2,5	6 196	4 829	10,5 %	15 796
Finnmark	0,5	1,2	1 484	3 436	12,8 %	16 409
Hele Norge	**41,1**	**68,5**	**121 851**	**137 219**	**5,3 %**	**13 569**

Source: Menon (2015: 39).

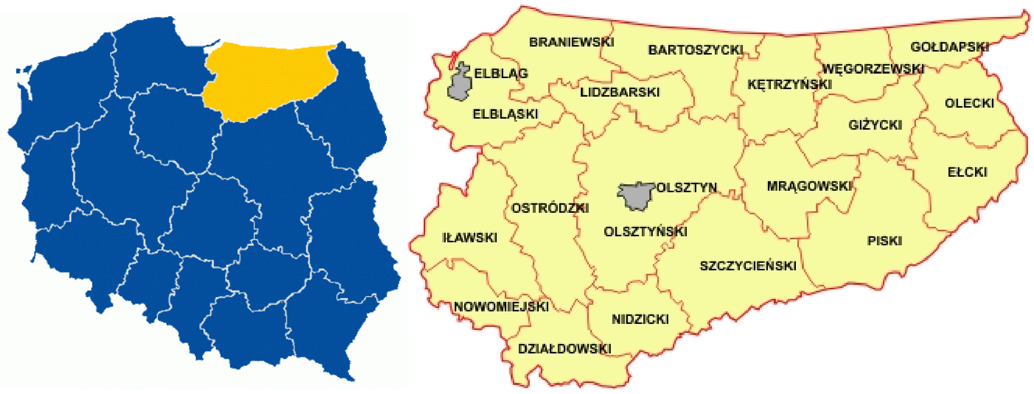
3.5 Poland

Poland has been labelled a “coal land”: «a country not only reliant on energy from coal but also arguing hard to safeguard the interests of the coal sector and against climate policy» (Szulecki 2017). Still, in 2015 Poland had the seventh largest installed wind energy capacity in Europe and was on the path of meeting its renewable energy targets. The focus in the WinWind project is on the wind-scarce Warmia-Mazury Province.

3.5.1 Technical conditions

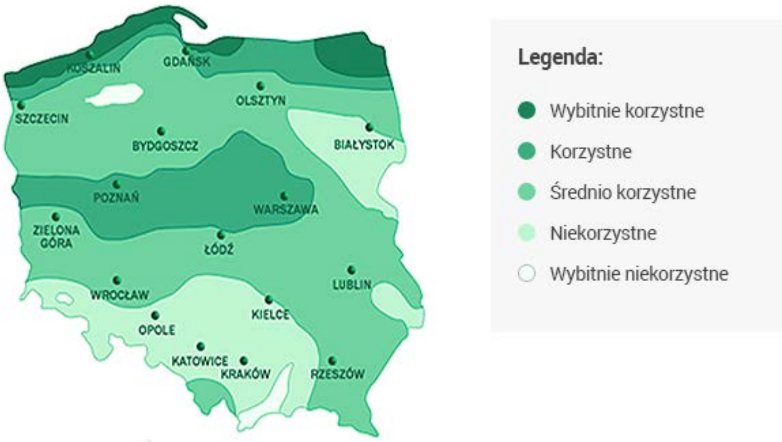
Basic facts (location, size, population). Warmia-Masuria Province (Warmian-Masurian Voivodeship) is located in the north-eastern part of Poland (Figure 3.5.1). Its capital and the largest city is *Olsztyn*. The voivodeship has area of 24,173 km^2 and population of 1,436,400. It consists of 19 counties and 119 communes.

Figure 3.5.1. Maps of the Warmia-Masurian Province



Wind energy potential. It is assumed that the operation of a wind power plant is profitable when the energy potential is at least 1 MWh/(m² year). In the case of the Warmian-Masurian Voivodeship such conditions prevail in the western and northern part of the voivodship, and in the north-western and north-eastern part of the voivodship (Fig. 3.5.2), these conditions are even better (from 1.25 MWh /(m² year) at the north-west tip up to 1.5 MWh /(m² year) at the north-east tip).

Figure 3.5.2. Map of wind conditions in Poland



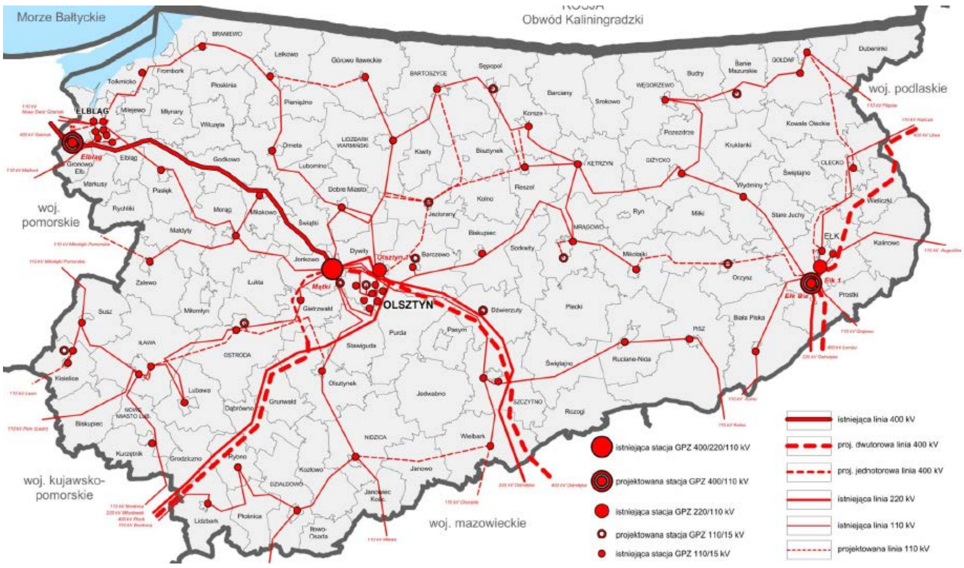
Local energy resources. The share of installed capacity in wind farms in the province to the corresponding capacity in Poland is only 6% at the moment. The main source of renewable energy in this region is wind (83%).

Table 3.5.1. Capacity installed and number of RES installations in the Warmian-Masurian province

Type of RES installation	**Capacity installed**	**Number of installations**
Biogas from wastewater treatment plants	3.791	6
Landfill biogas	1.574	3
Mixed biomass	25	1
On-shore wind energy	354.265	43
Agricultural biogas	9.469	10
Biomass from forestry and agricultural residues	4.444	3
Photovoltaic	8.888	34
Hydropower < 0.3 MW	5.316	66
Hydropower < 0.3 < 1 MW	4.829	8
Hydropower < 1 < 5 MW	7.076	3
Total	424.652	177

Grid capacity. The Polish Power Grid Company (PSE) manages and operates the 400 kV and 220 kV transmission network devices. The owner and manager of the distribution network in the central and western part of the Province is ENERGA-OPERATOR S.A. and PGE Dystrybucja S.A in the eastern part. There are no significant sources of electricity in the province. Local electricity production covers only about 12% of demand and takes place mainly in combined heat and power plants and renewable sources, including: wind farms, small hydropower plants, biomass power plants and biogas. The fact that the region is an importer of electricity does not affect the quality of energy supplied to consumers, the possibility of connecting new customers or energy prices. The required energy is supplied from other regions via the 400 kV and 220 kV transmission networks. Energy exchange with neighbouring provinces is also carried out via the 110 kV network. Due to the poorly developed 400 kV and 220 kV network in the north-eastern Poland, the power supply reliability of the Warmian-Masurian province is lower than in other regions of the country. There is a transient threat of power loss for a large area of the region. A particularly unfavourable situation is in the eastern part of the province, supplied unilaterally by the 220 kV line Ostrołęka - Ełk. The relatively poorly developed transmission and distribution network limits to a certain extent the possibility of connecting large wind farms.

Figure 3.5.3. Map showing transmission and distribution electricity networks

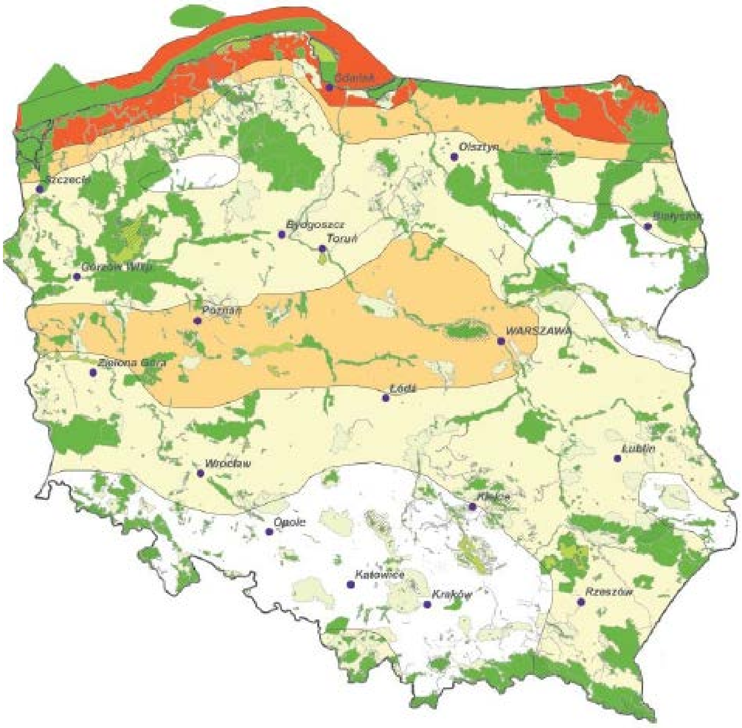


Accessibility of the population to the gas network in the province varies with distinct disproportions between cities and rural areas. On average, the population availability to the gas network in the region is 43.1% (Poland - 54.4%), in the cities 70.1% (Poland -72.4%), and rural areas only 3.7%. (Poland - 21.7%).

Population density. Population per 1 km^2 is 59. The average population density in Poland is 123, which is two times higher than for the Warmian-Masurian Province.

Restriction on land use. Areas marked by green colour show "Natura 2000"[92] areas and national parks (Fig. 3.5.4). In case of Warmian-Masurian Voivodeship these areas are mainly located where wind conditions are average. Zones with favourable and extremely favourable conditions feature enough space for wind energy deployment.

Figure 3.5.4. Nature protection areas against the background of wind energy zones



Wind potential. The Warmia-Mazury Province is perceived as an attractive land for the development of large wind energy, because it has good wind conditions, large acreage of arable land - about 1,100,000 ha, low population density index (only 59 people/km^2) and relatively large farms. The large area of protected zones, including these belonging to the "Nature 2000" network, is spatial limitation for the development of wind energy. Areas covered by the protection zones do not always exclude the location of wind farms, but considerably extend the process of investment preparation. An important difficulty for the development of wind farms is also the technical condition of power grids and limited possibilities of connecting new power to them.

LCA analysis. A single, modern turbine needs several months maximally to produce the energy needed for its production, exploitation and disassembly. When it comes to CO_2 emissions resulting from the production process, this period is even shorter and for countries with low usage of renewable energy fluctuates around 3 months.

[92] Natura 2000 is a network of nature protection areas in the territory of the EU. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive and the Habitats Directive. It stretches across all 28 EU countries, both on land and at sea.

Throughout the working period the wind turbine produces up to 80 times more energy than absorbs during its production, work and disassembly.

After the operation period of the power plant and its dismantling, the vast majority of turbine components are subject to recovery (even more than 90% of individual device elements), and the area of wind park can be reclaimed to its state prior to the investment.

3.5.2. Regulatory framework

Laws and Regulations. The following table gives an overview of important *laws* at the national level.

Table 3.5.2. Overview of selected laws and regulations at national level

The Energy Law	The Energy Law is a basic legal act which defines the principles of the state energy policy, the rules and conditions for fuels and energy supply as well as the principles of the energy companies' activity. The Law was approved by the Parliament in 1997. The Energy Law defines the principles of energy company activities and the roles of the government institutions in the supervision of fuels and the energy economy. The Energy Law is compatible with the EU requirements. It creates conditions for fulfilling national and international requirements for environmental protection. The Energy Law has been amended and modified many times, mainly in the area of the legal regulations which result from Poland's accession to the European Union.
Protection of Air against Pollution	The Ordinance of 12 February 1990 on the Protection of Air against Pollution, issued by the Minister of Environmental Protection, plays an important role in setting environmental standards. The Directive 88/609/EEC of the European Council constitutes a basis for the activities aimed at reducing the emissions of atmospheric pollutants by large combustion plants.
Renewable Energy Law (RES Law)	The main support schemes applicable to renewable energy sources are regulated in Poland in the 2015 Renewable Energy Law and supplemented by secondary legislation.

Institutions with jurisdiction. The Energy Regulatory Office (ERO) was established on the basis of the Energy Law in order to balance between the interests of the energy suppliers and energy consumers. The main activities of this Office include issuing the licenses for the energy companies, supervising the companies' activity in the field of their compliance with the Energy Law and licensing conditions as well as approving the energy prices for these market segments for which the Energy Law provides such procedure.

