UNIVERSITY OF STAVANGER BUSINESS SCHOOL

# MASTER'S THESIS

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| STUDY PROGRAMME:<br><br>**Master of Science in Business Administration** | THIS THESIS HAS BEEN WRITTEN WITHIN THE FOLLOWING FIELD OF<br><br>SPECIALIZATION: **Economic Analysis**<br><br>IS THE THESIS CONFIDENTIAL? **No**<br><br>**(NB!** Use the red form for confidential theses) |

TITLE:

**Ex ante versus ex post wind power attitudes and preferences**



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## Summary

Production of wind power installations have increased in the recent years, leading several people to be exposed to wind turbines. The aim of this thesis is to trace possible change in peoples' attitudes and preferences towards wind power after being exposed in their immediate housing area, which is presented as the main research question. In addition, five hypotheses substantiates our research question were conducted to find reasons for whether the respondents' attitude has changed. It is concluded that respondents experience a negative shift in their attitude and preferences towards wind power after being exposed, mainly due to indirect negative effects such as deterioration of natural and cultural landscape.


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# Foreword

This thesis is representing the completion of a Master's degree in Science of Business Administration at the University of Stavanger Business School. Our chosen study program is Economic Analysis, and the thesis is directed to this specialization. Based on the sharply increased development of wind power in recent years we have chosen to see if peoples wind power preferences and attitudes have changed due to larger exposure in a particular area. This is a highly relevant discussion and creates great engagement among the population, as well as it fits with our personal interest of environmental economics.

In this thesis, we have encountered many statistical challenges and the work with overcoming these issues have been both challenging and time consuming, at the same exciting and educational. In the thesis we have used knowledge we have acquired through our time as business students. Our collaboration has been great, and we have benefited from each other's knowledge.

We would like to take this opportunity to thank our supervisor Dr. Gorm Kipperberg for his supportive and helpful guidance.

# 1.0 Introduction

Wind power development in Norway has in recent years had an enormous focus and development, which has provided significant increase in onshore wind power production (Dugstad, Grimsrud, Kipperberg, Lindhjem, & Navrud, 2020). As of April 2020, there were over 800 operational wind turbines in Norway, spread over 42 wind farms. In addition, 19 wind farms were under construction (Regjeringen, 2020). The area with the densest development in Norway in recent years is Rogaland. Rogaland has become an important county for wind power, with many existing wind farms, and more licenses have currently been granted (NVE, 2020b). The balance between renewable energy production, socio-economically profitable polices and nature conservation has been a controversial topic in Norwegian politics. The development of onshore wind power has in recent years aroused both dissatisfaction and involvement on both local and national level, whereas the public acceptability is felt to be a major constraint in the development of wind power. The dilemma is that there are a lot of positive attitudes towards wind power development, if it does not work at the expense of the populations use value and non-use values.

There is an evident benefit of wind power production in terms of low greenhouse gas emission, but the wind parks require large areas and are located in exposed places to get the best wind conditions. The wind turbines are up to 220 meters high and is visible over a long distance (NVE, 2020b). The negative externalities associated with wind power development have had a great impact and attention, both in Norway and in the rest of the world. People's attitudes and preferences to wind power have previously been researched, but we find few recent studies that have examined if there has been a change in people's attitudes and preferences after local development of wind turbines has taken place. This gives the basis for this thesis research question:

*"Have peoples wind power attitudes and preferences changed after*

*being exposed to local wind power production?"*

The purpose of this thesis is to map people's preferences and attitudes and see if there is a change ex ante versus ex post development. The area researched in this thesis is limited to southern Rogaland, because this is an area that has had a large increase in wind power development the recent years. This thesis is based on quantitative research method using primary data collected from our own new wind power attitude survey conducted in April 2021 by Norstat. The survey is added in Appendix 5. It had 356 completes out of 1333 invitations that was sent out. The median length of the survey was 11,1 minutes, and the overall satisfaction score was 4,2 on a scale from 1 – 5.

The thesis is structured as follows: Firstly, a background section is given to the current wind power situation today, both locally and internationally. Then a literature section over previous research done with wind power externalities and historical preferences are presented. Further theoretical frameworks of nonmarket valuation are displayed with a microeconomic view on issues from the consumer demand side. In section 5, a description of the methodology and survey outline is presented. Further, in section 6 the data analysis is described in different parts. First descriptive statistics are presented, and hypothesis are stated. The next subsection describes the obtained results from the survey, then the different dependent and independent variables are analyzed through an ordered logit regression analysis to obtain empirical evidence on the research question. Finally, section 7 gives discussion and conclusion of the thesis, and underline potential for future research.

Through our analysis of change in people's preferences, this study can contribute to get a new indication on people's preferences, after the wind power projects are finalised. The study can also be relevant to other actors, such as developers of wind power, decision makers and others who have an interest in this field.

## 2.0 Background

Most countries in the world have entered ambitious and binding targets regarding the development of renewable energy (Korpås, 2019). The production of renewable resources is one component of worldwide efforts to limit the scale and impacts of global climate change (Tatchley et al., 2016). The development of modern wind turbines started after the oil crisis in the 1970s, where development mainly took place in Europe. In 2015, the world leaders agreed on two important agreements for the earth's future; the Paris climate agreement and the UN sustainability goals. The Paris agreement is an international agreement that will ensure that the countries of the world are able to limit climate change. In the autumn of 2015, the UN member states also adopted 17 goals with 169 sub-goals for a sustainable development by 2030. Today, wind power is used in more than 80 countries worldwide, where China has taken the role as the major wind power nation, with a 36 percent share of the world's total installed capacity (Hofstad, 2019).

Some of the best wind resources in the world is in Europe, providing a relatively cheap and exploitable renewable energy resource (Ellis & Ferraro, 2016). It appears in a research article by Science Direct that Europe has the potential to possess over 11 million wind turbines, which is enough to produce more electricity than the world is expected to use in 2050 (Enevoldsen et al., 2019). The development of wind farms has taken place in a high pace. Between 2001 and 2010, the worlds production capacity for wind power increased by 26 percent each year, and between 2013 and 2018, annual growth was 13 percent each year (Hofstad, 2019). The growth of this sector has involved the mobilization of billions of Euros of private investment and different energy policies. Additionally, an ongoing reconfiguration of grid systems and many other aspects related to the reorientation of energy systems, from being based on fossil fuel to more decentralized systems, where a variety of renewables contribute to increasing percentages of overall energy requirements (Ellis & Ferraro, 2016).

Denmark is the European country with the highest share of wind power electricity in 2018, with 41 percent of total electricity coming from wind power. Followed by Ireland, where 28 percent of the electricity came from wind power, and Portugal, with 24 percent. In Germany, almost 21 percent of electricity came from wind power in 2018 (Andersen, 2019).

## 2.1 Wind Power in Norway

Norway is obliged through the EU renewable energy directive, which is part of the EEA agreement, to set binding targets for the share of renewable energy (NVE, 2020a). In Norway, 98 percent of all electricity production come from renewable sources (Ministry of Petroleum and Energy, 2016). This puts Norway in a unique position in both European and global perspective (Ministry of Petroleum and Energy, 2016). In Europe Norway has one of the best conditions for establishing wind power production, with a lot of wind spread over large areas (NVE, 2020b). Thus, development and investment of onshore wind power has in Norway been limited compared to other European countries (Inderberg, Rognstad, Saglie, & Gulbrandsen, 2019). However, the electricity generation from wind power has in recent years increased sharply. Since the first wind farm with over 10 MW was installed in 1998, the Norwegian licensing authority has granted over 100 wind power licenses in total (Inderberg et al., 2019). Motivated by increased demand for renewable energy, large investments on wind power in other European countries, falling installation costs, and the increasing incorporation between the Norwegian and the European energy markets, the Norwegian authorities has grown increasingly supportive of onshore wind power (Dugstad et al., 2020). In 2017 a request was sent from the Ministry of Petroleum and Energy to the Norwegian Water and Energy Directorate (NVE) to propose a long-term National Framework in Norway for onshore Wind Power (NFWP). 13 geographical areas was considered by the NFWP to be the most suitable for future onshore wind power developments (WPDs) in Norway (NVE, 2021).

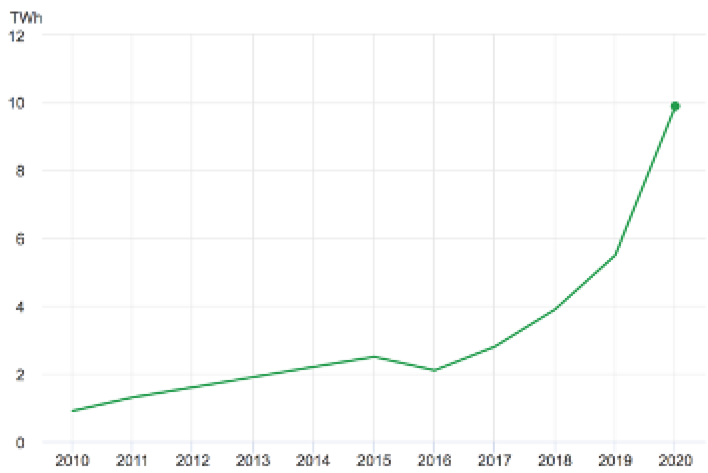



*Figure 1. Wind power generation in TWh*

*(Source: Statistics Norway)*

As seen in figure 1, 5.5 TWh was produced from wind power in Norway in 2019 (NVE, 2020b), 43 percent higher compared to 2018 (Holstad, 2020). The wind power generation came to 9.9

TWh in 2020, this is 79 percent or 4.4 TWh higher compared to the previous record in 2019 (Aanensen, 2021). The all-time high wind power production must be seen in conjunction with large investments in wind power production for several years and the opening of several new wind power plants (WPP). The wind power generation is equivalent to the average electricity consumption of about 620 000 households (Aanensen, 2021).

Although the wind power has grown rapidly in the last years, hydropower is still dominating the Norwegian power system. Hydro power accounted for 91.8 per cent of the total production in electricity of 154.2 TWh in 2020, while thermal and wind power accounted for 1.7 and 6.4 per cent respectively. Compared to 2019, the wind power share of total production increased by 2.3 percentage points (Aanensen, 2021). Even though Norway produces enough electricity for own consumption, there is a great amount of need for more renewable energy in neighboring countries. Several countries in Europe are far from achieving their agreed renewable targets and are willing to pay large amounts to import emission-free power (Hersvik, Ekren, & Helvig, 2011). Norway's export of power totaled 25 TWh in 2020, whereas imports where 4.5 TWh. This gave net export of about 20.5 TWh, which is the highest level of net export ever recorded. Exchange of power between countries is determined by differences in generation, the consumption situation and prices, in addition to the capacity of the power lines (Aanensen, 2021). In Norway, investors can to a certain degree choose the site of their WPP but must obtain a production license by NVE. The publicly available database of license applications for WPPs from the NVE contains detailed information on all the proposed wind power projects in Norway (Grimsrud, Hagem, Lind, & Lindhjem, 2020).

NVE decides whether the license application is granted or declined and must weigh the benefits against the negative impacts of the wind power project in an overall assessment. Basically, the license of energy installation represents a trade-off between various considerations. These include efficiency and procedural justice, fairness and predictability, as well as transparency (Inderberg et al., 2019). Wind power can reduce Norwegian greenhouse gas emissions by approximately 25 million tons according to a report from Statnett (Løkkevik, 2019). From an economic point of view, land-based wind power is the cheapest solution for producing renewable energy, after hydropower. Wind power development can also provide the municipalities with more jobs and increased income (Løkkevik, 2019). This is a great achievement for the current work towards fighting climate change.

Wind power construction in Norway has been proven controversial from several dimension. A large number of nature protection organizations and other stakeholders are finding the country's wind power policy misguided. The large increase in wind power production requires relatively remote and open areas (Grimsrud et al., 2020). Wind power installations are typically placed in wilderness and other valuable nature zones, where construction often requires building roads and installations in vulnerable, undisturbed areas (Inderberg et al., 2019). Trucks and excavators are in continuous traffic while the development is in progress. Drilling is taking place, and mountain areas are about to change forever which leads to permanent loss of valuable recreational nature. Although there are $C0_2$ emission associated with the construction of WPP, the conversion of wind energy into electricity generates no $C0_2$ emissions. However, there are other environmental concerns associated with WPP, such as noise and negative wildlife impacts (Grimsrud et al., 2020). The wind portal creates permanent noise for buildings closer than 1km, with the largest turbines providing up to 110 dB of noise (Grimsrud et al., 2020). Most turbines must also have flashing lights due to flight safety, to create visibility in the night darkness. Environmental concerns are considered in the sense that if a siting is assessed as "too harmful" for the environment, the license is not granted. However, once a license is granted, there is no environmental taxation of the externalities. Therefore, there is no policy to ensure that WPP investors take sufficient account of the externalities when they decide which of the licensed WPP to develop (Grimsrud et al., 2020). Wind power has become competitive and profitable without subsidies. At the same time foreign companies own at least 60 percent of the total wind power in Norway. Larger shares of wind power are owned by foreign companies, and these private companies gets the profit (Stavanger Turistforening, n.d.). This leads to increased debate among the locals.

## 2.2 Rogaland as a wind power municipality

Wind power is not equally distributed across Norway (Dugstad et al., 2020). The great grid capacity and infrastructure in combination with good wind conditions has led to many developed windfarms in Rogaland. At the same time, Rogaland is a densely populated county, and there are intersecting interests at the wind power sites (Dirdal, 2019). As mention the NFWP identified 13 geographical areas in Norway (Dugstad et al., 2020). Out of these, four were located in Rogaland County, while no areas in Oslo County were found to be suitable for wind power. As Rogaland County has a higher density of wind turbines, the population is more exposed to wind power development and associated externalities, compared to the population of Oslo County (Dugstad et al., 2020). In Rogaland, a new license was granted in the autumn of 2020 for WPP on an area of approximately 114 square kilometers. In comparison, the sum of all cities and towns in Rogaland is 198 square kilometers (Stavanger Turistforening, n.d.).

Rogaland has by far become Norway's largest wind power region, with over 240 wind turbines in operation (NVE, 2020c).

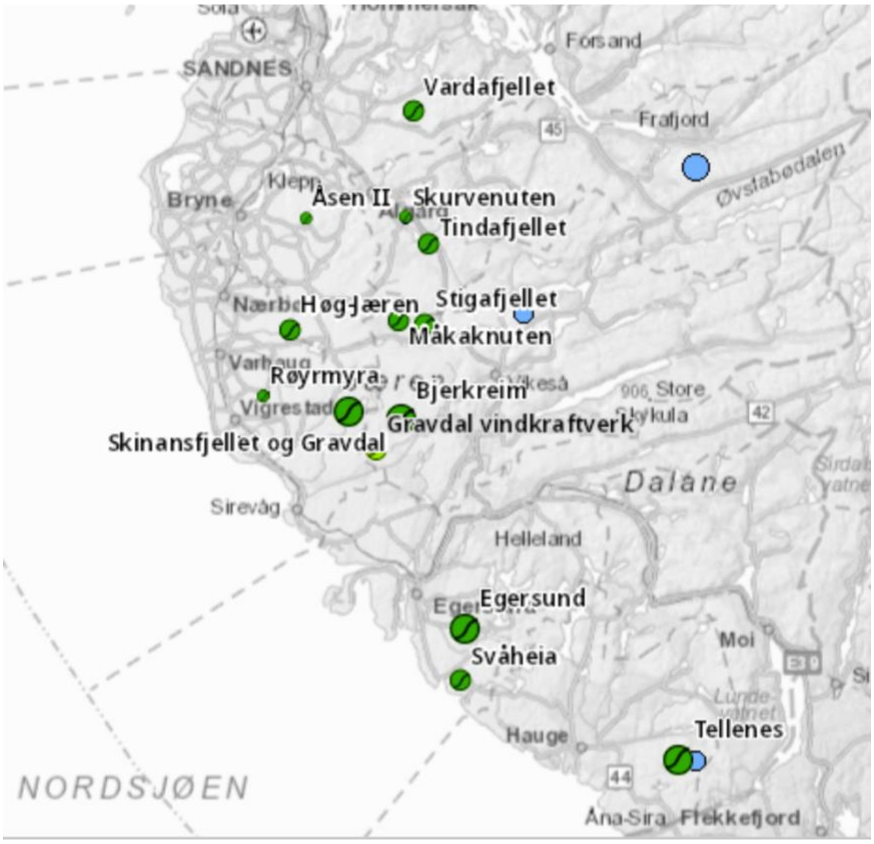



*Figure 2. Map of wind power in Rogaland.*

*Source: NVE (2020)*

Figure 2 illustrates where the wind power in South Rogaland is located. Høg-Jæren Energy Park is southern Norway's first major wind power project. The opening in September 2011 marked an important milestone for both Norsk Vind and wind power development in southern Norway in general. The wind park consists of 32 wind turbines that give a total installed capacity of 73.6 MW (Norsk Vind, n.d.). The wind conditions at Jæren are providing great production results, and the wind park has become a popular activity centre that is used for several outdoor activities. The wind park at Høg-Jæren entails a reduction in greenhouse gas emissions of between 100,000 and 200,000 tonnes of $CO_2$ per year. This corresponds to cuts in

$CO_2$ emission corresponding to the emissions from all private cars in municipalities Stavanger, Time and Hå combined (Norsk Vind, n.d.).

Tellenes wind park is one of Norway's largest (Fredriksen, Kleppe, & Figved, 2019), with foreign investors owning over 90 percent of it. Tellenes wind park is located in Sokndal municipality, with 50 wind turbines of 150 meters high, that will produce electricity corresponding to 28,000 households consumption. However, the electricity has already been sold to the technology company Google for the next 12 years, in order to supply its European data centers with renewable energy (NTB, 2017). The agreement provides the wind park with a predictable income. In 2018, Tellenes wind park had an income of NOK 242 million (Fredriksen et al., 2019). Because of depreciation and high interest expenses the wind farm still runs a tax deficit (Fredriksen et al., 2019). Bjerkreim wind park is located in Bjerkreim and Hå municipality in Rogaland County, and holds Norway's largest annual production of 1000 GWh. The wind park consists of three adjacent plants: Skinansfjellet, Eikelands-Streinsland and Gravdal, and is owned by a German financing company for renewable energy. The first turbines were commissioned in 2019, and the wind park was completed in the summer of 2020. 70 turbines at a height of 125 meter, each producing 4.2 MW, have been installed (NVE, 2020b).

# 3.0 Literature Review

Wind power and associated externalities have been investigated in previous literature. It seems to be a distinction between respondents that are negative to the changes, who believe wind power represents irreversible industrialization of the landscape, and respondents who believes that wind power represents a green shift and an extraction of natural resources, and thus is generally positive (Fast, Mabee, & Blair, 2015). Different studies consider different aspects of the topic, using various methods. In the following section, some of these studies will be presented, hereunder both positive and negative externalities. Further, willingness to pay and willingness to accept will be discussed, before the section ends with a presentation of the "Not-In-My-Backyard" concept will be given. In Appendix 4, cf. table 22, a full review of studies and reports that assess various aspects of the overall topic using different methods is provided. The literature table summarizes 23 studies and reports reviewed in this chapter.

## 3.1 Positive externalities

The most obvious argument in favour of wind power is the need for more sustainable production of energy. Rygg (2012) analyzed what local communities in Norway with established or planned wind power used as arguments. Most of the arguments in favor of wind power development addressed local concerns regarding economy, modernization, and employment opportunities, and not just a need for sustainable energy (Rygg, 2012). A US survey finds positive influence on people's preferences from positive net employment effects from wind turbines, with substantial job creation (Zerrahn, 2017). Lindhjem et al. (2019) also addressed positive factors such as climate challenges, economic benefits, and perceived wind turbines as an exciting element in the landscape. "Klimabarometeret" from 2016 is a survey conducted by 1071 respondents, where their attitudes towards renewable energy were mapped. According to the report, 65 percent of the respondents meant that Norway invests too little in the development of renewable energy, and 70 percent are in favor of onshore wind power. Overall, the majority is positive towards the development of more renewable energy, including onshore wind power. The two factors, age and income, are indicated to have a decreasing effect on finding individuals with positive attitude towards wind power (Ek, 2005).

## 3.2 Negative externalities

The literature indicates that although there is generally acceptance of wind power, the developers experience resistance. This observation is widely repeated in the literature. Although wind power onshore is considered a climate-friendly form of energy, WPP are also landscape changing and area demanding, which often conflicts with other important environmental and social considerations. Bergek (2010) classifies the causes of negative attitudes towards wind power into seven categories: visual effects, noise and shadow casting, encroachment on nature, effects on biodiversity, effects on tourism, property value reduction and safety effects. From a study conducted in the UK, the respondents opposing the planned wind farms, explained tree main reasons for being against the project. 75 percent were primarily concerned about the noise from the wind turbines, further the visual intuition and electromagnetic interference were mentioned (Krohn & Damborg, 1999). Wolsink (2000) identifies noise pollution and dangers to birds as important predictors of attitudes. Zerrahn (2017) highlights three factors that are important for negative preferences: distance to the WPP, getting used to them ("habituation") and type of landscape.

Wind power development is most often associated with major encroachments on nature, including that the visual effects are one of the most central themes regarding wind power. The wind farms are affecting the original, untouched, sublime landscape and the traditional and cultural connection that the population have to it (Dugstad et al., 2020). Zerrahn (2017) also indicates that the resistance is larger in areas that have particularly beautiful landscapes. Mattmann, Logar, & Brouwer, (2016) consistently find that visual effects from wind turbines on landscape and view, lead to a reduction in consumer welfare. An aim to objectify the influence of the visual impact in the recreation of the public, to the development of new wind farms, found that the physical attributes of the landscape and wind turbines influenced the respondent’s reactions far more than socio-demographic and attitudinal factors (Molnarova et al., 2012). Additionally, in the Greek Islands, the location and site of the wind turbines are more important than the socioeconomic attributes (Dimitropoulos & Kontoleon, 2009).

Krohn & Damborg (1999) found that people living in cities were generally more negative to wind power, compared to those living in a country zone. Due to the urbanization of our society, people in city zones could be more exposed by the wind turbines now than earlier, which could explain the negative shift in people’s preferences (Krohn & Damborg, 1999). The literature on getting used to wind turbines is not unequivocal. Some studies show that people adapt over time so that the negative effects are mitigated, some people's preferences are stable before and after, while other studies show that repeated experience and exposure intensifies and increases the negative effects (Zerrahn, 2017). Newer studies show that wind turbines receive better acceptance if the number of turbines in a landscape is limited (Molnarova et al., 2012). Further, Molnarova et al. (2012). find that acceptance is increased if wind turbines are kept away from settlements, transportation infrastructure and viewpoints. The resident’s well-being is significantly negative effected when wind turbines are constructed close to households (Krekel & Zerrahn, 2017). In Ireland the installation of onshore wind turbines has become progressively more difficult in some areas because of these potential negative externalities associated with their operation in housing areas (Brennan & Van Rensburg, 2016). Kipperberg et al. (2019) investigated how locals that use area for recreational purposes are affected by wind farms nearby. They found significant decrease in welfare, meaning there is a negative externality on recreation. Site affiliation and site identity are presented as possible framework for understanding why actors establish negative attitudes towards wind power plans. Place affiliation is based on positive emotions associated with a specific place, while place identity refers to how a place affects actors experiences of their own identity. Vorkinn & Riese (2001) identified site identity as the most important explanation for negative attitudes to the development of hydropower in Skjåk.