The governmental administration in the province is headed by the "voivodship office" (the province office) in Olsztyn. The voivodship self-government is headed by the Marshal's Office. The Marshal Office is responsible for realisation of the state energy policy. Other resolution bodies are Counties, District Authority Offices and Communes.

Renewable energy support schemes. There are three key support schemes for renewable electricity generation in Poland: (1) auctions, (2) net metering system for prosumers, in-kind payment, and (3) green certificates, which have been phased-out, but they are still running for projects which were implemented before the phase-out.

The 1997 Energy Law and the 2015 Renewable Energy Sources Act regulated the green certificates scheme, where renewable energy producers receive: (a) the price for electricity sold in the competitive market (with the right of the renewable energy producer to sell the entire generation to the last resort supplier with price equals to the average electricity price) plus (b) the price for tradable certificates of origin purchased in particular by suppliers selling electricity to final consumers. In terms of green certificates scheme the market price for certificates may not exceed in practice the so-called "substitute fee" ("buy-out" price) which is an alternative method of fulfilment of the obligation to obtain and redeem certificates of origin.

Under the 2015 RES Law, which was adopted in February 2015 and amended in December 2015 and June 2016, the mentioned green certificates scheme remained applicable, but with certain modifications for RES installations commissioned before 1 July 2016. RES installations commissioned after that date no longer benefit from the green certificates, but instead of that, they are part of a new auction-based support scheme. Renewable energy producers who were part of the green certificates scheme now have the opportunity to participate in the auctions instead of taking benefits from the green certificates scheme.

The regulations provided in the 2015 RES Law were significantly amended on 22 June 2016. The amendments modified the incentive schemes in order to promote auctions and RES installations. The auction scheme promotes all renewables technologies except co-firing and certain technologies. In some cases some technologies have to compete in the same auction.

The state-owned energy companies in Poland are important shapers of the energy policy, including the support schemes for renewables (Szulecki 2017). Szulecki (2017) argues that the Green Certificates introduced in 2005 and later the tenders in 2015 have been designed in a way so that they do not create too much competition for the utilities.

Tax policies. The main taxes in Poland, applicable to business, are the corporate income tax, tax on civil law transactions, value added tax (VAT), stamp duty, real estate tax and excise duty. All taxes in Poland are imposed by Taxation Acts, which set rules for imposing taxes, rates and duties, and all taxpayer responsibilities. The Tax Ordinance is the most general tax legislation. Other relevant legislation includes Corporate Income Tax, Value Added Tax, Civil Law Activities Tax Act and Local Taxes Act (e.g. for real estate tax). Standard corporate income tax rate, branch tax rate and capital gain tax rate are 19%.

Licencing process for wind energy projects. Procedures pertaining to "power generation" licences have been set out in the Energy Act and in the Act on the freedom of economic activity. Such licences have the form of administrative decisions issued to applicant entities, empowering them, under administrative law, to pursue economic activity in the sector in question. The obligation to obtain a licence rests with the entrepreneur intending to produce fuels or energy for commercial purposes, excluding:

- Production of solid or gaseous fuels,
- Production of electricity in sources with total installed electric capacity not exceeding 50 MW not classified as renewable energy sources or sources producing electricity in cogeneration,
- Production of heat in sources with total installed heat capacity not exceeding 5 MW.

The Energy Regulatory Office' President issues the licences. The applicant company must document that it has "technical capability guaranteeing the correct pursuance of activities". It is therefore a possibility that a promissory licence upon the start of investment process can be obtained.

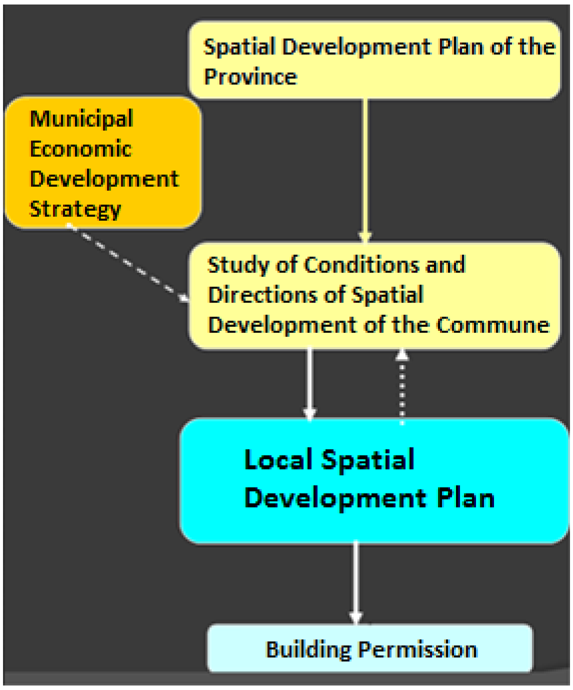
Construction of wind farms must be preceded by a range of necessary steps. Conditions that must be met prior to wind farm construction include location, building permit and environmental aspects. The following table includes the related procedures.

Table 3.5.3. Procedures before building a wind farm

Location procedure	• Provisions regarding possibilities of RES project construction entered into a study of conditions and directions of land use • Application submitted for adoption of a local area plan or for a planning decision • Resolution to start the development of a local area plan adopted by the commune council, if this procedure is chosen • Local area plan adopted/planning decision issued
Building permit procedure	• Assessment of the project's impact on the environment or assessment of the project's • impact on the "Nature 2000" network carried out • Permits, approvals or opinions of administrative bodies, including building permit, obtained by investor
Environmental procedure	• Application for a decision on environmental constraints submitted to the relevant administrative authority • Motion for opinion regarding the need to produce an environmental report and its scope filed by the organ handling the application with Regional Director for Environmental Protection and County Sanitary Inspector • Public consultations held • Investor's application, approvals, community comments and requests examined by the organ handling the application, • Decision on environmental constraints issued and go-ahead for the project is given

Land use planning. Studies of conditions and directions of spatial development of communes must be consistent with the strategic tasks adopted in the province's spatial development plan. Spatial areas for renewable energy are addressed in the local land use plans. The planning process implies that wind farms must be accepted by the local authorities in its land use planning, where the municipality studies the conditions and directions of spatial development and decides upon a development plan (see the following figure).

Figure 3.5.5. Spatial planning in the context of wind energy deployment



Impact assessment regulations. Environmental Impact Assessment (EIA) and the decision on environmental conditions in relation to the investment is part of the proceedings concerning the issuance of a decision on environmental conditions of approval to a project ("Decision"). These proceedings are of fundamental significance for the correct and timely conduct of the investment construction process. An EIA for planned projects is conducted to examine the possible impact of a specific investment on the environment and to agree on such conditions for completing it that it reduces – and if possible, eliminates – the risk of a negative impact on the environment. The basic legal act regulating the EIA in Polish law is the Act on Making Available Information about the Environment and its Protection, the Public's Participation in Environmental Protection, as well as on Environmental Impact Assessments of 3 October 2008 (Journal of Laws of 2013, item 1235) ("AEIA").

Based on AEIA, wind energy projects depending on total capacity, location and height of turbines can be allocated to one of 3 following categories: (a) the kinds of projects that may always have significant impact on the environment (so-called "group I"); (b) the kinds of projects that may potentially have significant impact on the environment (so-called “group II”); (c) the kinds of projects that may have significant impact on Natura 2000 areas.

The EIA process involves six key stages: (I) classifying a project for EIA proceedings (screening), (II) specifying the scope of expert analyses performed as part of the EIA (scoping), (III) presenting information on the environment, in the form of a report, to the appropriate authorities, (IV) verification of the report, (V) consultations with the appropriate environmental protection authorities and with the public, (VI) issuance of the decision and its publication.

3.5.3 Socio-economic conditions

Local knowledge. The local authorities, in particular the Energy Agency of Warminsko-Mazurskie Voivodeship Ltd and the Warmian-Mazurian Spatial Planning Office, have considerable wind expertise. The University Warmia and Mazury in Olsztyn also possesses relevant wind expertise.

Surveys on the perception of wind energy acceptance. The Polish Wind Energy Association (PSEW) carried out a survey in 2013. One of the result of this survey is that the majority of respondents do not believe that wind power has a negative aesthetic impact on landscape (61%) or that wind power makes areas surrounding wind farms less attractive to tourists (54%). These opinions did not correlate to the respondents’ political preferences. 47% of the respondents express that they are concerned with noise from wind turbines (i.e. respondents who have the opinion that wind turbines generate bothersome noise to residents living nearby). 35% of the respondents do not believe wind power creates bothersome noise. 40% of respondents were afraid of infrasound; in contrast, 34% were not afraid of such sounds; and as many as 26% had no opinion.

The biggest disadvantage of wind power in the eyes of respondents was the limitations in the use of property due to the required distance between wind turbines and buildings (a distance put down in Investments in Wind Farms Law). 60% of the respondents expressed that is was a disadvantage. There is also a general concern in the public that wind has negative effects on birds. 60% of the respondents express such concerns. The respondents mostly disagreed (45%) with the opinion that wind power is more costly than other energy sources. 34% of respondents perceived wind power to be more expensive than other energy sources.

Perception of wind energy/renewables. In 2013 the Polish Wind Energy Association hired an independent company to carry out a questionnaire in the Warmian-Mazurian Province. The findings from this study (Wind Energy – TNS Poland Report for Polish Wind Energy Association 2013) suggest that the vast majority (78%) of the inhabitants of the Warmian-Masurian Province are of the opinion that investments in wind energy can bring positive benefits for their region. Benefits from investments in wind energy that were most commonly ticked off by the respondents included: environmental benefits (65%), increase in communal income from taxes paid by the investor (51%) and a decrease in unemployment (46%). Research shows that residents of communes with wind farms see significantly more benefits related to wind farms compared to the general population.

Almost half of the residents of the Warmia-Mazury Province heard about risks related to the operation of wind farms. Three most frequently mentioned threats were listed: noise caused by turbines (57%), location of wind farms too close to buildings (47%), and depreciation of the value of the land around the power plant (44%).

The vast majority of respondents (87%) expressed that wind farms are a good source of energy, of which 39% think that it is a very good source. 75% of the respondents also agreed that such power plants should be established within their own commune.

Statistics on number of jobs in fossil and/or nuclear energy sector. Renewable energy policies have appeared in a “coal monoculture” due to its reliance on coal for power and heat generation (Szulecki 2017). In 1970s, the Polish authorities began to explore the possibility of gaining nuclear energy capacity. The aim was to limit the dominance of coal. However, the power system is still concentrated around large hard coal or lignite power plants: Poland has Europe’s largest lignite power plant and one the world’s 25 largest power plants, supplying 20% of electricity to the national system (Szulecki 2017). Based on information published by Central Statistical Office (CSO), 84.9 thousand persons were employed in mining of coal and lignite sector in 2016 and almost 120 thousand were involved in electricity, gas, steam and air conditioning supply (CSO 2017. Yearbook of Labour Statistics 2017). At the end of September 2016, 64,662 employees worked under the surface and 20,040 employees worked on the surface (Ministry of Energy 2017). At the end of March 2018, the employment status in the coal sector was 82.8 thousand people (Industrial Development Agency 2018).

Statistics on number of jobs in the RES sector. According to statistics run by the Renewable Energy Institute at the end of 2014, renewable energy in Poland has created more than 33.8 thousand jobs in total. This means that Poland with a 3% share of employment in the renewable energy industry, does not fully use the potential for job creation in this area.

3.6 Spain

As part of the Spanish case study, the Balearic Islands account for the Wind Energy Scarce Region. The Balearic Islands consists of four islands in particular: Mallorca, Menorca, Ibiza, and Formentera. The Balearic Islands are located to the West of Spain, in the Eastern Mediterranean. The energy situation of the Islands is characterized by very low levels of wind energy generation, high energy dependence and significant energy demand fluctuations due to mass tourism throughout the warmer seasons of the year. Despite this fact, there is considerable potential for wind energy in the region.