## 3.3 WTP and WTA compensation

Dugstad et al., (2020) states that non-exposed people are willing to pay more to increase general domestic renewable energy production than exposed people. One article in fact states that respondents would be willing to pay an amount extra to their monthly energy bill in order to move the wind turbines further away from their residential areas (Mariel, Meyerhoff, & Hess, 2015). Navrud & Bråten (2007) conducted a choice experiment on people's WTP for different energy sources. Households WTP is reduced if there are many, small wind farms, instead of fewer, large ones (Navrud & Bråten, 2007). Another reveal that the majority of respondents are willing to make tradeoffs to allow for wind power initiatives, that respondents require less compensation if provision is made for a community representative, and setback distance is increased (Brennan & Van Rensburg, 2016). One study found that people living close to a wind park, and those who use the area for recreational purposes, demanded higher compensation (García, Cherry, Kallbekken, & Torvanger, 2016). A study from Sweden states that income, social group and education is positively related to the WTP for renewable energy (Ek, 2005).

## 3.4 NIMBY

The term NIMBY is an acronym for Not In My Back Yard, and can be defined as "An attitude ascribed to persons who object to the siting of something they regard as detrimental or hazardous in their own neighbourhood, while by implication raising no such objections to similar developments elsewhere" (Wolsink, 2006, p. 87). Related to wind power, the NIMBY hypotheses are a popular explanation for the reason why actors establish negative attitudes towards wind power plans in their local communities (Wolsink, 2000). This theoretical framework explains the social attitude gap by saying "everyone" is positive to renewable energy from wind turbines, but no one wants it in their residential area (Wolsink, 2000). A finding repeated in several studies is the expressed positive attitudes regarding wind power in general, while local wind power plans meet strong opposition (Bell, Wild, Foster, & Hewson, 2015). An article by Lindhjem et al. (2019) presents some results from ongoing research that aims to map the preferences and considerations of the Norwegian population, concerning wind power. They are also implying clear preferences against more wind power onshore, due to the environmental effects. Furthermore, the study shows that the respondents do not want further development in their own region, while being indifferent to other places.

In the early 90´s, a “before/after installation” study of wind turbines was done in the UK. The survey showed that 70 percent of the respondents were supportive of general development of wind turbines in Wales, while only 40 percent were supportive of the three wind farms being planned (Krohn & Damborg, 1999). This indicates that a NIMBY reaction arose in relation to the development of these three specific wind farms. Bell et al. (2015) refer to this as a social attitude gap that constitutes a barrier to the realization of wind power plans. At the local level, the social attitude gap is expressed by the fact that the debate is often marketed by negative attitudes towards the wind power development. Bell et al. (2015) explains this by saying that while actors with negative attitudes have a lot to gain from active involvement, but actors with positive attitudes do not. Wolsink (2000) also points out that the planning process often follows a decide-advertise-defend model. First, the developer determines a planning area, then local actors are informed and then a process is set up where the plans must be defended against criticism (Wolsink, 2000). Such a process does not allow for actors with positive attitudes, and therefore contributes to the fact that there is often a one-sided debate locally (Bell et al., 2015). Even though the respondents in the study from UK expressed negative attitudes before realization, after the wind farms were built, the respondents were questioned once more about their attitudes towards the projects. Result from all three cases show that respondents who were against the wind farms, were outnumbered by the respondents supporting the projects (Krohn & Damborg, 1999). Furthermore, over one third of the respondents being unsure about the projects before realization, tended to be more supportive of the projects after completion, while only 25% were still against the project (Krohn & Damborg, 1999). In the Netherlands, the same pattern was discovered by a Dutch wind developer. The firm discovered that the general population were supportive of wind energy, while the acceptance decreased by specific projects due to the planning and construction phase, then acceptance tend to increase after implementation of wind farm project (Gipe, 1995). These results are also supported by a newer study done in Australia. Gross (2007) found that respondents are influenced by their perception of fairness during the process. Further, it shows that the acceptance of wind farm projects will increase if the respondents feel outcome fairness and favorability, as well as process fairness (Gross, 2007).

Results from a study done in Sweden does not support the NIMBY-hypothesis, as they reveal attitudes from people living with wind installations in sight of their residence or vacation house, is not significantly different from the attitudes of people without this experience (Ek, 2005). This finding is consistent with the argument that the NIMBY-explanation is too simplistic, and that institutional factors are of major importance (Wolsink, 2000). A study from Sydthy, Denmark, contributes to these findings. In Sydthy more than 98 percent of the total electricity consumption was covered by wind power in the 90´s (Krohn & Damborg, 1999). People who have a high degree of knowledge about green energy, generally is more supportive of wind power, than people with less knowledge (Krohn & Damborg, 1999). Furthermore, result show that people's perspective towards wind turbines in general, are not affected by the distance to the nearest wind turbine (Krohn & Damborg, 1999). This result implies that respondents who live close to the wind turbines, do not consider the visual impact and noise to be a significant problem (Krohn & Damborg, 1999). Interestingly, result show that people living in less distance than 500 meters to the nearest wind turbine, actually tend to have more positive attitudes toward wind turbines, than people located further away (Krohn & Damborg, 1999). A similar pattern was identified when number of visible wind turbines from the respondent's residence, were cross tabulated with the general attitudes towards wind turbines (Krohn & Damborg, 1999). The study found a trend that respondents with visual of 20 to 29 wind turbines were more positive towards wind energy, than respondents being able to see fewer turbines (Krohn & Damborg, 1999). Furthermore, the study shows that the middle-aged respondents find noise the most disturbing, and that men experience the noise as louder than women (Krohn & Damborg, 1999).

Based on previous literature on people's preferences towards wind power, both the local population and the population in total, are generally positive, due to good experiences and high knowledge. Especially when being included in the planning process of the projects. However, research done in the later years, show a more negative trend of attitudes towards wind power developments. This is likely to be related to the increased exposure. The main concerns mentioned are the visual effects of the wind turbines, in addition to the noise they produce.

# 4.0 Theory of non-market valuation

Consumers make choices based on perception, knowledge, and preferences. Microeconomics aims to explain how individuals act, or should act, to maximize their utility. It is often assumed that utility comes from consumption of market goods and services (Perman, Ma, Common, Maddison, & McGilvray, 2011). However, consumers can also derive value from the nonmarket impacts of goods such as wind power. As this thesis aims to map changes in preferences for wind power, the focus in this chapter will be on total economic value, consumer welfare analysis and ecosystem services.

## 4.1 Ecosystem Services

The Millennium Assessment (MA) has created a framework that focuses on how ecosystems have been altered by humans, and how these changes in ecosystem services have affected the human's well-being. This following section will give a more detailed description of this framework. Further, the four ecosystem services will be stated before the chapter is ended with a review of positive and negative impacts of wind power installations.

### 4.1.1 Framework

MA's framework point to how future decades can be affected by changes in the ecosystem, and highlight different responses at local, national and on global scale, which can improve management of these changes (Millennium Ecosystem Assessment, 2005). The central focus in the framework established by MA (2005) is human well-being, while continuously recognizing that ecosystems and biodiversity have intrinsic value. It assumes that there exists a dynamic interaction between ecosystem and humans, where changes in human conditions serves both directly and indirectly change in ecosystems, simultaneously as change in ecosystems causes change in human well-being (Millennium Ecosystem Assessment, 2005). Additionally, several independent factors lead to change the human condition, and ecosystems are influenced by natural forces (Millennium Ecosystem Assessment, 2005). Hence, considerations of both intrinsic value and human well-being are weighted when people make decisions concerning the ecosystems.

There are both positive and negative sides of implementing such a framework. History shows that for many of the wind farms, the planning and preparation process starts long before the actual operation. As this is a time-consuming process, the testing and clarifications of the given area may not be as accurate when construction starts, compared to in the initial planning processes. However, if important factors are correctly emphasized, wildlife and landscape can be preserved in a bigger scale, while securing a long-term sustainable energy source.

### 4.1.2 Ecosystem service categories

An ecosystem is "a set of interacting species and their local, non-biological environment functioning together to sustain life" (Bolund & Hunhammar, 1999, p. 294), while ecosystem services can be defined as "the products and services that people derive from ecological systems" (Howard et al., 2013, p. 21). Earth's ecosystems are a cornerstone in sustainable development, and the way human activities are affecting the ecosystems, will have consequences for the supply of food, fresh water, fuelwood, and fiber, as well as for the frequency and magnitude of floods and droughts, the prevalence of diseases and local as well as global climate (Millennium Ecosystem Assessment, 2005). These different factors can be classified into four groups of ecosystem services by, hereby; provisioning, regulation, cultural and supporting (Howard et al., 2013).

Provisioning services are products that are obtained from ecosystems, containing every kind of benefit to humans that can be extracted from nature (Millennium Ecosystem Assessment, 2005). This enables exploitation of resources that otherwise would be unused, but the installation of windfarms can have a long-term impact on soil and forest productivity, that can threaten the provisioning services, due to residuals removal for bioenergy or poor forest management (Hastik et al., 2015). Regulating services represent the benefits obtained from regulating the ecosystem processes, containing all benefits that moderate natural phenomena (Millennium Ecosystem Assessment, 2005). Intensifications of land use can alter the habitat quality for wild plants and animals, which supposes a threat to the regulating services (Hastik et al., 2015). Inappropriate management of the land scape during development of new windfarms, can result in pollution of water near the installation area (Hastik et al., 2015). Furthermore, combustion from development can lead to increased air pollution, and the carbon sequestration can be decreased by the increasing level of biomass extraction from the forests (Hastik et al., 2015). While these are threats to the regulating services, most emissions from biomass are usually accounted to be carbon-neutral and can therefore also be seen as a benefit (Hastik et al., 2015).

The non-material benefits that people can obtain from ecosystem services, are the cultural services (Millennium Ecosystem Assessment, 2005). These benefits can contribute to development of cultural advancement for people. The road infrastructure built in conjunction with new windfarm installations, can in many areas also be usable for recreational activities (Hastik et al., 2015), and therefore have a positive effect to the cultural services. On the other hand, these installations can contribute to new or increased disturbances from traffic and forest work (Hastik et al., 2015).

Finally, the fourth group of supporting services are those that are necessary for production of all the other ecosystem services. Supporting services are different from the other three groups, as their impact occur over a longer period or influence people indirectly (Millennium Ecosystem Assessment, 2005).

#### 4.1.3. Impact from wind turbines on the ecosystem

In general, there exist two main ways that wind power installations can influence the ecosystem services, hereby: impacts on functioning and structure of the habitat, and direct impacts on individuals (Saidur, Rahim, Islam, & Solangi, 2011). The complexity of ecological influence of wind power installations are sever, and can vary with many factors, such as location, weather, season, species and type. One large concern is the biologically significant impacts from wind power installations. Several species are experiencing indirect impact, like long-term decline in habitational loss, disease, increased mortality and non-native invasive species, due to construction of new wind turbines (NWCC, 2014). Further, direct adverse wildlife impact can be bats and birds colliding with wind turbines, causing death rates to increase (NWCC, 2014).

For humans, installation of wind turbines can affect the cultural aspect, in terms of changing or destroying historical, sacred, recreations sites (Saidur et al., 2011). When analyzing this specific factor, the main concern is that there should be done nonpermanent harm to the site, that would affect the integrity. Further, factors like noise, shadow flicker, electromagnetic interference, economic and fiscal impacts can occur. These factors can have both positive and negative impacts on human health and welfare. For the cultural aspect, many wind farms are used as tourist sights, which can increase knowledge on wind power, and increase the local economy. For direct human wellbeing, wind energy can help improve local air quality (Saidur et al., 2011), which can contribute to balance out the damage on regulating services. On the recreational side, there are both direct and indirect impacts from wind energy. The direct impact can occur if existing recreational activities need to be rearranged or cancelled due to the wind power installations. The indirect effects include the aesthetic impacts mentioned above, which can result natural or scenic values are critical to the current recreational activity.

Key environmental concerns with wind power installations, are the visual impacts and the landscape perceptions. This includes the height, size, material and number of turbines, in addition to infrastructure and transmission lines. However, wind farms are per definition not permanent, so the area can return to its original condition after a completed decommissioning phase. Moreover, consideration of design and placement of wind power installations can help minimize the potential visual impact of the turbines (Saidur et al., 2011).

Monetary incentives, like tax credits, and wind power impacts on the regional energy pricing, can cause impacts on private economy and public revenues and cost, in both negative and positive direction, depending on the scale (Saidur et al., 2011). One of the most studied impacts of wind turbines, are the noise. This factor can be predicted and measure more easily than visual impacts and impacts on landscape. The wind turbines do not only generate noise when in operation, but during the installation prosses heavy machinery will contribute to noise in the local area. However, statistics show that noise from wind turbines is rare, and therefore considered a small-scale problem (Saidur et al., 2011).

## 4.2 Total Economic Value

Individuals may derive value from other ways than just from direct consumption of environmental goods. Due to this, the nonmarket good and services are being valued properly through the broader concept of total economic value (TEV) (Perman et al., 2011). TEV is the sum of all benefits obtained from a resource, which in this case are wind power.

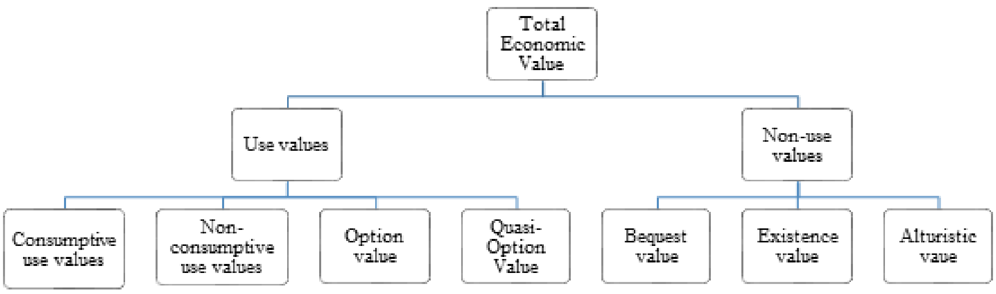



*Figure 3. Total Economic Value framework*

As seen in figure 3 the total economic value of a good can be divided into its use value and non-use value. Use-values consists of consumptive use-values, non-consumptive use-values and option values. The consumptive values are the direct extraction of valuable resources from wind power such as the electrification. Non-consumptive values are value arising from tourism, hikers and recreational activities in the wind park area. The use value also embraces the value it ascribes to safeguarding the resource so that we can use it in the future, this is called option value. The non-use values of an environmental good is associated with situations that people do not use or are not planning to take advantage of but will still feel that there is a loss if it disappears. Such as the loss of the landscape aesthetics and damage to the ecosystem when wind turbines are set up. The utility of non-use values is the benefits the population gets from the existence of the wind turbines, and from the belief that the wind turbines will be there for future generations, whereas people are enjoying a clearer environment by avoiding damage from climate change. These are known as existence and bequest values (Selfors, 1994).

## 4.3 Welfare Analysis of the nonmarket impacts of wind power production

Consumer welfare is the individual benefits gained from the consumption of goods and services. In theory, welfare is defined by an individual's own appraisal of their own satisfaction, given income and price. Welfare economics tries to identify circumstances under which it can be claimed that one allocation of resources is better than another without reducing the consumers utility (Perman et al., 2011).

To analyse the impacts of wind power production, assume consumers have preferences defined over consumption of private market goods & services ($X = X_1, X_2, \dots, X_j$), and the non-market impacts from wind power production is defined as ($Z = Z_1, Z_2, \dots, Z_k$) with both negative and positive externalities from wind power that leads to several dimensions of *Z*. Some of the elements of *Z* could give positive utility like reducing climate gas emission, whereas others could give negative utility (disutility) like landscape degradation. It is recognized that people are likely to have heterogenous preferences such that the elements of *Z* and their marginal utilities vary across individuals. For simplicity, the different dimensions of *Z* are redefined as a scalar index of the net nonmarket impact of wind power. For some individuals, this index will be overall positive, while the majority will have a net negative *Z*. Further *X* are market goods that can be chosen, while *Z* is exogenous to the consumer and can therefore not be chosen. It is also determined that for the sake of simplicity all other non-market goods and services that the consumer can get utility from are in this case ignored. Examples are hospitals and transport, as there are also health risks and infrastructure changes in connection with wind power development. In other words, consumers cannot choose the environmental quality, nor can they choose how good a hospital is or how many kilometres a road is. With the above, a consumer's preferences can be represented by the utility function of general form:

$$U = U(X, Z)$$

*Equation 1. General utility function*

The marginal utility is found by deriving the utility function with respect to *X* and *Z*. It is expected that $\frac{\partial U}{\partial X_j} \geq 0$ for all *j = 1, 2,…, j*. But for the non-market good, if wind power impacts are a "net good" then the marginal utility is positive, and we have a welfare improvement

$\frac{\partial U}{\partial Z} > 0$. Conversely If wind power impacts are a "net bad" then the marginal utility is negative, and we have a welfare degradation $\frac{\partial U}{\partial Z} < 0$ .

The consumer is assumed to maximize utility subject to the budget constraint. Solving the utility-maximizing problem yields an indirect utility function defined over the exogenous factors that are consumers income *(M)*, market prices ($P = P_1, P_2, \ldots, P_j$) and the wind power impact *(Z)*, such that:

$$V = V\ (P, M, Z)$$

*Equation 2. Indirect utility function*

From this indirect utility function, we can conceptualize the welfare impact from an increase in wind power exposure, level $Z^0$ to $Z^1$ by the assumption that $Z^1 > Z^0$:

$$V\ (P^0, M^0, Z^0) = V\ (P^0, M^0 + CS, Z^1)$$

*Equation 3. Conceptualization of welfare impact on utility function 1*

Where CS is the compensating surplus. On the left side of the equal sign is the utility of the original wind power exposure, while on the right side is the same utility function, but a higher level of *Z*. Income and market prices play a passive role on this case. The consumer will either get a positive or negative effect on their utility from this increase in *Z*. The compensating surplus is therefore an adjustment of income so that the utility is kept the same as before. If the consumer gets a lower level of utility from the increase in $Z$ from $\frac{\partial V}{\partial Z} < 0$, then CS > 0, which means the consumer needs to be compensated, to be as well off after the expansion as he was before. Positive compensating surplus is also referred to as WTA. If the consumer gets a higher level of utility from an increase in $Z$ from $\frac{\partial V}{\partial Z} > 0$, then $CS < 0$, which means that the consumer can have a reduction in income and still be as well off after the expansion as he was before. The reduction in income can for example be from an additional tax. Negative compensating surplus is also referred to as WTP.

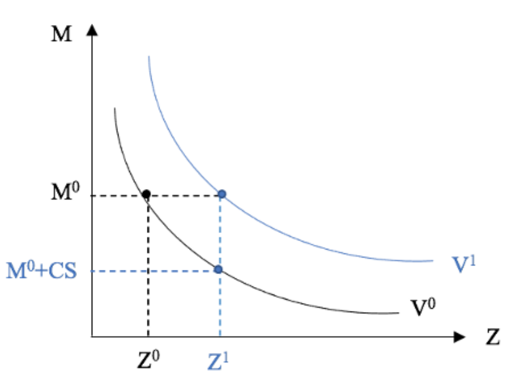



*Figure 4. Wind power a net non-market good*

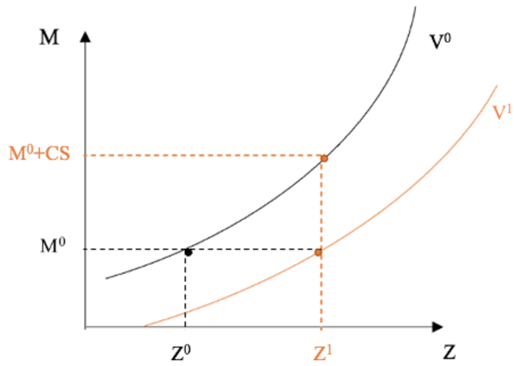



*Figure 5. Wind power a net non-market bad*

Figure 4 illustrates wind power as a net non-market good. $V^0$ is the original indifference curve and $V^1$ is the new indifference curve after expansion $V^1 > V^0$. Where $Z^0$ and $M^0$ meet is the original welfare. By expanding $Z^0$ to $Z^1$, but with the same level of income the utility level will shift to $V^1$. The consumer will then be deducted a negative amount (CS) from the income, to return to $V^0$. The distance between $V^0$ and $V^1$ represents the net positive externality. Figure 5 illustrates wind power as a net-market bad $V^1 < V^0$. The indifference curves are upward sloping, with wind power expansion being negative to the consumer. $M^0$ and $Z^0$ is the original welfare level, but by expanding wind power to $Z^1$, with the same income the utility level will be lower. Then a positive amount of compensation to the income must be given to obtain the same utility level as before. The distance between $V^0$ and $V^1$ represents net negative externality.

Because this thesis aims to see if the consumers preferences and perceived utility/disutility can change from experience and exposure of wind power, it is necessary to define two different types of CS measures:

$$CS^{EXANTE} \text{ and } CS^{EXPOST}$$

Where $CS^{EXANTE}$ is the compensating surplus before the consumer are exposed to wind power, and $CS^{EXPOST}$ is the compensating surplus after consumer is exposed. The change from not being exposed to being exposed can be both negative and positive. The consumers can go from being positive before to become even more positive after exposing, or they can go from being positive to negative, negative to more negative, negative to positive and so on. The change in CS is defined as:

$$\Delta CS \equiv CS^{EXPOST} - CS^{EXANTE}$$

*Equation 4. Change in compensating surplus*

If $\Delta CS > 0$ then the consumer become more negative or less positive than before.

If $\Delta CS < 0$then the consumer become less negative or more positive than before.

The assumption underlying CS as a welfare measure is that the consumers have a legal right in the status quo situation ($Z^0$). This does not necessarily fit the current way wind power deployment has been taking place in Norway, where it is the government and NVE that decides. So, if we instead were to assume that the consumer does not have a right to $Z^0$, we would use the equivalent surplus (ES) welfare measure. ES will be $ES^{EXPOST,}$ since this applies only after exposure. Wind power impacts goes from $Z^1$ to $Z^0$, because the consumers have no legal rights to not be exposed, defined as:

$$V\ (P^0, M^0, Z^1) = V\ (P^0, M^0 + CS, Z^0)$$

*Equation 5. Conceptualization of welfare impact on utility function 2*

If, $\frac{\partial V}{\partial Z} < 0$ then $ES^{EXPOST} > 0$. Those that are positive to wind power, and have the right to get $Z^1$, will then have a right to get the WTA compensation.

If $\frac{\partial V}{\partial Z} > 0$ then $ES^{EXPOST} < 0$. Those that are negative and gets a welfare deterioration but have no legal rights. They will have the right get a WTP compensation.

# 5.0 Method

The social sciences seek to establish knowledge of what reality looks like (Johannessen, Tufte, & Christoffersen, 2006). Different research methods are used to achieve this goal (Jacobsen, 2015), and the choice of method provides guidelines for how information is to be obtained and processed (Johannessen et al., 2006). In this chapter, the choice of methodological approach and research design will be explained. Further, an explanation of how the data material will be analysed is given. Finally, weaknesses in implementation, validity and reliability of the data material will be discussed.