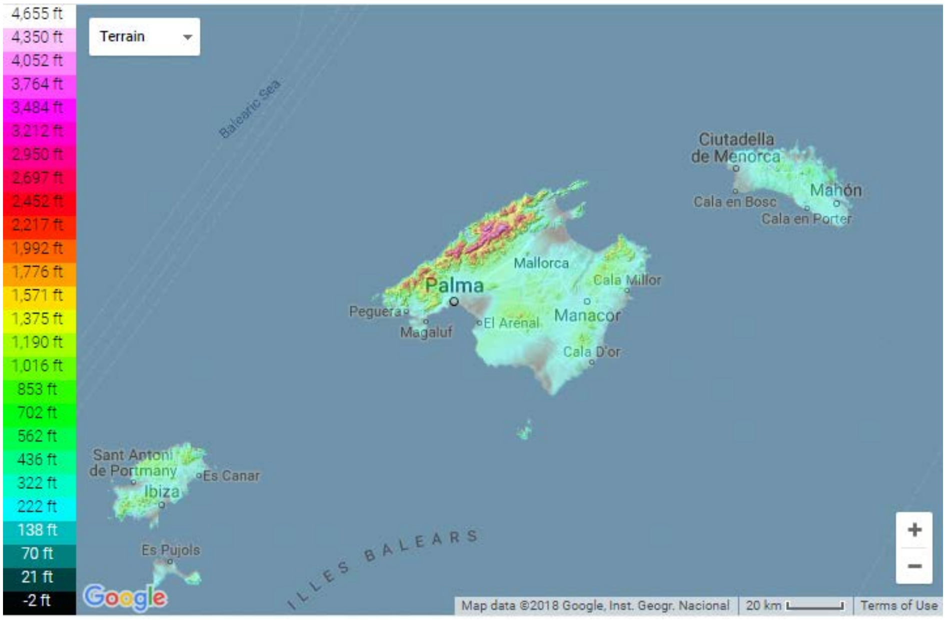
3.6.1 Technical conditions

Basic facts about location, size and population. The following map depicts the geographical location of the Balearic Islands, which together form one of Spain's seventeen Autonomous Communities. The city of Palma in the largest Island, Mallorca, is the capital of the region. The total area of the islands is 4,992 km2 with a population of 1,115,999 (2017) and thereby with a population density of 220/km2. It is one of the more densely populated regions in Spain, particularly given that the islands host over 13 million tourists per year (Government of the Balearic Islands, 2016), which are largely concentrated in the months between March and September. Naturally, the demand for energy dramatically increases during these months. Given this significant market for tourism, the Balearic Islands are also one of the wealthiest regions in Spain, with a GDP per Capita of 24,870 (Government of the Balearic Islands, 2016).

Figure 3.6.1. Maps of the Balearic Islands

Topography. The Balearics exhibit a varied terrain, with undulating hills, plateaus, and lowlands. Minorca has extensive plains. Annual precipitation is low, rarely exceeding 18 inches (450 mm), and occurs mainly in the autumn and spring.

Figure 3.6.2. Map that shows the terrain of the Balearic Islands



Grid Capacity. The Grid in the Balearic Islands is owned by Red Electrica de Espana, who is the sole transmission agent and systems operator for the Spanish Electricity System. The distribution of electric power is provided by 69Kv and 15Kv grids.

There exists a HVDC Submarine Cable connection from mainland Spain, in Movedre near Valencia, to Santa Ponsa close to Palma de Mallorca. Subsequently, the electricity is distributed to the other islands from the island of Mallorca.

Wind Energy in the Balearic Islands. The Balearic Islands current wind energy generation is the second lowest of region in Spain, after Extremadura. The current amount installed is 3.68 MW[93] generated by four wind turbines in the Es Milá Wind Park on the island of Menorca. This provides for 0.02% of the market share and total energy used in the Balearic Islands. The wind park was created in 2004, however has since not experienced any form of expansion or growth.

Wind Energy Potential in the Balearic Islands. Despite the low generation of wind energy in the Islands, the Government of the Balearic Islands has commissioned a report (2016) which unequivocally establishes the significant potential for greater exploitation of wind energy. Indeed, this is evident with an average wind speed in the Islands is 4.5m/s. The following map shows the areas within the islands with sufficient resourced, coloured in red, which are largely the areas which are located on high grounds. Brown has moderate amount, whereas green has insufficient amount of wind.

[93] https://www.aeeolica.org/en/map/baleares/

Table 3.6.1. Wind energy potential in the Balearic Islands

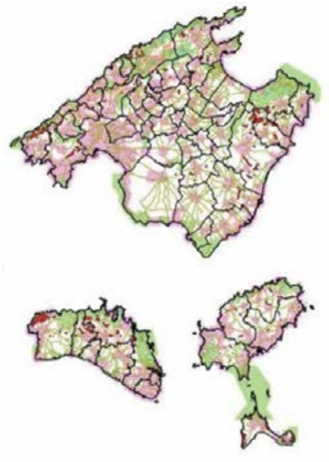


Table 3.6.2. Potential for energy generation. Source: Government of the Balearic Islands 2016[94]

	Annual Energy (GWh)	Potential (MW)	Number of wind mills*	Occupation of land (km2)	% occupied surface
Mallorca	7308	3210	1605	47,78	1,31
Menorca	2599	1320	660	19,46	2,77
Eivissa	511	258	129	3,57	0,66
Formentera	483	250	125	3,70	4,51
Illes Balears	10901	5038	2.519	74,52	1,49

* *Including traditional water pump wind mills*

The table above shows that the existence of wind resources is much higher than the current demand for electric power. In total, 289 areas have been identified in the whole of the Balearic Islands.

Protected Land. In the Balearic Islands there is a designated Natural Park, Cabrera Archipelago, a small island of 100sq meters 14km off the coast of Mallorca. There are also a few natural reserves across the Islands. In Mallorca there are four, the largest being Parc Natural de s'Albufera de Mallorca, which is a protected wetland park of 1,647 hectares. In Menorca there are also two nature reserves, and one in Ibiza. It

[94] http://www.caib.es/sacmicrofront/archivopub.do?ctrl=MCRST5325ZI160851&id=160851

should also be mentioned that the Island of Menorca was declared a Biosphere Reserve by UNESCO in 1993, because of the great variety of habitats that it comprises.

3.6.2 Regulatory framework

Laws and Regulations. Spain has a national action plan (Plan de Energías Renovables 2011-2020. Vol. I.) designed to implement and deliver the obligations under the EU Renewable Energies Directive 2009/28/CE.

The following table provides an overview of important *laws and regulations* at the national level.

Table 3.6.3. Overview of selected laws and regulations

Royal Decree 947/2015 16th of October Orden IET/2212/2915	This Decree announced a call for renewable energy auctions to be held yearly, in order to procure wind and biomass generation capacity. This capacity development was aimed at contributing to Spain´s EU 2020 renewable energy target. More specifically, the government opened an auction for 500MW of onshore wind generation capacity, and for all the years thus far, all opened capacity was awarded. All the Royal Decrees are related to the law and they are in fact a lower regulation development of the Law 23/2014. This Royal Decree initiated the auctions process which was followed by two new Royal Decrees in 2017: RD 359/2017 and RD 650/2017. In the first RD 947/2015 wind farms in Baleares were allowed not in the 2017 ones. There are not specific Balearic laws but now it has been announced a new tender for isolated system including Baleares.
Royal Decree-Law 413/2014	Regulates payment to renewable energy generation.

Renewable energy support schemes. Renewable energy incentives are established at the central state level (economic incentives, priority of access, and priority of dispatch). In Spain, the Ministry of Energy, Tourism and Digital Agenda is the body with exclusive competence to determine the economic regime for those facilities entitled to regulated remuneration, such as renewable energies installations.

Under the Spanish incentive scheme, which is regulated by the Royal Decree-Law 413/2014, renewable power generators: (a) sell the electricity they generate into the Spanish wholesale market and receive market price for such sales; and (b) receive additional regulated payments during their respective regulatory lives (e.g., 20 years for wind farms and 30 years for solar photovoltaic facilities, starting on the commissioning operation date).

Renewable energy generators receive the regulated payments for the (i) investment and (ii) operation – in addition to the market price: (i) Remuneration for the investment is intended to compensate for investment costs in renewable installed capacity that cannot be recovered through the market price. This remuneration is based on the investment costs that an efficient and well-managed company cannot recover from the market (based on technology-dependent standards). The set of standard parameters includes a standard value of initial investment. (ii) Remuneration for the operation is intended to compensate for the difference between operating costs and operating income. This is also determined by reference to technology-dependent standards, including a standard value of operating costs.

The present system adopted to implement RES is based on an auction procedure. The results and main conditions of auctions from previous years are stated (projects in the Baleares are not included). It is estimated that if new auctions will be opened for Balearic Islands, it will follow the same procedure as the one listed below:

Table 3.6.4. Results of Auctions 2016-2017

Auction Design criteria: Discount to Investment. *Source AEE 2018*[95]

January 2016 Market Price system	**May 2017** 42,53 €/MWh	**July 2017** 33,41 €/MWh
Differences per technology	Technology neutral (3 technologies)	Technology neutral (2 technologies)
Total 700 MW	Total 3000 MW	Total offered 5037 MW
Wind Energy 500MW	Wind Energy 2979 MW	Wind Energy 1128 MW
Biomass 200 MW	PV or others 21 MW	PV: 3909MW

Licensing Process for wind energy projects and impact assessment. The environmental impact assessment (EIA) of the projects is a part of the administrative licensing process and is necessary in order to get the administrative license necessary to build the installations. This EIA is the part of all the permitting processes when the project is released for public hearing. It is also utilised to get the opinion of the rest of the administrative areas with some kind of involvement in the project: archaeological, rivers, roads. The administrative license is normally processed once the access and connection permits are obtained. In practice, the environmental assessment process takes at least six or seven months.

Institutions with jurisdiction. At the central state level, the Ministry of Energy, Tourism and Digital Agenda (MINETAD) is in charge of proposing and executing government policies in relation to energy. Among other functions, the MINETAD is responsible for adopting the necessary measures to secure the supply of electricity and the economic and financial sustainability of the electric system. The establishment of the National

[95] https://www.aeeolica.org/uploads/AEE_ANUARIO_17_web.pdf

Energy Plan and of an economic regime for those facilities entitled to regulated remuneration is also part of the MINETAD's duties.

Broadly speaking, autonomous communities are in charge of developing basic regional-level legislation. They also grant the necessary authorizations when the electric infrastructure solely affects their territory unless such authorizations are expressly reserved for the MINETAD. Within the Balearic region, there is a Directorate General of Energy and Climate Change, which is the most competent institution with this regard. More specifically, in this Directorate General, the Department of Energy Efficiency and Renewable Energies is specialized for decision making and expertise for wind energy issues

At the municipal level, town councils are in charge of granting the necessary works and activity licenses for the installation of the facilities. Environmental and town planning regulations (which are mainly developed at autonomous community and town council levels) also have to be taken into consideration when developing a renewable energy project.

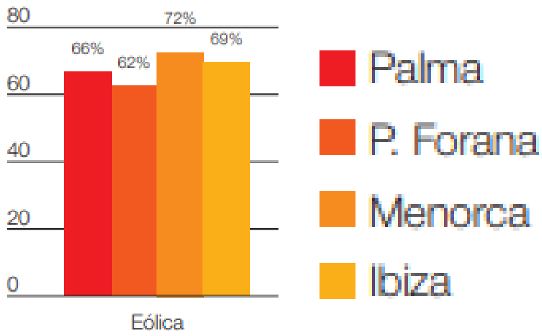
3.6.3 Socio-economic conditions

Local Knowledge/Expertise. Perhaps one of the most significant reasons and obstacles for the lack of development of wind energy, and indeed renewable energies in the Balearic Islands, is due to the fact that there are exists no specific wind energy or renewable energy associations in the islands. This significantly contributes to the lack of information and promotion of wind energy in the islands.

Local Perceptions on Wind Energy. A recent study carried out by The Environmental Technologies Park of Mallorca[96] reveals that the local populations in the region are largely in favour of wind energy and concerned with the lack of its existence in the Islands. More specifically, the general wind energy acceptance in the in the Islands is 71% (2017). Furthermore, in the individual islands, Menorca has the highest acceptance with 72%, followed by Ibiza 69%, Mallorca 66% and Formentera 62%. This is shown in the following illustration.

[96] http://www.tirme.com/ct/upload/424pdf_file12_09_34.pdf

Figure 3.6.3. Wind energy acceptance in the Balearic Islands. Source: TIRME 2017[97]



Opposition Against Wind Energy. Balearic Ornithology and Nature Defence Group (GOB) has been the most significant and effective form of opposition against the use of wind energy. Indeed, it wants protected natural areas to be excluded from the implementation of wind and photovoltaic parks. Furthermore, it demands that Areas of Agricultural Interest of the Territorial Plan of Mallorca be excluded from the areas of exploitation**.** They believe that the installation of wind farms is a serious risk during the migratory movements for threatened species as they pass through Mallorca.[98]

Other Energy Resources in the Balearic Islands. Given the low generation of wind energy, and indeed equally low proportions of the use of other renewable energies, the Islands are highly dependent on energy from other sources. Such energy import comes in a number of forms via the cable to mainland Spain.

Furthermore, four thermal power plants exist in Mallorca (527 MW, 432 MW, 412MW & 400MW), one thermal power plant in each of Ibiza (292MW), Formentera (10.5MW) and Menorca (245MW). These are all either coal-oil fired or gas turbines. The coal is largely imported from South Africa, the natural gas comes from the mainland through the Denia-Evissa-Mallorca submarine gap, and oil is also imported.

Role of Tourism. As mentioned, the Balearic Islands receive 13 million tourists each in a multi-billion-euro sector.[99] Naturally therefore, the overwhelming majority of the jobs in the Balearic economy are dependent on this sector.

[97] http://www.tirme.com/ct/upload/424pdf_file12_09_34.pdf
[98] https://www.gobmallorca.com/que-feim/energia-i-canvi-climatic/04-03-2015-el-gob-demana-que-s-excloguin-totes-les-arees-naturals-protegides-de-la-implantacio-de-parcs-eolics-i-fotovoltaics
[99] http://www.caib.es/sacmicrofront/archivopub.do?ctrl=MCRST5325ZI160851&id=160851

4 Summary and further work

This section sums up the main findings from the literature review of social acceptance of wind energy development (see 4.1) and the technical, socio-economic and regulatory starting conditions in the wind energy scarce target regions (see 4.2). Finally, it gives information on how WinWind uses this information in further work (see 4.3).