## 5.1 Overview

It is common to distinguish between quantitative and qualitative methods. Qualitative method is based on the fact that reality cannot be measured using numbers, assuming that it is not possible to obtain objective knowledge about the research question and are therefore approaching reality through an individual's verbal representation of it (Jacobsen, 2015).While quantitative research method refers to information, interpretation and meaning of raw data derived from numbers (Saunders, Lewis, & Thornhill, 2009). Data in raw form often give little to no meaning to most people, forcing the data to be processed into understandable variables and results. The analysis can be conducted through statistics, graphs and diagrams, enabling us to examine trends and relationship within our data (Saunders et al., 2009). The purpose of this master thesis is not to get a deep understanding of attitudes, but to map which preferences that are decisive for different exposed individuals in establishing different attitudes towards wind power, and the main focus is to look for a change in preferences before and after the development of wind power. A quantitative survey is a simple method to get multiple respondents and therefore getting a broader picture on whether the respondents in general change their preferences for wind power or not. Based on this, it is found most appropriate to use a quantitative approach to shed light on the research question. In quantitative research, either primary or secondary data can be utilized (Saunders et al., 2009). The researcher collects all primary data themselves, which can be very time consuming, while secondary data is data already collected by others. As our research question focuses on factors that has not been researched before, a new data collection has been conducted, where a questionnaire has been developed to gather the primary data to analyse. The advantage of collecting the information yourself is that it is directed to the research question and forms the basis for the later analysis in the thesis.

## 5.2 Quantitative preference and attitude survey

The most frequently used approaches to valuation are "attitude" surveys (Clifton & Carrasco, 2018). In social psychology the concept of an "attitude" is defined as a psychological tendency that is expressed by evaluating a good with some degree of disfavour or favour (Phillips, Johnson, & Maddala, 2002). Attitude surveys ask respondents to rate or rank their opinion about discrete goods. Common attitudinal questions may be that respondents need to identify the environmental problems that most concern them. Respondents can be asked whether they (a) strongly agree, (b) agree, (c) neither agree or disagree, (d) agree or (e) strongly agree with a series of statements. The purpose of these questions is to generate different variables which can be used to check whether key questions such as preferences for development of wind power have a basis in individuals' attitudinal beliefs (Perman et al., 2011). Measurement of "preferences" is another approach. The concept comes from economic theory, where preferences is defined as individual's "utility" from non-market goods. The theory furthers argues that utility can be scaled in money value terms such as WTP and WTA (Phillips et al., 2002). Although the term "preference" is often used to mean "attitude" in an informally manner, the economic concept of "preference" assumes fidelity to economic theory (Clifton & Carrasco, 2018). The theoretical literature on preferences and attitudes are broad, and to measure attitudes there is a range from simple approaches that uses straight forward ranking questions, to more complex approaches that separates perceptions, attitudes, beliefs and values (Phillips et al., 2002). In this thesis, we adopted the approach of measuring attitudes with ranking and rating questions. The question design will further be described in chapter 5.4.3.

## 5.3. Revealed and stated preference methodology

Environmental actors are becoming more aware that environmental policies such as wind power development must be created in a way that incorporates people's dimensions of the projects. Wind power policies can fail due to people's preferences concerning wind turbines and the their impact on the environment were not properly considered (Hicks, 2002). There are two types of methodologies for quantifying people's preferences for environmental goods: Stated and revealed preference methods. Stated preference methods assess the value and characteristics of goods by using individuals stated behaviour in a hypothetical setting (Lusk, Roosen, & Shogren, 2011). The main characteristics of stated preference techniques is that they are based on survey data, that they enable researchers to measure both non-use and use values, and to estimate WTP and WTA measures of economic value (Perman et al., 2011). Revealed preference method uses observations on actual choices made by individuals, to measure preferences and estimate the demand function for the environmental good. Stated preference surveys are useful when observed behaviour ("revealed preference") is not relevant, such as when markets do not exist (Clifton & Carrasco, 2018). The stated preference method includes a number of different approaches such as conjoint analysis, contingent valuation, and choice experiments (Lusk et al., 2011). Choice experiments examines the response of individuals to changes in the attributes of a scenario. But the most established stated preference method is the contingent valuation (CV) method (Lusk et al., 2011), and is used in this thesis. CV method stipulates a hypothetical scenario for the preservation or provision of a non-market good (Ladenburg, 2009). The survey should include questions about the characteristics of the respondent, as well their preferences when it comes to the good that is being valued (Perman et al., 2011). The respondents are also asked whether they would be willing to pay a certain percentage amount extra on their electricity bill, in change for not being exposed to wind power.

## 5.4 Statistical and econometric techniques

To address our research question, an ordered logit regression (OLR) approach is utilized. OLR is used when predicting an ordered-level dependent variable from several independent variables. The OLR sets up analysis containing one dependent variable (or outcome), with one or more independent variables (or predictors), like any conventional multiple regression approaches. The difference between ordinary least squares multiple regression and OLR, is that the dependent variable is treated as an orders categorical variable (Stewart et al., 2019). This makes the interpretation or the estimated regression slope more complicated and different from a multiple regression, but in advantage it considers that the intervals between scoring categories can be unequal (Stewart et al., 2019). In a traditional multiple regression, the slope "is interpreted as the expected increase in outcome when a predictor value increases by one unit" (Stewart et al., 2019, p. 274). For OLR, the slope "is interpreted as the expected cumulative log-odds decrease when the predictor increases by one unit" (Stewart et al., 2019, p. 274). In chapter 6 an OLR analysis of collected data will be presented.

## 5.5 The survey

We have developed a survey on attitudes and preferences for wind power in Rogaland. The data were collected online in April 2021 by conducting a panel survey through the professional survey agency Norstat. The survey has been answered by 356 respondents. The collected data will mainly consist of how the respondents' preferences towards wind power have changed after being exposed to wind power development in their immediate environment, and what factors that influence these attitudes. When the survey was conducted, there were 243 functioning wind turbines in Rogaland.

### 5.5.1 Selection of respondents

As there are several windfarms in Rogaland County, with a variety of scope and number of wind turbines. Respondents needed to live close to a windfarm and preferably have visual to a wind turbine from their residence, to be relevant for the questionnaire. Some of the windfarms reaches over several municipalities, which in one way increases the chance of findings relevant respondents. However, in some of the municipalities, only a small part of the citizens is actually directly exposed to the windfarms. People who are not exposed to wind power would not provide representative data for this thesis. The relevant municipalities for this thesis were established to be eight counties located in Rogaland. Further both the questionnaire and wanted area of respondents were sent to Norstat. Then, they completed the process by locating and sending out the questionnaire to relevant respondents.

### 5.5.2 Collection of background information and implementation

To get a comprehensive picture of the topic, finding background information has been an important part. Previous articles and reports in the field have been thoroughly reviewed to find useful questions for the survey. Wind power attitudes is currently a highly relevant topic, which is leading to a lot of recent news articles and reports online. This has been a useful source for gathering information.

Inspiration for the survey has also been found in the ongoing research work by Lindhjem et al. (2019), who made a survey on wind power preferences which was carried out by Norstat. Also, another survey regarding attitudes towards wind farms on land and at sea in Norway, developed by Anders Dugstad (2020), Ståle Navrud (2020), and the WINDLAND project, conducted by Norstat, was used as inspiration. Several of the questions asked in these two surveys were relevant and well-formulated, which led to some of the same questions being used in the survey for this thesis. Additionally, new questions were developed and included to gain information about the research question in this thesis. After obtaining background information and other necessary information, the implementation of the survey started.

### 5.5.3 Question design

The structure of the questions for the survey is in-depth thought through, and the basis for the questions is the research problem. The questions were made straight forward, with either a matrix-based answer, or simple check-out questions. There is a red thread throughout the survey to build up the questions as the respondents are going through it. Scenario-based questions and situations were avoided to make the survey rather easy and simple to understand. Moreover, this reduces the time it takes for respondents to answer the survey, enabling us to increase number of respondents. To ensure validity and reliability, the questions were designed in a clear and self-explanatory way. This was important considering there was no personal contact with the respondents (Johannessen et al., 2006). The survey mainly consists of closed questions, this is done by the fact that it is easier to decode, and it takes less time to complete the survey. Using questions with predefined answer options makes it easier for respondents to complete the survey. The respondents are also then "forced" to choose one answer, making it a more complete dataset. Moreover, indifferent answer options such as "I do not know" and "I am not sure", where excluded in many of the questions, in order to force the respondents to have an opinion and give a clear answer. A disadvantage of this may be that the respondents does not have the opportunity to provide information beyond the stated questions and answer alternatives. To avoid this, an open question was added to several of the questions for the respondents to have an opportunity to provide additional information. Most of the questions were measured on a Likert scale. Likert scale was devised to measure attitude in a scientifically validated and accepted manner. Respondents are asked to show their level of agreement (from strongly disagree to strongly agree) with the given statement on a metric scale. The same way respondents were asked to show their level of affection on a scale from "in large negative degree" to "in large positive degree" and on some questions on a scale from "Not at all" to "In large degree". Here all the statements in combination reveal the specific dimension of the attitude towards wind power (Joshi, Kale, Chandel, & Pal, 2015).

### 5.5.4 Survey design

The survey consists of 27 questions. It starts with a few background questions on what the respondents already know about the scope of wind power in Rogaland, which wind power plant they are exposed to and to what extent. Furthermore, some questions about site affiliation are included. The main part of the survey is based on finding out the respondents positive and negative attitudes towards wind power before and after being exposed. At the end follows questions about electricity bill and a WTP question. Finally, demographic question on gender, age, income and work situation is included. These questions are included to compare different factors between the respondents and their preferences based on the different characteristics.

### 5.5.5 Testing and implementation

The survey was through several rounds of changes, corrections and feedback from other researchers in the field. After the survey was completed an online a test link was in collaboration with Norstat, and 12 people were selected to conduct a pre-test. This was done to get feedback on any improvements and to map the use of time. The test panel consists of people in both genders, and an age range between 20 – 80. This was done as an attempt to cover all the different respondents who will answer the final version of the survey. The test panel generally reported back that they used approximately the same amount of time to complete it (<10 minutes) and that the questions and answers were understandable and clear. However, some of the layout in the survey needed to be altered. A couple of the answer options were switched into reversed order, and some questions were enabled to be skipped by the respondents if they were irrelevant. These elements were reported back to Norstat, who changed the current factors and sent the final version to the relevant respondents.

## 5.6 Evaluation of data material

Problems can occur that can degrade the quality of the data collected. Assessment of the quality and credibility of the survey is therefore important. This implies the survey's reliability and validity, which will be presented in the following section.

### 5.6.1 Reliability

Reliability checks to which extent the data collected will yield consistent findings or similar observations could be made (Saunders et al., 2009). These factors can be assessed by considering if the measures will yield the same results on other occasions, if the observations can be reached by others, and by checking for transparency in how opinion was formed from the raw data (Saunders et al., 2009). Several factors can pose a threat to the reliability of this report. One of them is how respondents can answer the questionnaire differently depending on the day and time answering it, called subject and participant error (Saunders et al., 2009). In our case, the respondents are constantly being exposed to wind turbines, meaning that we believe the answers would be similar no matter which day they answered the questionnaire. On the other hand, the Covid-19 pandemic has led several employees to work from home, which could be causing some respondents to be more exposed during this past year, than earlier. A second threat is subject or participant bias, meaning that respondents may respond in the way they believe are expected or preferred (Saunders et al., 2009). To avoid this happening, we have kept the questionnaire anonymous. Furthermore, there are the threats of observer error and observer bias. These factors focus on how the questions are asked, and how they are interpreted, as well as how the answers given are interpreted by us (Saunders et al., 2009). The questionnaire created for this report, were made relatively short and with concrete questions and answers, as well as columns where respondents could fill in additional information. By doing so, we hope to increase both the observer error and bias.

### 5.6.2 Validity

Validity checks how accurately the data collection method measure what they are intended to measure (Saunders et al., 2009). There are three main types of validity. The first one in content validity, checking to which extent the research instrument accurately measures all the aspects as it is supposed to (Heale & Twycross, 2015). The questionnaire developed in conjunction with this report, are based on former surveys done on similar topics, trying to include all the relevant aspects. Second, construct validity checks to which extent "the research instrument (or tool) measures the intended construct" (Heale & Twycross, 2015, p. 1). As we created a new questionnaire for this thesis all the aspects we wanted to analyse, were included. The third type checks to which extent the "research instrument is related to other instruments that measures the same variables" (Heale & Twycross, 2015, p. 1)

There are several factors that can weaken the validity of a questionnaire, such as history, testing, instrumentation, morality, maturation and ambiguity about causal direction (Saunders et al., 2009). Trying to prevent these factors from reducing the validity of our questionnaire, we conducted both general and more personal questions, and questions who separates long-time exposed respondents, from short-term exposed respondents.

# 6.0 Empirical Analysis

This chapter is divided into six parts. Firstly, the variables and descriptive statistics will be presented. Furthermore, hypotheses, correlation matrix between the variables and a factor analysis will be represented, before the chapter ends with the regression analysis. To conduct the statistical analyses the software's SPSS and R is used.

## 6.1 Description of variables

| ID | NAME | DESCRIPTIONS |
|---|---|---|
| $Y_1$ | ALOCALLY | Affection to wind turbines in their immediate area |
| $Y_2$ | AGENERALLY | Affection to wind turbines in general |
| $Y_3$ | AFLOCALLY | Experienced change in affiliation to the immediate area |
| $Y_4$ | RECACTIVITY | Uses the local area less for recreation |
| $Y_5$ | ATTITUDEB | Attitude towards wind power before being exposed. |
| $Y_6$ | ATTITUDEA | Attitude towards wind power after being exposed. |
| $Y_7$ | WTP | Willingness to pay extra on electricity bill in order to avoid wind turbines. |
| $X_1$ | AFFILIATION | Affiliation to immediate area |
| $X_2$ | MUNC | Municipalities where wind power installations were developed in year. |
| $X_3$ | DISTANCE | Indicates the distance between housing and the nearest wind park. |
| $X_4$ | YEARLIVED | Indicates how many years the respondent have lived in the area |
| $X_5$ | VISIBLE | Visible wind turbines from housing. |
| $X_6$ | LEISUREH | Leisure housing in proximity of wind turbines. |
| $X_7$ | DIR_NEGEFF | Sum of all direct negative effects (FACTOR1-5) |
| $X_8$ | INDIR_NEGEFF | Sum of all indirect negative effects (FACTOR6-11) |
| $X_9$-$X_{19}$ | FACTOR1-FACTOR11 | *described in table 12 in appendix 1 |
| $X_{20}$ | AGE | Respondent's age |
| $X_{21}$ | AGE^2 | Respondent's age squared. |
| $X_{22}$ | FEMALE | Respondent's gender |
| $X_{23}$ | INCOME | Respondents' income |
| $X_{24}$ | INCOME^2 | Respondents' income squared. |
| $X_{25}$ | RETIRED | Respondent are retired. |
| $X_{26}$ | FULLTIME | Respondent are working fulltime |
| $X_{27}$ | UNI_EDU | University Education |
| $X_{28}$ | POS_EFF | Sum of all positive effects |
| $X_{29}$ | TAX | Provides local tax revenues. |
| $X_{30}$ | RECREATION | Provides new recreational opportunities. |
| $X_{31}$ | WORKPLACE | Creates local business activity and new jobs |
| $X_{32}$ | CLIMATECH | Helps to combat climate change. |
| $X_{33}$ | LOW_ELEC | Provides lower electricity prices. |

*Table 1. Description of variables*

Table 1 provides ID, names and descriptions of all variables used in the data analysis. Corresponding coding/units to each of the variables is shown in Appendix 1 cf. table 10. The variables $Y_1$- $Y_7$ is the dependent variables and represents the outcome of what we want to measure explained by the independent variables $X_1$-$X_{33}$. Some of the variables have been altered to fit our model. For the dependent variable "WTP", respondent's monthly electricity bill has been multiplied with the percentage value they are willing to pay extra on their monthly bill. The electricity bill variable and the percentage to pay extra variable was stated in intervals, where the midpoint of each interval is used. For the last interval of percentage willing to pay extra "over 20%" an assumption of 25% is made. On the last interval on the electricity bill "over 2800 NOK each month", an assumption of 3200 NOK is made. By multiplying these two variables the amount in NOK the respondents are willing to pay extra to avoid wind turbines in the immediate area is estimated resulting in the dependent variable "WTP". For the variable "MUNC" the municipalities have been divided into new and old wind power municipalities. The new wind power municipalities are Bjerkreim, Lund, Sandnes, Sokndal, Egersund and Gjesdal. While the old wind power municipalities are Hå and Time. The variables FEMALE, VISIBLE, LEISUREHOME, RETIRED, FULLTIME and UNI_EDU have been converted to dummy variables. The rest of the variables in the table have not been altered. Descriptions of FACTOR 1-11 is stated in Appendix 1 cf. table 9.

### 6.2 Descriptive statistics

Descriptive statistics are the numerical and graphical techniques used to present, organize and analyse data. By the fact that we have carried out a completely new and original survey, much emphasis will be placed on presenting descriptive statistics.

The form of descriptive statistics that is used to describe a variable in a sample is dependent on the level of measurement that has been used (Fisher & Marshall, 2009). The number of responses, N, varies from 290 to 356. The discrepancies are from respondents that have used the answer options "I do not know" or "I do not want to answer", which has been excluded from the dataset.

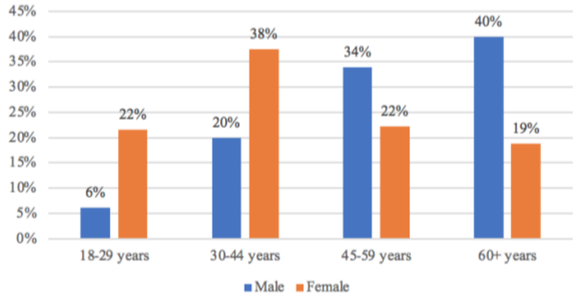
Minimum and maximum show the highest and the lowest value for the variable, giving an indication of whether there are values outside the range. All the variables with minimum of 0 and maximum of 1 are dummy variables.

| NAME | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| ALOCALLY | 329 | 1 | 5 | 3.42 | 1.077 |
| AFLOCALLY | 337 | 1 | 3 | 2.26 | 0.528 |
| REACTIVITY | 314 | 1 | 5 | 3.62 | 1.416 |
| ATTITUDEA | 356 | 1 | 5 | 3.73 | 1.046 |
| AFFILIATION | 356 | 0 | 1 | 0.79 | 0.406 |
| MUNC | 356 | 0 | 1 | 0.60 | 0.490 |
| DISTANCE | 356 | 1 | 25 | 9.50 | 6.272 |
| YEARLIVED | 356 | 1 | 60 | 22.16 | 19.671 |
| VISIBLE | 356 | 0 | 1 | 0.48 | 0.500 |
| LEISUREH | 356 | 0 | 1 | 0.12 | 0.323 |
| DIR_NEGEFF | 356 | 1 | 4 | 1.46 | 0.634 |
| INDIR_NEGEFF | 356 | 1 | 4 | 2.22 | 0.971 |
| AGE | 356 | 18 | 85 | 48.85 | 16.742 |
| FEMALE | 356 | 0 | 1 | 0.49 | 0.501 |
| INCOME | 290 | 50000 | 2000000 | 872241.38 | 440525.178 |
| RETIRED | 356 | 0 | 1 | 0.21 | 0.410 |
| FULLTIME | 356 | 0 | 1 | 0.50 | 0.501 |
| UNI_EDU | 355 | 0 | 1 | 0.45 | 0.498 |
| POS_EFF | 356 | 1 | 4 | 2.01 | 0.667 |
| Valid N (listwise) | 242 | | | | |

*Table 2. Descriptive Statistics*

As seen in table 2, the variables that are not dummy, has different minimum and maximum values. The independent variables DISTANCE, INCOME and YEARLIVED is classified in possible groups that indicates which of the ranges the respondent belongs to. Because it makes more sense if the groups are stated as a value, the data has been corrected to an approximate value, which has been determined to be the midpoint of each group. As an example, the distance interval 5-10 km is set to 7 km. The last interval for DISTANCE "over 20%" an assumption of 25 km is made. For INCOME the last interval "1.500.000 NOK or more" an assumption of 2.000.000 NOK is made. Lastly, for YEARLIVED the last interval "my whole life" an assumption of 60 year is made. In this way, the numbers will be easier to interpret. For the other variables such as POS_EFF it is chosen to keep the absolute value, as these can be interpreted. The table is also showing statistical variables such as mean and std deviation. The variable POS_EFF that has a maximum value of 4 and a minimum value of 1, which indicates non degree and in large degree respectively. The mean is 2.01, saying that the average score of respondents is experiencing positive effects to a small degree. The variable ALDER shows a minimum of 18 years and a maximum of 85 years, and the mean is 49 years. Table 2 further shows standard deviation. The standard deviation is to which extent the variables are different, as well as how large the deviation or spread of the various variables is in relation to the average value. If the standard deviation has a low value, it means that the units are grouped around the average, and vice versa with a large standard deviation (Christophersen, 2009).

### 6.2.1 Demographic information



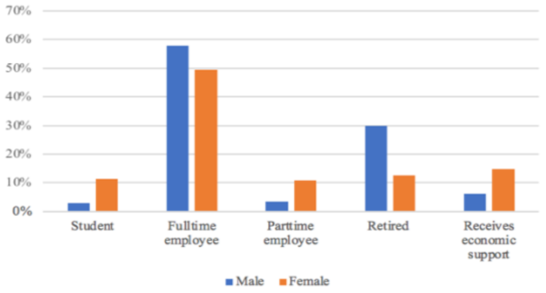




*Figure 6. Age by gender*

*Figure 7. Daily occupation by gender*

As shown in figure 6, the respondent's gender is evenly distributed, whereas 51% of the respondents are male, and 49% of the respondents are female. The respondents are also evenly distributed across all age groups. Most females are in the age group 30-44 years, while the majority of male are in the age group 60+ years. From figure 7 it can be seen that 75 % of the respondents are either fulltime employees or retired. This agrees well from the age distribution. Fulltime employees are highest represented with 54 % of the sample.

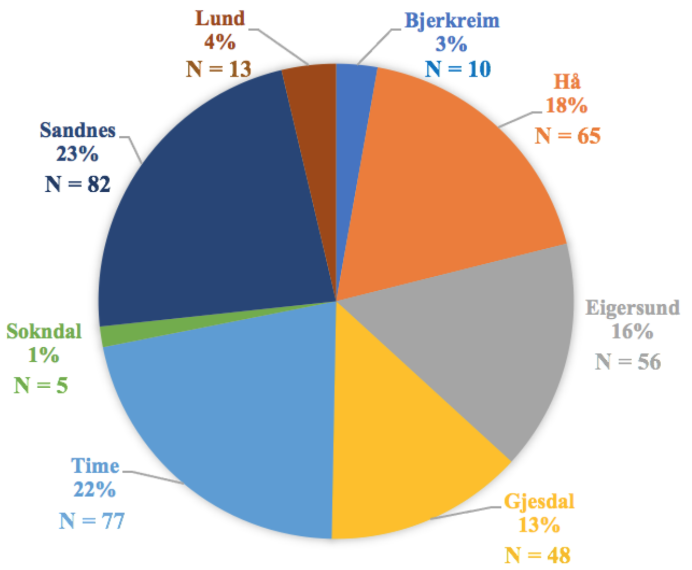



*Figure 8. Respondents municipality*

Further, figure 8 is showing the respondents home municipality. The figure shows that 92% of the respondents are living in the largest municipalities based on population; Sandnes, Time, Hå, Eigersund and Gjesdal. While only 8% of the respondents are living in the small municipalities Lund, Bjerkreim and Sokndal. Sandnes is highest represented with 23% of the respondents.