4.1 Key factors in the literature

Based on the comprehensive review of the existing literature, the social acceptance of wind energy projects depends on at least five factors: 1) the technical characteristics of the project and the geographical characteristics of the location (e.g. the number of turbines, and the number of neighbouring projects, 2) the local environmental, economic and societal impacts of the project, 3) the broader context for wind energy development in the community and what characterises this context (e.g. argumentation and opinion formation, and legal frameworks), 4) how individual characteristics, such as socio-cultural and psycho-social factors, influence attitudes toward the project (including argumentation and opinion formation), and 5) considering point 1–4, how the local wind energy development is governed, and the measures used to address salient local acceptance barriers (e.g. conflicts related to the distribution of benefits and costs and lack of involvement). When analysing the social acceptance of individual projects in the WESRs, each of these factors will likely be as unique as the context itself. However, the key to shaping social acceptance across contexts are local impacts, whether the governance of local wind energy development is perceived as just, and whether the process is characterised by mutual trust.

Throughout this report, we have highlighted the complexity of social acceptance. For instance, although the WinWind project is primarily concerned with analysing community acceptance of specific wind energy projects, we have emphasised the fact that social acceptance is produced at different scales (socio-political, market and community acceptance), and these dimensions interact in shaping acceptance of wind energy development. Also, we have highlighted the difference between outcomes and process (acceptance versus acceptability) and the fact that social acceptance is only one necessary condition for the actual *deployment* of wind energy technologies (the other is financial viability). These complexities must be kept in mind aiming to enhance the (socially inclusive) deployment of wind energy increasing the social acceptance of wind energy in the WESRs.

In part 2 of this report, we discuss key findings in the existing literature, and identify research gaps. A central theme throughout has been the location-specific nature of impacts of wind energy projects, and how these impacts are perceived and valued by the community. For instance, impacts depend on the technical and geographical characteristics of the proposed wind energy project. Also, the environmental, economic and societal impacts of wind energy development could depend on what wildlife species are present in a particular location, on the extent and nature of local tourism, and whether the proposed land use changes conflict with existing societal uses, for instance by indigenous groups. How such impacts are perceived and valued, in turn, also depend on a range of contextual factors (including political-administrative factors) and individual characteristics (including socio-cultural values and socio-psychological factors). Again, such location-specific nuances must be considered in order to fully understand local responses to wind energy development in the WESRs.

Location-specific characteristics are also key to the successful governance of wind energy development, and to the design and implementation of policy and corporate measures aimed at enhancing social acceptance in cases where barriers are identified. Local environmental, economic and societal impacts are key determinants in shaping social acceptance. Despite the very location-specific nature of such impacts, however, there seems to be a consensus in literature on the importance of procedural justice, distributional justice and trust in shaping social acceptance, across diverse contexts. Although common acceptance factors and general best practices have been identified in the literature, it ultimately depends on the specific circumstances and challenges surrounding a particular project how justice and trust are ensured.

Thus, a general conclusion from the literature review is that there is no “one size fits all” solution to enhancing social acceptance in the WinWind regions. Each project is unique, facing unique challenges and opportunities, rooted in the local context. Indeed, part 3 of this report has clearly illustrated the very different technical, socio-economic and regulatory conditions for wind energy development in the six WinWind countries. Thus, while the findings in this report can help direct attention to central challenges and key questions related to the social acceptance of wind energy development, solutions and answers to these questions must take into consideration the location-specific factors that ultimately shape community acceptance of specific wind energy projects.

4.2 Summary of conditions in the WES target regions

Based on the description of the technical, regulatory and socio-economic conditions for wind energy in the WES target regions in part 3 of this report, we find large differences but also similarities across the cases. Below, we summarise key findings under three sub-headings: 1) technical conditions, 2) regulatory framework, and 3) socio-economic conditions.

4.2.1 Technical conditions

The literature review emphasises the impacts of wind energy development on human health and wellbeing, in particular of visual impacts and noise as well as the societal dimension of the use of contested land. For the analysis of such impacts it might be important whether a region is densely or sparsely populated, as *population density* may give an indication of how many people might be affected or how close wind power projects may be to where people live. In the WES target regions, population density varies from 14 inhabitants per km^2 in Norway to 342 in Lazio.

Table 4.1. Population density in the WinWind target regions

WinWind region	People/km^2
Saxony	221
Thuringia	133
Lazio	342
Abruzzo	121
Latvia	30
Norway	14
The Warmian-Masurian province	59
The Balearic Islands	220

While low population density tends to be considered a good condition for social acceptability of wind development, this relationship is not clear. Studies from Norway, where the population density is particularly low, show that opposition still may be strong due to nature conservation concerns.

The literature review also emphasizes that the number of wind turbines and scale affect social acceptance. The description of the WESRs show how *wind energy resources* vary across the regions.

Table 4.2. Wind power installations in the WinWind target regions

WinWind region (year)	Number of installed wind turbines	Installed electrical capacity (MW)
Saxony (2017)	891	1,199
Thuringia (2017)	834	1,295
Lazio (2016)	46	52.5
Abruzzo (2016)	121	232
Latvia (2017)		77

Norway (2017)	468	1,188
The Warmian-Masurian province (2017)	43 wind farms	354.3
The Balearic Islands (2016)	4	3.68

Although wind resources in Norway are excellent, the share of wind power in electricity generation is only 1.4%. In Latvia the share is similarly low (only 2% of the total electricity supply).

The *share of renewable energy* in the regions vary. While the share of renewables in Norwegian electricity generation is 98%, it is 57% in Thuringia. This is an important condition for social acceptability because one aim of increasing the share of wind energy is to phase-out fossil fuels. In Norway, opponents of wind energy point to the fact that Norwegian nature should not be destroyed, when the electricity generation is already fully renewable. This is in contrast to for example Poland, which is highly dependent on coal and where concerns regarding social welfare effects of phasing out coal are prevailing. Safeguarding coal interests is therefore more important than climate policy. Germany, which also has high dependency on coal, has in contrast to Poland introduced a Coal Commission to find the appropriate measures to phase out coal. In other words, the share of renewables in existing electricity generations affects social acceptability, but the relationship is not clear (e.g. the contrast between Poland and Germany). Both high shares of renewables (e.g. Norway) as well as high shares of fossil fuels (e.g. Poland) may contribute to form opposition against wind energy.

Moreover, wind energy creates pressures on *grid capacity*. This is clear for example in Italy, where a large majority of new requests for connection to the national grid is because of new wind turbines. In Germany there is a major challenge to improve transport of electricity from the northern/eastern regions where there is a lot of wind energy to the south of Germany where wind energy is not as developed and there is a high demand for power. In Italy, Germany and Norway grids are being upgraded to improve the security of supply and increase the capacity. We also see that harsh climate, as in Norway, creates challenges for grid maintenance and causing outages. Other regions, like the Warmian-Masurian Province in Poland, experience grid problems due to a poor network and therefore a constant threat of power loss in large areas in the region. Power loss issues hampers the development of wind power. However, improvements in grid capacity may also affect social acceptance, if wind power increases the need for grids that are perceived as large nature interventions (e.g. conflicts related to “monster masts” in Norway).

Similarly, *accessibility to the regions* is also related to existing infrastructure. In Germany potential sites can normally be reached using the existing road network. In contrast, new roads typically have to be built for new wind energy projects in Norway. This results in large infrastructure interventions in areas that are sparsely populated, noise levels are lower and expectations of quietness higher than in urban areas.

Related to people's concerns about infrastructure, *dismantling and restoration of the used land* is of interest. In Germany operators have to ensure that they will dismantle wind turbines and restore the nature back to how it was prior to being allowed to construct, for example by providing a bank guarantee. Operators are required to dismantle the whole turbine and remove the foundations up to a minimum of 1 meter into the ground so that the land can be used for agriculture. Poland also has rules that require that the area of wind parks shall be restored to its state before construction was made. In contrast, Norway has no such obligation, i.e. there is no guarantee that the nature will be recovered to its original state in for example cases of bankruptcy or need to shut-down because of age.

The literature review highlights that siting of turbines close to the most sensitive and protected landscapes provokes the most negative responses to wind energy. All the WESRs analysed have *restrictions on land use*. For example, they all have nature conservation areas that cannot be used for wind energy production. Most of the WESRs also have rules on minimum setback distances between settlements and the wind turbines. In Lazio and Abruzzo, the use of wind power is forbidden in urban areas. In Germany rules about setback distances are set by the regional planning bodies. In Saxony, the setback distance between wind turbines and residential areas used to be fixed at 1,000 metres but is more flexible under the new government. In Latvia wind power stations shall not be placed closer than 500 metres to residential houses in rural areas and 1,000 metres to dense existing or planned residential buildings or public buildings. The distance between residential houses in rural areas and wind farms shall be no less than five times larger than the maximum height of the wind power station; for dense residential buildings and public buildings the distance shall be at least 2,000 metres. Poland also has setback distance regulations. In May 2016, Poland adopted limits on where wind farms can be built. Wind farms must be built at a distance from housing of at least 10 times the height of turbine. In contrast, Norway does not have any such rules. It means that wind development projects may be placed closer to where people live than in regions and countries that have such rules. There is no clear consensus in the literature on the relationship between social acceptance and distance to wind turbines, but setback rules may be important for social acceptability. However, they also exclude large areas from potential use for wind turbines. For example, the setback rule in Thuringia excludes 60% of Thuringia's area from being used for wind power.

4.2.2 Regulatory framework

Renewable energy support schemes are particularly important for the deployment of renewable energy. All the WESRs have support instruments for renewable energy. However, Latvia has phased out its feed-in tariff support scheme (i.e. there is no feed-in tariff/feed-in premium support scheme for new RES power plants in Latvia) and

Norway is phasing out its green certificate scheme in 2021. Among the other countries there is a general tendency to move towards auction-based support schemes.

Who is eligible and how support is granted varies across the countries. Most of the countries have different instruments for large-scale and small-scale projects. For large-scale investments there is a relatively new tendency to introduce auctions. Countries that used to have green certificates (e.g. Poland) or feed-in tariffs (e.g. Germany) for large-scale projects, have introduced auctions instead. In 2015 Poland decided to introduce auctions for large scale renewable energy generation, Germany in 2016. Italy also has a reverse auction process as one way of granting support.

The literature review highlights the importance of procedural stakeholder *participation*. Almost all the countries involve the public in consultations either during the licensing process and/or spatial planning processes. In Italy the public is not involved in the general permitting/concession procedure, unless the regions establish public consultation procedures.

All the countries, also Norway (which is a member of the European Economic Area), are obliged to adhere to the EU Environmental *Impact Assessment* Directive.

4.2.3 Socio-economic conditions

People's perceptions of wind energy or renewables vary across the countries. In Germany people are in general positive towards renewables; a dominating majority support further expansion of renewable energy and consider such a development important. Yet it should be mentioned that Thuringia and Saxony are part of the former GDR, where the population tends to support wind energy to a lesser extent than the population in other federal states in Germany.

In Latvia surveys indicate that there is a somewhat positive attitude towards renewables; however, a majority is not willing to pay more for energy. Because of certain issues related to the support instrument that has now been phased-out in Latvia, renewable energy has received some negative attention in the news.

In the Norwegian election survey in 2009 and 2013, a large majority agreed that wind power should be further developed in Norway. However, the attitudes may be more negative now, given increasing development that puts pressure on nature conservation, which has always spurred a lot of conflict in Norway.

In the Warmian-Mazurian Province the general view in the population is that investments in wind energy can bring positive benefits for the region, including environmental improvements, boosting tax income and decreasing unemployment.

Also, in the Balearic Islands evidence suggests that the local population is largely in favour of wind energy.

Similarly, in Italy a majority responds that they "trust" wind energy.

Some patterns of conflict are similar across all the cases. There are in particular concerns with *nature conservation*, given the rapid expansion, and some concern about health risks in all the countries. Other conditions are very different. For example, in Italy certain wind projectsgained a bad image because of corruption charges.. In Norway there are conflicts related to minority rights of the Sami people and reindeer farming. Different instruments are necessary to cope with such different conflicts. However, there might still be some possibilities to learn across such different cases because in both instances it might be difficult to separate associations to corruption or minority rights from other reasons of opposition or protest like ecology, aesthetics and heritage. In other words, there is a need to disentangle the different reasons for opposition in each country and region (see Oles and Hammarlund 2011) and then seek to understand what kind of instruments may affect social acceptability related to each reason. The literature review shows that for example, landscape aesthetics often contributes to create local opposition against wind power but may represent larger institutional failures.

As highlighted in the literature review, a compromise between actors opposing and those promoting wind power is not always possible. Conflicts related to minority rights (like in Norway) is one typical example: Any nature interventions in areas with strong links to minority cultures may not be acceptable under any circumstances, because they touch the “soul” of a culture. In contrast, there might be possible compromise solutions when conflicts are related to tourism (which is particularly important on the Balearic Islands), unemployment (because it may be seen as challenging jobs in the coal sector in Poland) or non-transparency in political-administrative processes (as reported on in Italy and Latvia). Compensation may to some extent be a solution to tourism and welfare losses. However, as discussed in part two of this report, several studies show that compensation and community benefits do not automatically increase acceptance. In addition, corruption needs to be dealt with by ending impunity, reforms of public administration and most of all through information, communication and transparency in the planning and siting procedures.

4.3 Further work in WinWind

This report (Deliverable 2.1) will together with the other outcomes of Work package 2, the conceptual framework (Deliverable 2.2) and the taxonomy (Deliverable 2.3) provide the basis for further work in WinWind. This report, first, creates the basis for the conceptual framework, which is crucial for the development of the taxonomy.

The outcomes of work package 2 will be used for the case study research in Work package 4. This report contributes with insights to the identification and selection of good/best practice cases (Task 4.2) in terms of which factors such cases should address (i.e. technical and geographical characteristics; the local environmental, economic and societal impacts of the project; the broader context for wind energy development in the community; socio-cultural and psycho-social factors; as well as governance). The report also informs the in-depth analyses of best practice cases (Task 4.3) as it provides information useful for the comparative analysis across diverse cases.

Similarly, the report and the other outcomes of Work package 2 will inform the transfer of best practices (in WP5). They will also be integrated into the stakeholder dialogues and consultations (in WP3) and provide the basis for scientific and popular scientific articles and selected project factsheets (in WP7). Finally, WP2 provides a basis for the assessment of technical and non-technical regulations, guidelines and recommendations and the development of policy guidance (in WP6). In particular, some of the information contained in this report will be further deepened in the Technical Screening Report which systematically assesses technical and non-technical regulations, guidelines and recommendations in the WinWind countries and target regions, being critical for social acceptance such as minimum distances from housing, protected areas or height-specific regulations (Task 6.1).

5 References

Agterbosch, S., P. Glasbergen, W.J. Vermeulen (2007). Social barriers in wind power implementation in The Netherlands: perceptions of wind power entrepreneurs and local civil servants of institutional and social conditions in realizing wind power projects. *Renewable and Sustainable Energy Review* 11:1025–55.

Agterbosch, S., R.M. Meertens, W.J.V. Vermeulen (2009). The relative importance of social and institutional conditions in the planning of wind power projects. *Renewable and Sustainable Energy Reviews* 13(2): 393-405.

Aitken, M. (2010a). Why we still don't understand the social aspects of wind power: A critique of key assumptions within the literature. *Energy Policy* 38(4): 1834-1841.

Aitken, M. (2010b). Wind power and community benefits: Challenges and opportunities. *Energy Policy* 38(10): 6066-6075.

Aitken, M., C. Haggett, D. Rudolph, D. (2016). Practices and rationales of community engagement with wind farms: awareness raising, consultation, empowerment. *Planning Theory & Practice* 17(4): 557-576.

Aitken, M., S. McDonald, P. Strachan, P. (2008). Locating 'power' in wind power planning processes: the (not so) influential role of local objectors. *Journal of Environmental Planning and Management* 51(6): 777-799.

Anderson, C. (2013). The networked minority: How a small group prevailed in a local windfarm conflict. *Energy Policy* 58: 97-108.

Angulo, I., D. de la Vega, I. Cascón, J. Cañizo, Y. Wu, D. Guerra, P. Angueira, P. (2014). Impact analysis of wind farms on telecommunication services. *Renewable and Sustainable Energy Reviews* 32: 84-99.

Anker, H.T., M.L. Jørgensen (2015). Mapping of the legal framework for siting of wind turbines – Denmark. Frederiksberg: Department of Food and Resource Economics, University of Copenhagen. IFRO Report, No.239

Anshelm, J., H. Simon (2016). Power production and environmental opinions – Environmentally motivated resistance to wind power in Sweden. *Renewable and Sustainable Energy Reviews* 57: 1545-1555.

Ardente, F., M. Beccali, M. Cellura, V. Lo Brano (2008). Energy performances and life cycle assessment of an Italian wind farm. *Renewable and Sustainable Energy Reviews* 12(1): 200-217.

Arnett E.B., E.F. Baerwald (2013). "Impacts of Wind Energy Development on Bats: Implications for Conservation". In: Adams R., S. Pedersen (eds) *Bat Evolution, Ecology, and Conservation*. New York: Springer.

Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fiedler, B.L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. J. O'Connell, M. D. Piorkowski, R. D. Tankersley JR (2008). Patterns of Bat Fatalities at Wind Energy Facilities in North America. *Journal of Wildlife Management* 72(1): 61-78

Arnett, E.B., M.M.P. Huso, M.R. Schirmacher, J.P. Hayes (2011). Changing wind turbine cut-in speed reduces bat fatalities at wind facilities. *Frontiers in Ecology and the Environment* 9: 209–214.

Arvesen, A., E.G. Hertwich (2011). Environmental implications of large-scale adoption of wind power: A scenario-based life cycle assessment. *Environmental Research Letters* 6(4): 045102.

Asdrubali, F., G. Baldinelli, F. D'Alessandro, F. Scrucca (2015). Life cycle assessment of electricity production from renewable energies: Review and results harmonization. *Renewable and Sustainable Energy Reviews* 42: 1113-1122.

Baraja-Rodríguez E., D. Herrero-Luque, and B. Pérez-Pérez (2015). "A Country of Windmills Wind Energy Development and Landscape in Spain". Ch 3 in Frolova, M. et al. (2015) *Renewable Energies and European Landscapes Lessons from Southern European Cases*. New York: Springer.

Barclay, R.M.R., E.F. Baerwald, J.C. Gruvera (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(3): 381-387.

Barry, J., G. Ellis, C. Robinson (2008). Cool rationalities and hot air: A rhetorical approach to understanding debates on renewable energy. *Global Environmental Politics* 8(2): 67-98.

Batel. S., P. Devine-Wright (2015). Towards a better understanding of people's responses to renewable energy technologies: insights from social representations theory. *Public understanding of Science* 24(3): 311-325.

Bauwens, T., B. Gotchev, L. Holstenkamp (2016). What drives the development of community energy in Europe? The case of wind power cooperatives. *Energy Research & Social Science* 13: 136-147.

Baxter, J., R. Morzaria, R. Hirsch (2013). A case-control study of support/opposition to wind turbines: the roles of health risk perception, economic benefits, and community conflict. *Energy Policy* 61: 931–943.

Bergek, A. (2010). Levelling the playing field? The influence of national wind power planning instruments on conflicts of interest in a Swedish county. *Energy Policy* 38(5): 2357-1369.

Betakova, V., J. Vojar, P. Sklenicka (2015). Wind turbines location: How many and how far? *Applied Energy,* 151: 23-31.

Bevanger, K., R. May, B. Stokke (2017). Landbasert vindkraft. Utfordringer for fugl, flaggermus og rein. NINA Temahefte 66. Trondheim: CEDREN.

Bidwell, D. (2013). The role of values in public beliefs and attitudes towards commercial wind energy*. Energy Policy* 58: 189-199.

Bigerna S, P. Polinori (2011). Italian consumers' willingness to pay for renewable energy sources. USAEE Working Paper 2011.

Birkeland, C. (2011). Assessing the Life Cycle Environmental Impacts of Offshore Wind Power Generation and Power Transmission in the North Sea. MA-thesis. Trondheim: Norwegian University of Science and Technology.

Blaydes Lilley, M., J. Firestone, W. Kempton (2010). The effect of wind power installations on coastal tourism. *Energies* 3(1): 1–22.

Boasson, E.L. (2015). National climate policy. A multi-field approach. London: Routledge.

Bolin, K., G. Bluhm, G. Eriksson, M.E. Nilsson (2011). Infrasound and low frequency noise from windturbines: exposure and health effects. *Environmental Research Letters* 6(3).

Bollino, C.A. (2009). The willingness to pay for renewable energy sources: the case of Italy with Socio-demographic determinants. *The Energy Journal* 30(2): 81-96.

Borchers, A.M., J.M. Duke, G.R. Parsons (2007). Does willingness to pay for green energy differ by source? *Energy Policy* 35(6): 3327-3334.

Boyles, J.G., P.M. Cryan, G.F. McCracken, T.H. Kunz (2011). Economic importance of bats in agriculture. *Science* 332(6025): 41-42.

Brennan, N., T.M.V. Rensburg, C. Morris (2017). Public acceptance of large-scale wind energy generation for export from Ireland to the UK: evidence from Ireland. *Journal of Environmental Planning and Management* 60(11): 1967-1992.

Breukers, S., M. Wolsink (2007). Wind power implementation in changing institutional landscapes: An international comparison. *Energy Policy* 35(5): 2737-2750.

Bristow, G., R. Cowell, M. Munday (2012). Windfalls for whom? The evolving notion of 'community' in community benefit provisions from wind farms. *Geoforum* 43: 1108-1120.

Broekel, T., C. Alfken (2015). Gone with the wind? The impact of wind turbines on tourism demand. *Energy Policy* 86: 506-519.

Brohmann B., Y. Feenstra, E. Heiskanen, M. Hodson, R. Mourik, G. Prasad, R. Raven (2007). Factors influencing the societal acceptance of new, renewable and energy efficiency technologies: meta-analysis of recent European projects. Basel; 2007.

Bronfman N.C., R.B. Jiménez, P.C. Arévalo, L.A. Cifuentes (2012). Understanding social acceptance of electricity generation sources. *Energy Policy* 46:246–52.

Brown, JP, J. Pender, R. Wiser, E. Lantz, B. Hoen (2012). Ex post analysis of economic impacts from wind power development in U.S. counties. *Energy Economics* 34(6): 1743-1754.

Burningham, K., J. Barnett, G. Walker (2015). An Array of Deficits: Unpacking NIMBY Discourses in Wind Energy Developers' Conceptualizations of Their Local Opponents. *Society & Natural Resources* 28(3): 246-260.

Bye, T., M. Hoel, S. Strøm (1999). Et effektivt kraftmarked – konsekvenser for kraftkrevende næringer og regioner. Oslo: Statistics Norway. Available from: https://brage.bibsys.no/xmlui/handle/11250/181354.

Caporale, D., D. De Lucia (2015). Social acceptance of on-shore wind energy in Apulia Region (Southern Italy). *Renewable and Sustainable Energy Reviews* 52: 1378-1390.

Cass, N., G. Walker, P. Devine-Wright (2010). Good neighbours, public relations and bribes: the politics and perceptions of community benefit provision in renewable energy development in the UK. *J Environ Policy Plan*12: 255– 75.

Cicia, G., L. Cembalo, T. Del Giudice, A. Palladino (2012). Fossil energy versus nuclear, wind, solar and agricultural biomass: Insights from an Italian national survey. *Energy Policy* 42: 59-66.

Cohen, J.J. (2014). Re-focussing research efforts on the public acceptance of energy infrastructure: a critical review. *Energy* 76(1): 4-9.

Colman, J. E., S. Eftestøl, D. Tsegaye, K. Flydal, A. Mysterud (2012). Is a wind-power plant acting as a barrier for reindeer Rangifer tarandus movements? *Wildlife Biology* 18(4):439-445.

Corscadden, K., A. Wile, E. Yiridoe (2012). Social license and consultation criteria for community wind projects. *Renew Energy* 44: 392–7.

Cowell, R. (2007). Wind power and the 'planning problem': the experience of Wales. *European Environment* 17(5): 291-306.