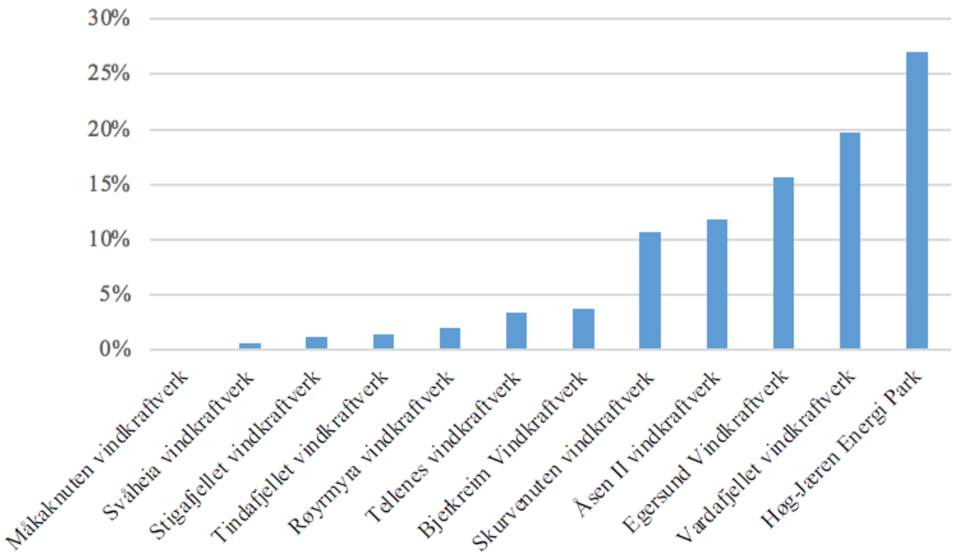



*Figure 9. Wind park closest to house*

Figure 9 provides the results of which wind park the respondents live closest to. Most of the respondents (27%) live closest to Høg-Jæren energy park and 20% live closest to Vardafjellet windpark. Egersund windpark is also strongly represented with 16% of the respondents. None of the respondents lives close to Måkaknuten windpark.

### 6.2.3 Respondents background knowledge

The respondents were asked a question about their best estimate on how many wind turbines there are in Rogaland today.

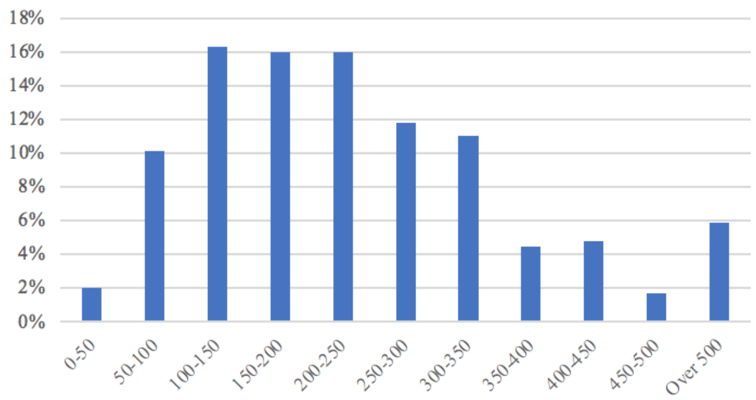



*Figure 10. Respondents' estimates of number of wind turbines in Rogaland*

From figure 10, most of the respondents believes that there is between 100-250 wind turbines located in Rogaland. The purpose of this question is based on the expectation that if respondent's perception is larger than reality, they will psychologically feel more impacted or be more negative towards wind power development. As of today, there are over 240 wind turbines in Rogaland, which is close to what most respondents have assumed. Still 6% of the respondents are assuming that there are over 500 wind turbines in Rogaland, which is twice the reality. It would then be interesting to see if there is a connection between the estimates and which municipality the respondents live in, provided in Appendix 1 cf. table 14 and figure 26. The table shows slightly divided opinions on how many wind turbines that are built in Rogaland. The respondents from Eigersund had the highest response rate on believing that Rogaland has more than 500 wind turbines. This can therefore be an indication that the respondents from Eigersund is generally more exposed to wind turbines than for example the respondents in Sandnes are.

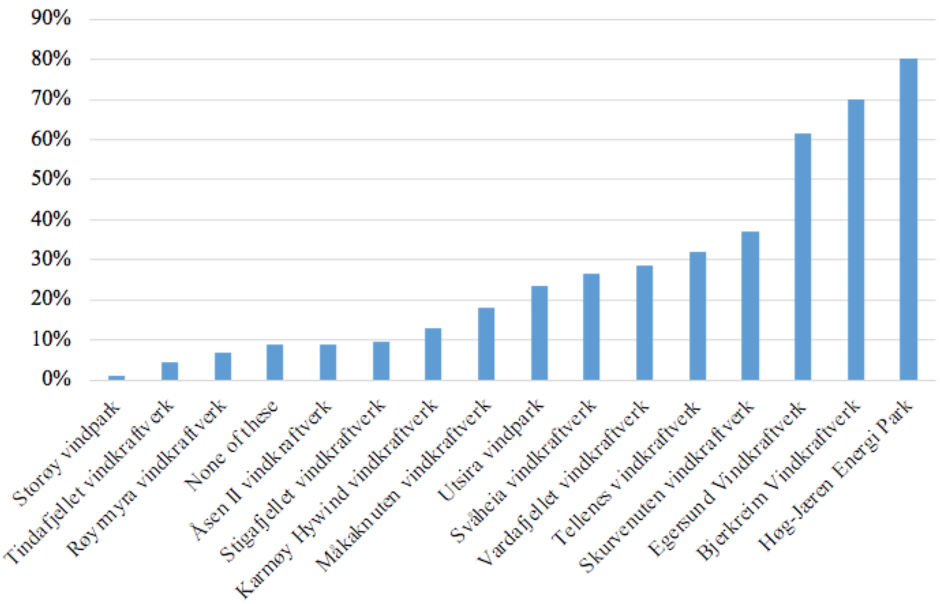



*Figure 11. Respondents have heard of the following wind parks*

A question about which of the wind power parks in Rogaland the respondents have heard of, was also included in the survey. From figure 11, the wind turbines that most respondents had heard of were Høg-Jøren energi park, Egersund vindkraftverk and Bjerkreim vindkraftverk. Few of the respondents had knowledge of Storøy and Tindafjellet. Surprisingly, as many as 9% had not heard of any of the wind power installations in Rogaland.

### 6.2.2 Affiliation to immediate area

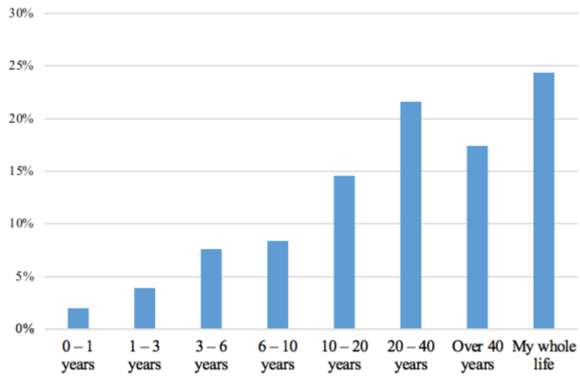



*Figure 12. Number of years lived in municipality*

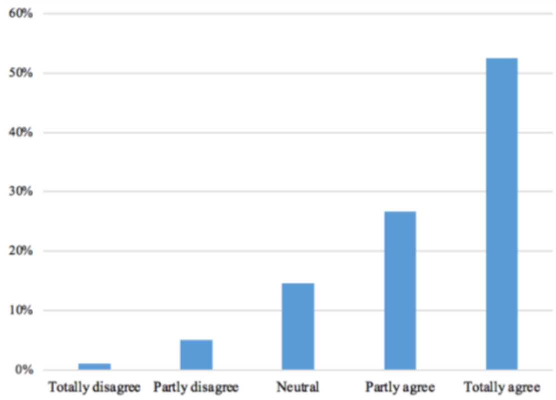



*Figure 13. Affiliation to immediate area*

Affiliation to respondents own municipality will be an interesting factor when attitudes and preferences are examined, as this can have great influence for some. Figure 12 provides data on numbers of years respondents have lived in their municipality. Most of the respondents have lived their whole life in the same municipality, but data for all intervals are obtained. From Appendix 1 cf. table 11 and figure 23 the municipality where most of the respondents have lived their whole life is Hå. In Sokndal, as many as 40% have only lived in the area for less than 1 year. But by looking at the table, one can see a clear majority in the upper categories (from 20 years and more) in almost all the municipalities. In figure 13, 79% of the respondents states that they "Partly agree" or "Totally agree" to having strong affiliation to their immediate area. From Appendix 1 cf. table 11 and figure 23, Sokndal is the municipality where the highest proportion of respondents only had lived in the area for under a year, even though as shown in Appendix 1 cf. table 12 and figure 24 the respondents living in Sokndal have highest affiliation to their immediate area. This is an interesting finding, as this is not necessarily what is expected. In general, the bar for strong affiliation to immediate area are very high in all municipalities. Very few respondents express that they have weak affiliation to their municipality.

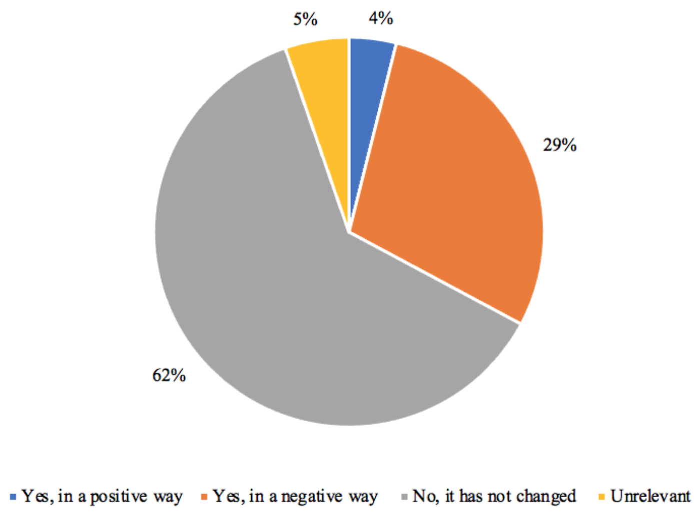



*Figure 14. Changed affiliation*

Furthermore, a question as to whether the development of wind power has affected your affiliation to your immediate area is included. This is also one of the dependent Y-variables that is analyzed in chapter 6. From figure 14, 62% of the respondents are saying that it has not changed, while 29% of the respondents affiliation has changed in a negative direction. Only 4% has answered that the development of wind turbines has affected their affiliation in a positive way.

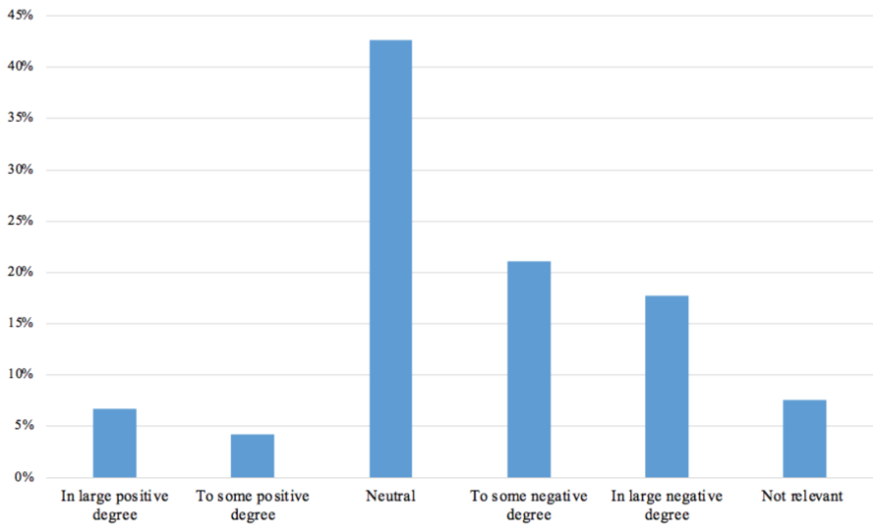



*Figure 15. Feels affected in immediate housing area*

Whether the respondents feel affected by wind power in their immediate area is also an important element to look at, because this question may vary individually. Even if respondents are living in the same place and are "directly" affected in the same way, some will feel more exposed than others. From figure 15 most of the respondents answer that they are neutral to the question (43%), but there are quite a big proportion of respondents answering that they feel affected in some negative degree or in large negative degree. This applies to as many as 39% of the respondents. Shown in Appendix 1 cf. table 13 and figure 25, the respondents in Sandnes are overall those who feel the least negatively affected. Respondents in Bjerkreim are quite divided on how they feel affected. They have one of the highest “in large negative degree” response rates, at the same time having the highest response rate on “in large positive degree”. This may be explained by differences that are depending on where in Bjerkreim you live.