Cowell, R., G. Bristow, M. Munday (2012). *Wind energy and justice for disadvantaged communities*. York; 2012.
Crawford, R.H. (2009). Life cycle energy and greenhouse emissions analysis of wind turbines and the effect of size on energy yield. *Renewable and Sustainable Energy Reviews* 13(9): 2653-2660.
Crichton, F., K.J. Petrie (2015). Health complaints and wind turbines: The efficacy of explaining the nocebo response to reduce symptom reporting. *Environmental Research* 140: 449-455.
Czapiewska, G. (2015). Renewable energy sources in the context of sustainable development of northern Poland rural areas. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management. *SGEM* 1(4): 447-454.
Dahl, E.L., K. Bevanger, T. Nygård, E. Røskaft, B.G. Stokke (2012). Reduced breeding success in white-tailed eagles at Smøla windfarm, western Norway, is caused by mortality and displacement. *Biological Conservation* 145(1): 79-85.
Davidsson, S., M. Höök, G. Wall, G. (2012). A review of life cycle assessments on wind energy systems. *The International Journal of Life Cycle Assessment* 17(6): 729-742.
Demski, C., W. Poortinga, N. Pidgeon (2014). Exploring public perceptions of energy security risks in the UK. *Energy Policy* 66: 369–78.
Devine-Wright, P. (2005). Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy* 8:125–39.
Devine-Wright, P. (2007). *Reconsidering public attitudes and public acceptance of renewable energy technologies: a critical review.* United Kingdom: Manchester; 2007.
Devine-Wright, P. (2009). Rethinking NIMBYism: the role of place attachment and place identity in explaining place-protective action. *Journal of Community and Applied Social Psychology* 19: 426–441.
Devine-Wright, P. (2011). Place attachment and public acceptance of renewable energy: a tidal energy case study. *J. Environ. Psychol*: 336-343.
Devine-Wright, P., Y. Howes (2010). Disruption to place attachment and the protection of restorative environments: A wind energy case study. *Journal of Environmental Psychology* 30 (3): 271–80.
Dimitropoulos, A., A. Kontoleon (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.
Dolan, S.L., G.A. Heath (2012). Life Cycle Greenhouse Gas Emissions of Utility-Scale Wind Power. Systematic Review and Harmonization. *Journal of Industrial Ecology* 16: S136-S154.
Dröes, M.I., H.R.A. Koster (2016) Renewable Energy and Negative Externalities: The Effect of Wind Turbines on House Prices. *Journal of Urban Economics* 96: 121-141.
Dütschke, E., U. Schneider, J.Z. Wesche (2017). Knowledge, Use and Effectiveness of Social Acceptance Measures for Wind Projects. *Zeitschrift für Energiewirtschaft* 41(4): 299-310.
Ejdemo, T., P. Söderholm (2015). Wind power, regional development and benefit-sharing: The case of Northern Sweden. *Renewable and Sustainable Energy Reviews* 47: 476-485.
Ek, K. (2005) Public and private attitudes towards “green” electricity: the case of Swedish wind power. *Energy Policy* 33:1677–89.
Ek, K., S. Matti (2015). Valuing the local impacts of a large scale wind power establishment in northern Sweden: public and private preferences toward economic, environmental and sociocultural values. *Journal of Environmental Planning and Management* 58(8): 1327-1345.
Ek, K., L. Persson, M. Johansson, Å. Waldo (2013). Location of Swedish wind power—random or not? A quantitative analysis of differences in installed wind power capacity across Swedish municipalities. *Energy Policy* 58:135–41.
Ek, K., L. Persson (2014). Wind farms - where and how to place them? A choice experiment approach to measure consumer preferences for characteristics of wind farm establishments in Sweden. *Ecological Economics* 105: 193-203.
Ellis, G., J. Barry, C. Robinson (2007). Many ways to say 'no', different ways to say 'yes'. Applying Q-methodology to understand public acceptance of wind farms proposals. *Journal of Environmental Planning and Management* 50(4): 517-551.
Ellis, G., R. Cowell, C. Warren, P. Strachan, J. Szarka, R. Hadwin, P. Miner, M. Wolsink, A. NadaÏ (2009). Wind Power: Is There A “Planning Problem”? *Planning Theory and Practise* 10(4): 521-547.
Ellis, G., G. Ferraro (2016). The Social Acceptance of Wind Energy: Where we stand and the path ahead. Joint Research Center (European Commission).
Eltham, D.C., G.P. Harrison, S.J. Allen (2008). Change in public attitudes towards a Cornish wind farm: Implications for planning. *Energy Policy* 36(1): 23-33.
Enevoldsen, P., B. Sovacool (2016). Examining the social acceptance of wind energy: Practical guidelines for onshore wind project development in France. *Renewable and Sustainable Energy Reviews* 53: 178-184.
Ertör-Akyazı, P., F. Adaman, B. Özkaynak, Ü. Zenginobuz (2012). Citizens’ preferences on nuclear and renewable energy sources: evidence from Turkey. *Energy Policy* 47:309–20.

European Commission (2011a) Energy Roadmap 2050, the reports are available on the European Commission's website: http://www.roadmap2050.eu/reports. Accessed: 15.11.17

European Commission (2011b) Special Eurobarometer 364 – Public Awareness and Acceptance of CO_2-capture and storage. https://data.europa.eu/euodp/en/data/dataset/S848_75_1_EBS364. Accessed: 15.11.17

European Wind Energy Association (2010). Administrative and grid access barriers to wind power. http://www.ewea.org/fileadmin/files/library/publications/reports/WindBarriers_report.pdf. Accessed 15. Nov 2017.

European Wind Energy Association (2010). WindBarriers. Administrative and grid access barriers to wind power. July 2010.

Evans, A., V. Strezov, T.J. Evans (2009). Assessment of sustainability indicators for renewable energy technologies. *Renewable and Sustainable Energy Reviews* 13: 1082-1088.

Fast, S. (2013). Public opinion and communicative action around renewable energy projects. PhD thesis, Department of Geography, Faculty of Arts, University of Ottawa, Canada.

Fast, S., W. Mabee, J. Baxter, T. Christidis, L. Driver, S. Hill, J.J. McMurtry, M. Tomkow (2016). Lessons learned from Ontario wind energy disputes. *Nature Energy* 1: Article number: 15028.

Fast, S., W. Mabee (2015). Place-making and trust-building. The influence of policy on host community responses to wind farms. *Energy Policy* 81: 27-37.

Fauchald, O.K. (2018). Concession Processes for Wind Power Developments in Norway – an Analysis of the Legal Framework. FNI Report 1/2018. Lysaker : Fridtjof Nansen Institute. https://www.fni.no/getfile.php/137519/Filer/Publikasjoner/FNI%201-2018%20OKF.pdf

Fergen, J., J.B. Jacquet (2016). Beauty in motion: Expectations, attitudes, and values of wind energy development in the rural U.S. *Energy Research & Social Science* 11: 133-141.

Firestone, J., A. Bates, L.A. Knapp (2015). See me, Feel me, Touch me, Heal me: Wind turbines, culture, landscapes, and sound impressions. *Land Use Policy* 46: 241-249.

Firestone, J., W. Kempton, A. Krueger (2009). Public acceptance of offshore wind power projects in the USA, *Wind Energ*y 12(2) :183–202.

Fisher, J., K. Brown (2009). Wind energy and Isle of Lewis: implications for deliberative planning. *Environment and Planning A* 41: 2516-2526.

Fehrenbach, H. (2009). Pilotstudie zur Akzeptanz vertikaler Windenergieanlagen: Abschlussbericht zum BMU-EE-Querschnitts-Forschungsvorhaben (FKZ: 0327644). Arbeitspaket Umweltverträglihkeit und Ökobilanz vertikaler Windenergieanlagen, Heidelberg; 2009.

Ferguson-Martin, C.J., S.D. Hill (2011). Accounting for variation in wind deployment between Canadian provinces. *Energy Policy* 39:1647–58.

Ferri, V., C. Battisti, C. Soccini (2016). Bats in a Mediterranean Mountainous Landscape: Does Wind Farm Repowering Induce Changes at Assemblage and Species Level? *Environmental Management* 57(6): 1240-1246.

Fournis, Y., M.-J. Fortin (2016). From social 'acceptance' to social 'acceptability' of wind energy projects: towards a territorial perspective. *Journal of Environmental Planning and Management* 60(1): 1-21.

Frantál, B., J. Kunc (2011). Wind turbines in tourism landscapes: Czech Experience. *Annals of Tourism Research* 38(2): 499-519.

Frantál, B. (2009). Impacts of the operation of wind turbines as perceived by residents in concerned areas. *Moravian Geographical Reports* 17:35–45.

Frantál, B. (2014). Have local government and public expectations of wind energy project benefits been met? Implications for repowering schemes *J Environ Policy Plan* 17:217–36.

Frantál, B, A. Prousek (2016). It's not right, but we do it. Exploring why and how Czech farmers become renewable energy producers. *Biomass Bioenergy* 87:26–34.

Fthenakis, V., H.C. Kim (2009). Land use and electricity generation: A life-cycle analysis. *Renewable and Sustainable Energy Reviews* 13: 1465-1474.

Gamboa, G., G. Munda (2007). The problem of windfarm location: a social multi-criteria evaluation framework. *Energy Policy* 35:1564–83.

Gibbons, S. (2015). Gone with the wind: Valuing the visual impacts of wind turbines through house prices. *Journal of Environmental Economics and Management* 72: 177-196.

Graham J.B., J.R. Stephenson, I.J. Smith (2009). Public perceptions of wind energy developments: case studies from New Zealand. *Energy Policy* 37:3348–57.

Goedkoop, F., P. Devine-Wright (2016). Partnership or placation? The role of trust and justice in the shared ownership of renewable energy projects*. Energy Research & Social Science* 17: 135-146.

Greenberg, M. (2009). Energy sources, public policy, and public preferences: Analysis of US national and site-specific data. *Energy Policy* 37(8): 3242-3249.

Greenberg, M. (2014). Energy policy and research: the underappreciation of trust. *Energy Res Soc Sci*.1:152–60.

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.
Groth, T.M., C. Vogt (2014). Residents' perceptions of wind turbines: an analysis of two townships in Michigan. *Energy Policy* 65: 251.
Guezuraga, B., R. Zauner, W. Pölz (2012). Life cycle assessment of two different 2 MW class wind turbines. *Renewable Energy* 37(1): 37-44.
Hager, C.P. (2014). Skiftende bris? En case-studie av de største endringene i norsk vindkraftpolitikk i perioden 1990 til 2012. FNI Report 6/2014. Oslo: Fridtjof Nansen Institute.
Hall, N., P. Ashworth, P. Devine-Wright (2013). Societal acceptance of wind farms: Analysis of four common themes across Australian case studies. *Energy Policy* 58: 200-208.
Hall, N., J. Lacey, S. Carr-Cornish, A.-M. Dowd (2015). Social license to operate: understanding how a concept has been translated into practice in energy industries. *Journal of Cleaner Production* 86: 301-310.
Harding, G., P. Harding and A. Wilkins (2008). Wind turbines, flicker, and photosensitive epilepsy: characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them. *Epilepsia* 49(6): 1095-1098.
Hartley, P., K. Medlock, T. Temzelides, X. Zhang (2015). Local employment impact from competing energy sources: Shale gas versus wind generation in Texas. *Energy Economics* 49: 610-619.
Heinbach, K. et al. (2014) Renewable energies and their impact on local value added and employment. *Energy, Sustainability and Society* 4(1).
Heyerdahl Refsum AS (2017). Rapporten Incoming 2017. Available at: https://www.virke.no/globalassets/bransje/bransjebilder-reise-og-kultur/incoming-2017-pr.-12.12.2017-denne.pdf
Hill, S.D., J.D. Knott (2010). Too Close for Comfort: Social Controversies Surrounding Wind Farm Noise Setback Policies in Ontario. *Renewable Energy Law and Policy Review* 1(2): 153-168.
Hirsch, R.F., B.K. Sovacool (2013). Wind Turbines and Invisible Technology: Unarticulated Reasons for Local Opposition to Wind Energy. *Technology and Culture* 54(4): 705-734.
Hobman, E.V., P. Ashworth (2013). Public support for energy sources and related technologies: The impact of simple information provision. *Energy Policy* 63: 862-869.
Hoen, B., R. Wiser, P. Cappers, M. Thayer, G. Sethi (2011). Wind Energy Facilities and Residential Properties: The Effect of Proximity and View on Sales Prices. *Journal of Real Estate Research* 33(3): 279-316.
Hoen, B., J.P. Brown, T. Jackson, M.A. Thayer, R. Wiser, P. Cappers (2015). Spatial Hedonic Analysis of the Effects of US Wind Energy Facilities on Surrounding Property Values. *The Journal of Real Estate Finance and Economics* 51(1): 22-51.
Höfer, T., Y. Sunak, H. Siddique, R. Madlener (2016). Wind farm siting using a spatial Analytic Hierarchy Process approach: A case study of the Städteregion Aachen. *Applied Energy* 163*:* 222-243.
Holburn, G., K. Lui, C. Morand (2010). Policy risk and private investment in Ontario's wind power sector. *Can Public Policy* 36:465–86.
Holden, E., K. Linnerud, D. Banister (2014). Sustainable development: Our common future revisited. *Global Environmental Change* 26: 130–139.
Holden, E., K. Linnerud, D. Banister (2017). The imperatives of sustainable development: needs, equity, and limits. *Sustainable Development* 25(3): 213-226.
Hübner, G., J. Pohl, F. Meinel, K. Schikora (2010). Pilotstudie zur Akzeptanz vertikaler Windenergieanlagen: Abschlussbericht zum BMU-EE-Querschnitts-Forschungsvorhaben. Arbeitspaket Soziale Akzeptanz und Anlagengestaltung, Halle (Saale) 2010.
Hübner, G., J. Pohl (2015). Mehr Abstand - mehr Akzeptanz? Ein umweltpsychologischer Studienvergleich. Fachagentur Windenergie an Land. https://www.fachagentur-windenergie.de/fileadmin/files/Akzeptanz/FA-Wind_Abstand-Akzeptanz_Broschuere_2015.pdf. Accessed: 03.05.18.
Huesca-Pérez, M. E., C. Sheinbaum-Pardo, J. Köppel (2016). Social implications of siting wind energy in a disadvantaged region – The case of the Isthmus of Tehuantepec, Mexico. *Renewable and Sustainable Energy Reviews* 58: 952-965.
Huijts, N.M.A., E.J.E. Molin, L. Steg (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. *Renewable and Sustainable Energy Reviews* 16(1): 525-531.
Ifeu (2009). Pilotstudie zur Akzeptanz vertikaler Windenergieanlagen: Abschlussbericht zum BMU-EE-Querschnitts-Forschungsvorhaben. Arbeitspaket Marktanalyse „Kleine Windkraft", Heidelberg, 2009.
International Energy Agency (IEA) (2013). Social Acceptance of wind energy projects - Expert group summary on recommended practices, Task 28.

International Energy Agency (IEA) (no date). Wind energy in Norway. Website available at: https://community.ieawind.org/about/member-activities/norway

Iuga, D., M. Dragan, B. Claessens, E. Dütschke, U. Schneider, J. Wesche, J. Ramsay (2016). Final result-oriented report WISE Power, Foster social acceptance for wind power, October 2016 (Deliverable 1.1). Available at http://wisepower-project.eu/wp-content/uploads/FINAL_WISE-Power-Result_oriented-report_Deliverable-D1.1-1.pdf. Accessed: 28.03.18.

Jacquet, J.B., R.C Stedman (2013). Perceived impacts from wind arm and natural gas development in Northern Pennsylvania. *Rural Sociology* 78(4): 450-472.

Jensen, C.U., T.E. Panduro, T.H. Lundhede, A.S.E. Nielsen, M. Dalsgaard, B.J. Thorsen (2018). The impact of on-shore and off-shore wind turbine farms on property prices. *Energy Policy* 116: 50-59.

Jepson, W., C. Brannstrom, N. Persons (2012). "We Don't Take the Pledge": Environmentality and environmental skepticism at the epicenter of US wind energy development. *Geoforum* 43(4): 851-863.

Jerpåsen, G.B., K.C. Larsen (2011). Visual impact of wind farms on cultural heritage: A Norwegian case study. *Environmental Impact Assessment Review* 31(3): 206-215.

Jobert, A., P. Laborgne, S. Mimler (2007). Local acceptance of wind energy: factors of success identified in French and German case studies. *Energy Policy* 35:2751–60.

Johansson, M., T. Laike (2007). Intention to Respond to Local Wind Turbines: The Role of Attitudes and Visual Perception. *Wind Energy* 10: 435-451.

Jones, C.R., J.R. Eiser (2009). Identifying predictors of attitudes towards onshore wind development with reference to an English case study. *Energy Policy* 37: 4604-4614.

Jones, C.R., B.J. Orr, J.R. Eiser (2011). When is enough, enough? Identifying predictors of capacity estimates for onshore wind-power development in a region of the UK. *Energy Policy* 39(8): 4563-4577.

Kaldellis, J.K., M. Kapsali, E. Kaldelli, E. Katsanou (2013). Comparing recent views of public attitude on wind energy, photovoltaic and small hydro applications. *Renewable Energy* 52:197–208.

Karlstrøm, H., M. Ryghaug (2014). Public attitudes towards renewable energy technologies in Norway. The role of party preferences. *Energy Policy* 67: 656-663.

Katsaprakakis, D.A. (2012). A review of the environmental and human impacts from wind parks. A case study for the Prefecture of Lasithi, Crete. *Renewable and Sustainable Energy Reviews* 16(5): 2850-2863.

Klæboe, R., H. Sundfør (2016). Windmill noise annoyance, visual aesthetics, and attitudes towards renewable energy sources. *International Journal of Environmental Research and Public Health* 13: 746.

Komarek, T.M., F. Lupi, M.D. Kaplowitz (2011). Valuing energy policy attributes for environmental management: choice experiment evidence from a research institution. *Energy Policy* 39:5105–15.

Knopper, L.D., Ollson, C.A. (2011). Health effects and wind turbines: A review of the literature. *Environmental Health*10(1).

Knopper, L. D., Ollson, C. A., McCallum, L. C., Whitfield Aslund, M. L., Berger, R. G., Souweine, K., McDaniel, M. (2014). Wind turbines and human health. *Frontiers in Public Health* 2: 63.

Korner-Nievergelt, F., P. Korner-Nievergelt, O. Behr, I. Niermann, R. Brinkmann, B. Hellriegel (2011). A new method to determine bird and bat fatality at wind energy turbines from carcass searches. *Wildlife Biology* 17(4): 350-363.

Kubiszewski, I., C.J. Cleveland, P.K. Endres (2010). Meta-analysis of net energy return for wind power systems. *Renewable Energy* 35(1): 218-225.

Ladenburg, J., J.-O. Dahlgaard (2012). Attitudes, threshold levels and cumulative effects of the daily wind-turbine encounters. *Applied Energy* 98: 40-46.

Ladenburg, J. (2008). Attitudes towards on-land and offshore wind power development in Denmark; choice of development strategy. *Renewable Energy* 33(1) :111–8.

Ladenburg, J., M. Termansen, B. Hasler (2013). Assessing acceptability of two onshore wind power development schemes: a test of viewshed effects and the cumulative effects of wind turbines. *Energy* 54:45–54.

Landry, C.E., T. Allen, T. Cherry, J.C. Whitehead (2012). Wind turbines and coastal recreation demand. *Resource and Energy Economics* 34(1): 93-111.

Langer, K., T. Decker, J. Roosen, L. Menrad (2016). A qualitative analysis to understand the acceptance of wind energy in Bavaria. *Renewable and Sustainable Energy Reviews* 64: 248-259.

Lantz, E., S. Tegen (2008). Variables affecting economic development of wind energy. National Renewable Energy Laboratory, conference paper, NREL/CP-500-43506, 2008.

Lawrence, R. (2014) Internal colonisation and Indigenous resource sovereignty: wind power developments on traditional Saami lands. *Environment and Planning D: Society and Space* 32: 1036 – 1053.

Lehnert, L.S. S. Kramer-Schadt, S. Schönborn, O. Lindecke, I. Niermann, C.C. Voigt (2014). Wind farm facilities in Germany kill noctule bats from near and far. *PLoS ONE* 9(8),e103106.

Liebe, U., A. Bartczak, J. Meyerhoff (2017). A turbine is not only a turbine: The role of social context and fairness characteristics for the local acceptance of wind power. *Energy Policy* 107: 300-308.

Liljenfeldt, J. (2014). Legitimacy and Efficiency in Planning Processes—(How) Does Wind Power Change the Situation? *European Planning Studies* 23(4): 811-827.

Longo, A., A. Markandya, M. Petrucci (2008). The internalization of externalities in the production of electricity: willingness to pay for the attributes of a policy for renewable energy. *Ecological Economics* 67(1): 140–52.

Łopucki, R., I. Mróz (2016). An assessment of non-volant terrestrial vertebrates response to wind farms—a study of small mammals. *Environmental Monitoring and Assessment* 188(2),122: 1-9.

Loss, S. R., T. Will, P. P. Marra (2013). Estimates of bird collision mortality at wind facilities in the contiguous United States, *Biol. Conserv*. 168: 201–209.

Lovich, J.E., J.R. Ennen (2013). Assessing the state of knowledge of utility-scale wind energy development and operation on non-volant terrestrial and marine wildlife. *Applied Energy* 103: 52-60.

Magari, S. R., C.E. Smith, M. Schiff, A.C. Rohr (2014). Evaluation of community response to wind turbine-related noise in Western New York State. *Noise Health* 16 (71): 228.

Mariel P, J. Meyerhoff, S. Hess (2015). Heterogeneous preferences toward landscape externalities of wind turbines – combining choices and attitudes in a hybrid model. *Renewable and Sustainable Energy Reviews* 41: 647-657.

Mårtensson, K., K. Westerberg (2007). How to transform local energy systems towards bioenergy? Three strategy models for transformation. *Energy Policy* 35: 6095-6105.

Martínez, E., F. Sanz, S. Pellegrini, E. Jiménez, J. Blanco (2008). Life cycle assessment of a multi-megawatt wind turbine. *Renewable Energy* 34(3): 667-673.

Martínez, E., E. Jiménez, J. Blanco, F. Sanz (2010). LCA sensitivity analysis of a multi-megawatt wind turbine. *Applied Energy* 87: 2293-2303.

McCallum, L.C., M.L.W. Aslund, L.D. Knopper, G.M. Ferguson, C.A. Ollson (2014). Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern? *Environmental Health* 13(1): 9.

McCunney, R.J, K. A. Mundt, W.D. Colby, R. Dobie, K. Kaliski, M. Blais (2014). Wind Turbines and Health. A Critical Review of the Scientific Literature. *Journal of Occupational and Environmental Medicine* 56(11): 108-130.

McLaren, L.J. (2007). Wind energy planning in England, Wales and Denmark: factors influencing project success. *Energy Policy* 35:2648–60.

Menon (2015). Verdiskapingsanalyse av reiselivsnæringen i Norge – utvikling og fremtidspotensial. Report. Available at: https://www.regjeringen.no/contentassets/78e603ad6c8e432695d2bca64fe54d3f/verdiskapingsanalyse-av-reiselivsnaringen-sluttrapport-28--januar-2015.pdf

Meyerhoff, J., C. Ohl, V. Hartje (2010). Landscape externalities from onshore wind power. *Energy Policy* 38:82–92.

Meyer, N.I. (2007), Learning from wind energy policy in the EU: lessons from Denmark, Sweden and Spain. *Environmental Policy and Governance* 17: 347–362.

Ministry of Trade, Industry and Fisheries (2017). Meld. St. 19 (2016 – 2017). Opplev Norge – unikt og eventyrlig. Available at: https://www.regjeringen.no/contentassets/95efed8d5f0442288fd430f54ba244be/no/pdfs/stm201620170019000dddpdfs.pdf

Molnarova, K., Sklenicka P., Stiborek J, Svobodova K., Salek M., Brabec E. (2012). Visual preferences for wind turbines: Location, numbers and respondent characteristics. *Applied Energy* 92: 269–78.

Mukinovic M, Aragall R, Brenner G. (2009) Pilotstudie zur Akzeptanz vertikaler Windenergieanlagen: Abschlussbericht zum BMU-EE-Querschnitts-For-schungsvorhaben. Clausthal 2009.

Multiconsult og Analyse & Strategi (2016). Omsetning og sysselsetting i den norskbaserte fornybarnæringen. Rport 126814-RIEn-RAP-001. Available at: https://www.regjeringen.no/contentassets/2c36d6161862496e8035170c98bf1106/omsetning-og-sysselsetting-i-den-norskbaserte-fornybarnaringen_endelig-r....pdf

Musall, F.D., Kuik O. (2011). Local acceptance of renewable energy—a case study from southeast Germany. *Energy Policy* 39:3252–60.

Norwegian Petroleum (no date). Employment in the petroleum industry. Norwegian Petroleum's website. Available at: https://www.norskpetroleum.no/en/economy/employment/

Nugent, D., Sovacool, B. (2014). Assessing the lifecycle greenhouse gas emissions from solar PV and wind energy: A critical meta-survey. *Energy Policy* 65: 229-244.

Oles, T., Hammarlund, K. (2011). The European Landscape Convention, Wind Power, and the Limits of the Local: Notes from Italy and Sweden. Landscape Research, 36 (4), 471-485.

Olson-Hazboun, S.K., R.S. Krannich, P.G. Robertson (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 Res. Soc. Sci*. 21 (2016).

Øvrebø, O.A (2016, 15 February). Ni EU-land – og Norge – har klart fornybarmålet for 2020. Energi og klima. Available at: http://energiogklima.no/nyhet/aktuell-grafikk/ni-eu-land-og-norge-har-klart-fornybarmalet-2020/

Parent, O., A. Ilinca (2011). Anti-icing and de-icing techniques for wind turbines: Critical review. *Cold Regions Science and Technology* 65(1): 88-06.

Pasqualetti, M.J. (2000). Morality, space, and the power of wind-energy landscapes. *Geographical Review*: 381–4.

Pasqualetti, M.J. (2011) Opposing Wind Energy Landscapes: A Search for Common Cause. *Annals of the Association of American Geographers* 101(4): 907-917.

Petrova, M.A. (2013). NIMBYism revisited: public acceptance of wind energy in the United States, *Wiley Interdisciplinary Reviews: Climate Change* 4(6): 575–601.

Phadke, R. (2013). Public Deliberation and the Geographies of Wind Justice. *Science as Culture* 22(2): 247-255.

Phimister, E., D. Roberts (2012). The role of ownership in determining the rural economic benefits of on-shore wind farms. *Journal of Agricultural Economics* 63(2): 331-360.

Pedersen, E. (2011). Health aspects associated with wind turbine noise—Results from three field studies. *Noise Control Engineering Journal* 59(1): 47-53.

Petterson, M, K Ek, S Söderholm, P Söderholm (2010). Wind power planning and permitting: Comparative perspectives from the Nordic countries. *Renewable and Sustainable Energy Reviews* 14: 3116-3123.

Pinto, J., Matthews, J.C.G., Sarno, G.C. (2010). Stealth technology for wind turbines. *IET Radar, Sonar and Navigation* 4(1): 126-133.

Pohl, J., J. Gabriel, G. Hübner (2018). Understanding stress effects of wind turbine noise – The integrated approach. *Energy Policy* 112: 119–128.

Pohl, J., G. Hübner, A. Mohs (2012). Acceptance and stress effects of aircraft obstruction markings of wind turbines. *Energy Policy* 50: 592–600.

Polish Wind Energy Association (2016). The State of Wind Energy in Poland.

Price, L., A. Kendall (2012). Wind Power as a Case Study Improving Life Cycle Assessment Reporting to Better Enable Meta-Analyses. *Journal of Industrial Ecology* 16: 22-27.

Priedite, I., G. Bazbauers (2016). Combination of wind power plants and district heating systems - Technical, economic and environmental aspects. *Engineering for Rural Development*: 1280-1285.

Prno, J. and D. S. Slocombe (2012). Exploring the origins of 'social license to operate' in the mining sector: Perspectives from governance and sustainability theories. *Resources Policy,* 37(3), 346-357.

Raadal, H.L., I.S. Modahl, T.H. Bakken (2012). Energy indicators for electricity production. Report no. OR.09.12. Østfoldforskning.

Rand, J., Hoen, B. (2017). Thirty years of North American wind energy acceptance research: What have we learned? *Energy Research and Social Science* 29: 135-148.

Rave T, Goetzke F. (2016). Explaining the heterogeneous growth of wind energy across Germany. *Utilities Policy* 41: 193-205.

Reed, M.S. (2008) Stakeholder participation for environmental management: A literature review. *Biological conservation* 141: 2417-2431.

Research Council of Norway (2016). Norsk næringsliv innenfor miljøvennlig teknologi. Oslo: The Research Council of Norway.

Ribe, R.G., Manyoky, M., Wissen Hayek, U., Pieren, R., Heutschi, K., Grêt-Regamey, A. (2018). Dissecting perceptions of wind energy projects: A laboratory experiment using high-quality audio-visual simulations to analyze experiential versus acceptability ratings and information effects. *Landscape and Urban Planning* 169: 131-147.

Ribeiro F, Ferreira P, Araújo M, Braga AC. (2014) Public opinion on renewable energy technologies: the Portuguese case. Portugal: University of Minho; 2014.

Rollins, K. E., Meyerholz, D. K., Johnson, G. D., Capparella, A. P., Loew, S. S., (2012). A forensic investigation into the etiology of bat mortality at a wind farm: barotrauma or traumatic injury? *Veterinary Pathology Online* 49(2): 362-371

Roques, F., C. Hiroux, M. Saguan (2010). Optimal wind power deployment in Europe – a portfolio approach. *Energy Policy* 38:3245–56.

Ruud, A., L.C. Wold, Ø. Aas (2016). Økt samfunnsaksept for fornybar energi. Hvordan redusere konflikter under planlegging, utygging og drift? NINA Temahefte 68. Trondheim: CEDREN.

Rydell, J., L. Bach, M.J. Dubourg-Savage, M. Green, L. Rodrigues, A. Hedenström (2010). Bat mortality at wind turbines in northwestern Europe. *Acta Chiropterologica* 12(2): 261-274.

Rygg, B.J. (2012). Wind power—An assault on local landscapes or an opportunity for modernization? *Energy Policy* 48: 167-175.

Schacht, V., R. Wiese (2009). Pilotstudie zur Akzeptanz vertikaler Windenergieanlagen: Abschlussbericht zum BMU-EE-Querschnitts-For- schungsvorhaben. Arbeitspaket Exportpotenzial von VWEA für dezentrale Anwendungen in Entwicklungs- und Schwellenländern. Halle; 2009.

Schumann, D., W. Fischer, J.-F. Hake (2012). Akzeptanz der Transformation des Energiesystems in der Bevölkerung. *Energiewirtsch Tagesfr* 62(6): 29-33.

Sklenicka P, J. Zouhar (2018). Predicting the visual impact of onshore wind farms via landscape indices: A method for objectivizing planning and decision processes. *Applied Energy* 209:445-454.

Slattery, M.C., B.L. Johnson, J.A. Swofford, M.J. Pasqualetti (2012). The predominance of economic development in the support for large-scale wind farms in the U.S. Great Plains. *Renewable and Sustainable Energy Reviews* 16 (6): 3690–3701.

Smarsly, K., D. Hartmann, K. H. Law (2013). An integrated monitoring system for life-cycle management of wind turbines. *Smart Structures and Systems* 12(2): 209-233.

Söderholm, P., K. Ek, M. Pettersson (2007). Wind power development in Sweden: global policies and local obstacles. *Renewable and Sustainable Energy Reviews* 11:365–400.

Solli, J. (2010) Where the eagles dare? Enacting resistance to wind farms through hybrid collectives. *Environmental Politics* 19(1): 45-60.

Sonnberger, M., M. Ruddat (2017). Local and socio-political acceptance of wind farms in Germany. *Technology in Society* 51: 56–65.

Sovacool, B.K. (2009). Rejecting renewables: the socio-technical impediments to renewable electricity in the United States. *Energy Policy* 37(11): 4500–4513.

Sovacool, B.K., P.L. Ratan (2012). Conceptualizing the acceptance of wind and solar electricity. *Renewable and Sustainable Energy Reviews* 16(7): 5268-5279.

Sovacool, B.K., M.A. Munoz Perea, A.V. Matamoros, P. Enevoldsen (2016). Valuing the manufacturing externalities of wind energy: assessing the environmental profit and loss of wind turbines in Northern Europe*. Wind Energy* 19(9): 1623-1647.

Sovacool, B, R. Sidortsov, B. Jones B (2014). *Energy security, equality and justice*. London: Routledge.

Spanish Wind Energy Association (2013). Wind power 2013.

Spence, A., D. Venables, N. Pidgeon, W. Poortinga, C. Demski (2010). Public perceptions of climate change and energy futures in Britain: summary findings of a survey conducted in January– March 2010. Understanding Risk Working Paper 10-01, Cardiff University, Wales.

Sperling, K., F. Hvelplund, B.V. Mathiesen (2010). Evaluation of wind power planning in Denmark – Towards an integrated perspective. *Energy* 35(12): 5443-5454.

Stanek, W., L. Czarnowska, W. Gazda, T. Simla (2018). Thermo-ecological cost of electricity from renewable energy sources. *Renewable Energy* 115: 87-96.

Strazzera, E., M. Mura, D. Contu (2012) Combining choice experiments with psychometric scales to assess the social acceptability of wind energy projects: A latent class approach. *Energy Policy* 48: 334-347.

Strunz, S. (2014). The German energy transition as a regime shift. *Ecological Economics* 100: 150-158.

Sunak, Y., R. Madlener (2016). The impact of wind farm visibility on property values: A spatial difference-in-differences analysis. Energy Economics 55: 79-91.

Swofford, J., M. Slattery (2010) Public attitudes of wind energy in Texas: local communities in close proximity to wind farms and their effect on decision-making. *Energy Policy* 38:2508–19.

Szarka, J. (2007). *Wind power in Europe: politics, business and society*. Basingstoke: Palgrave Macmillan.

Szulecki, K. (2017). 'Poland's renewable energy policy mix: European influence and domestic soap opera', CICERO Working Paper 1/2017.

Sæþórsdóttir, A.D., R. Ólafsdóttir, D. Smith (2017). Turbulent times: tourists' attitudes towards wind turbines in the Southern Highlands in Iceland. *International Journal of Sustainable Energy*, advance online publication.

Tapia, L., Domínguez, J., Rodríguez, L. (2009). Using probability of occurrence to assess potential interaction between wind farms and a residual population of golden eagle Aquila chrysaetos in NW Spain. *Biodiversity and Conservation* 18(8): 2033-2041.

Tellería, J.L. (2009). Wind power plants and the conservation of birds and bats in Spain: a geographical assessment. *Biodiversity and Conservation* 18:1781.

Toke, D., S. Breukers, M. Wolsink (2008). Wind power deployment outcomes: how can we account for the differences? *Renewable and Sustainable Energy Reviews* 12(4):1129–47.

Tremeac, B., F. Meunier (2009). Life cycle analysis of 4.5 MW and 250 W wind turbines. *Renewable and Sustainable Energy Reviews* 13(8): 2104-2110.

Umwelt Bundesamt (2018). Erneuerbare Energien in Zahlen. Available at: https://www.umweltbundesamt.de/themen/klima-energie/erneuerbare-energien/erneuerbare-energien-in-zahlen#statusquo.

UN (2015). *Transforming our world: the 2030 Agenda for Sustainable Development.* Resolution adopted by the General Assembly on 25 September 2015, A/RES/70/1. United Nations General Assembly.

Upham, P., C. Oltra, À Boso (2015). Towards a cross-paradigmatic framework of the social acceptance of energy systems. *Energy Research and Social Science* 8: 100-112.

Van der Horst, D. (2007). NIMBY or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies. *Energy Policy* 35: 2705–14.

Van der Horst, D., D. Toke (2010). Exploring the landscape of wind farm developments; local area characteristics and planning process outcomes in rural England. *Land Use Policy*: 214–21.

Veidemane, K., O. Nikodemus (2014). Coherence between marine and land use planning: public attitudes to landscapes in the context of siting a wind park along the Latvian coast of the Baltic Sea. *Journal of Environmental Planning and Management* 58(6): 949-975.

Vistnes, I., C. Nellemann (2008). The matter of spatial and temporal scales: a review of reindeer and caribou response to human activity *Polar Biology* 31: 399–407.

Voigt, C.C., L.S. Lehnert, G. Petersons, F. Adorf, L. Bach (2015). Wildlife and renewable energy: German politics cross migratory bats. *European Journal of Wildlife Research* 61(2): 213-219.

Voltaire, L., M.L Loureiro, C. Knudsen, P.A.L.D. Nunes (2017). The impact of offshore wind farms on beach recreation demand: Policy intake from an economic study on the Catalan coast. *Marine Policy* 81: 116-123.

Walker, C., J. Baxter (2017). “It's easy to throw rocks at a corporation”: wind energy development and distributive justice in Canada. *Journal of Environmental Planning and Management*: 1-15.

Walker, G., P. Devine-Wright (2008). Community renewable energy: what should it mean? *Energy Policy* 36:497–500.

Walker, B.J.A., B. Wiersma, E. Bailey (2014). Community benefits, framing and the social acceptance of offshore wind farms: an experimental study in England. *Energy Research and Social Science* 3: 46-54.

Walter, G., H. Gutscher (2010). Public acceptance of wind energy and bioenergy projects in the framework of distributive and procedural justice theories: Insights from Germany. Austria and Switzerland: Zürich; 2010.

Wang, S., S. Wang (2015). Impacts of wind energy on environment: A review. *Renewable and Sustainable Energy Reviews* 49: 437-443.

Warren, C.R., M. McFadyen (2010). Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. *Land Use Policy* 27:204–13.

Warren C.R., C. Lumsden, S. O'Dowd, R.V. Birnie (2005). 'Green on green': public perceptions of wind power in Scotland and Ireland. *Journal of Environmental Planning and Management*:853–75.

Watson, I., S. Betts, E. Rapaport (2012). Determining appropriate wind turbine setback distances: Perspectives from municipal planners in the Canadian provinces of Nova Scotia, Ontario, and Quebec. *Energy Policy* 41:782–9.

Weisser, D. (2007) A guide to life-cycle greenhouse gas (GHG) emissions from electric supply technologies, *Energy* 32(9): 1543-1559.

Wells, M. (2009). Overcoming wind resistance: enhancing community acceptance of wind projects in Ontario. Master Thesis, Faculty of Arts and Social Sciences, Simon Fraser University, Canada, 2009.

Wiedmann, T.O., S. Suh, K. Feng, M. Lenzen, A. Acquaye, K. Scott, J.R. Barrett (2011). Application of hybrid life cycle approaches to emerging energy technologies--the case of wind power in the UK. *Environmental Science and Technology* 45(13):5900-7.

Wilson, G.A., S.L. Dyke (2016). Pre- and post-installation community perceptions of wind farm projects: the case of Roskrow Barton (Cornwall, UK). *Land Use Policy* 52: 287-296.

Wizelius, T. (2007). *Developing wind power projects*. 1st ed. United Kingdom: Earthscan.

Wolsink, M. (2000). Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support. *Renewable Energy* 21:49–64.

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.

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.

Wüstenhagen, R., M. Wolsink, M.J. Bürer (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy* 24: 2683-2691.

Zakeri, B., S. Syri, (2015). Electrical energy storage systems: A comparative life cycle cost analysis. *Renewable and Sustainable Energy Reviews* 42: 569-596.

Zerrahn, A. (2017) Wind Power and Externalities. *Ecological Economics* 141: 245-260.

Zhong, Z.W., B. Song, P.E. Loh (2011). LCAs of a polycrystalline photovoltaic module and a wind turbine. *Renewable Energy* 36: 2227-2237.

Zimmerling, J., A. Pomeroy, M. d’Entremont, C. Francis (2013). Canadian estimate of bird mortality due to collisions and direct habitat loss associated with wind turbine developments. *Avian Conservation and Ecol*ogy 8(2):10.

Zoellner, J., P. Schweizer-Ries, C. Wemheuer (2008). Public acceptance of renewable energies: results from case studies in Germany. *Energy Policy* 36:4136–41.

Zografos, C., J. Martinez-Alier (2009). The politics of landscape value: a case study of wind farm conflict in Catalonia. *Environment and Planning A* 41(7): 1726-1744.

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