### 6.2.4 Attitudes towards wind power development

When the population of Rogaland's attitudes are affected, several elements come into play. These factors may also vary from individual to individual. Below, the respondents have been served several statements regarding wind power development in Norway.

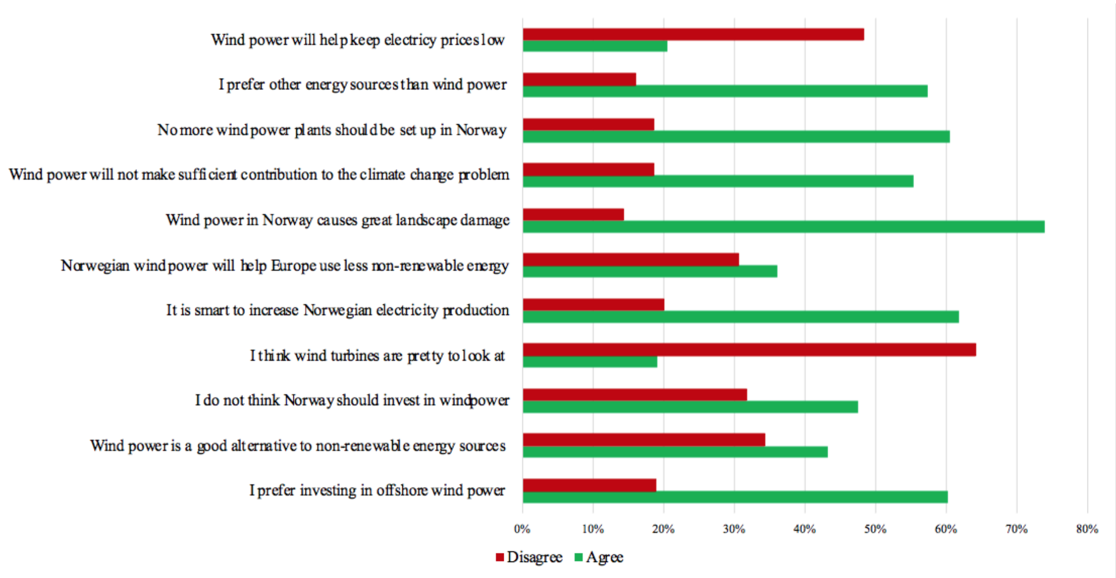



*Figure 16. Statements on wind power developments in Norway*

From figure 16, the statements that most respondents are disagreeing with is that wind turbines are pretty to look at, and that wind power will help keep electricity prices low. The statements that most of the respondents are totally agreeing with is preferring other energy sources than wind power, no more WPP should be set up in Norway, and that wind power in Norway causes great landscape damage. These answers could give an indication that there are many people that have negative attitudes against wind power.

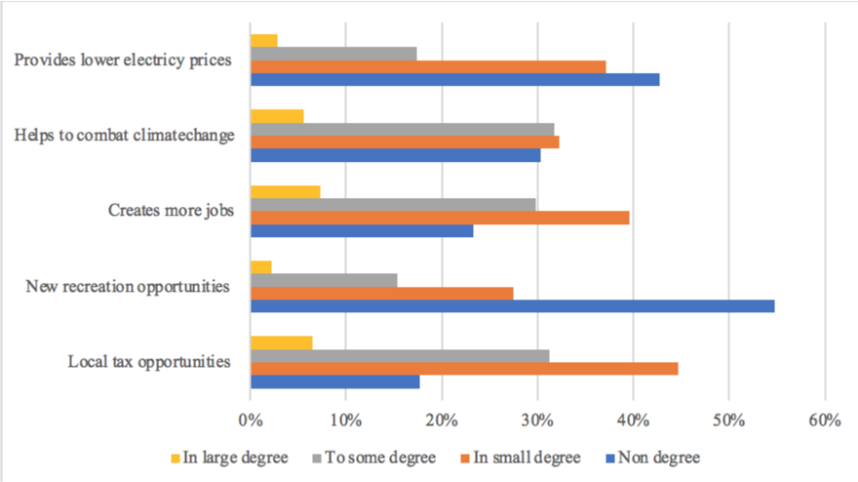



*Figure 17. Positive effects*

Furthermore, from figure 17 the respondents were asked to what extent they thought wind power had these positive effects. Overall, the respondents believed that wind power had in little or no degree these listed positive effects. In particular many disagreed with the fact that wind power provides new recreational opportunities. But there were a few respondents who believe that wind power, among other things, creates more jobs and provides local tax opportunities.

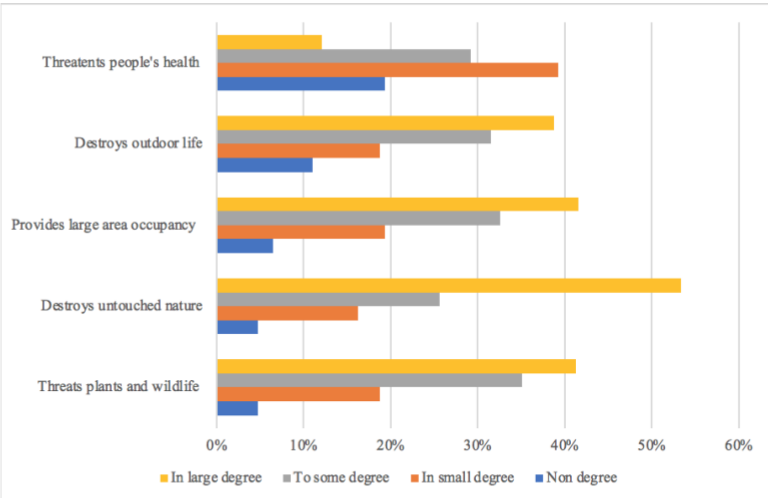



*Figure 18. Negative effects*

The associated negative effects of wind power were represented in similar way as the positive effects. From figure 18 most of the respondents (53%) agreed on the statement that wind power destroys untouched nature in large degree. As well as it destroys outdoor life, provides large area occupancy and threats plants and wildlife. Thus, the statement "wind power threatens people's health" was only agreed to a small degree. Further it is useful to know whether the respondents actually have experienced negative effects in their immediate area from wind power.

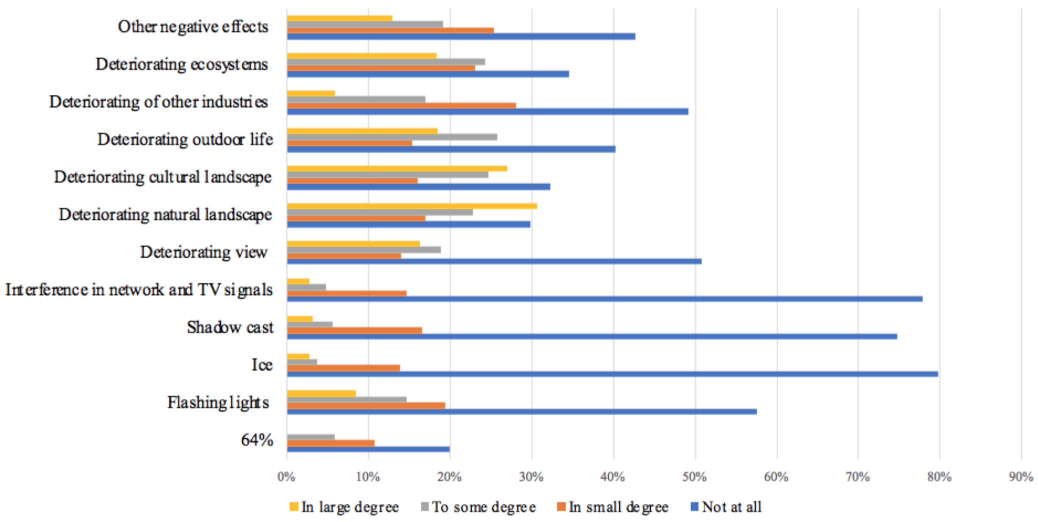



*Figure 19. Experienced effects*

From figure 19, as many as 31% of the respondents have experienced to a large degree that the natural landscape is being destroyed, and 27% have experienced that the cultural landscape to a large degree has been destroyed. Concrete numbers can be found in Appendix 1 cf. table 15 However, it is quite clear that the majority of the respondents have not experienced any of these negative effects. It would be interesting to further investigate where the respondents that experiences negative effects "in large degree" are located. In Appendix 1 cf. table 16 and figure 27, only the respondents who experiences the stated negative effects to a large degree is included. From the table it looks like Lund is the municipality that is mostly bothered by negative effects.

### 6.2.5 Change in preferences

The main emphasis in this thesis is on whether the respondents have changed their attitudes before and after development of wind power. Based on this the following tables and figures are highly relevant on getting an indication of the research question. The "Attitude after wind power development" question is therefore also an important Y-variable in the later analysis.

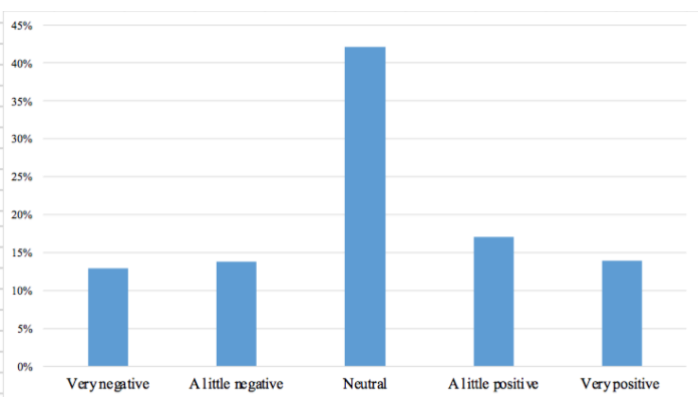


*Figure 20. General attitude towards wind power BEFORE local development*

Firstly, the respondents were asked about their attitudes before wind power development. As seen from figure 20, most of the respondents had neutral attitudes, and the distribution between those who were positive and those who were negative was quite equal. From Appendix 1 cf. table 17 and figure 28, it varies a bit between the different municipality, but in general there is a great deal of positive attitudes among the respondents. The municipalities that were most negative is Lund and Bjerkreim, while the most positive municipalities are Hå and Time.

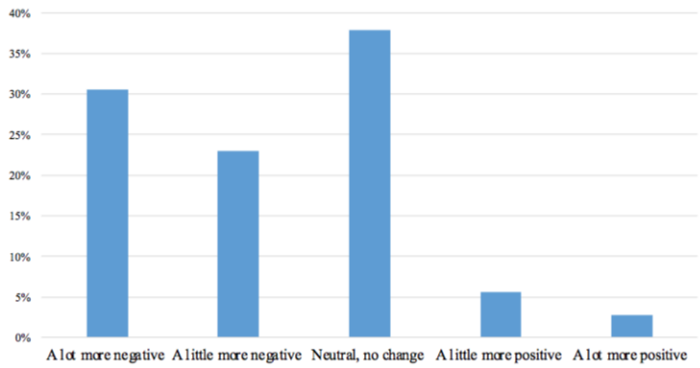



*Figure 21. Attitudes AFTER local development*

Then the respondents were asked about how their attitudes towards wind power has changed after the development of more wind turbines in Rogaland. As seen from figure 21, in total more than half of the respondents have become either a little more negative or a lot more negative (54%). 38% is neutral, meaning that their preferences have not changed. Only 9% of the respondents have become more positive. From Appendix 1 cf. table 18 and figure 29, those respondents that have become the most negative after the development is respondents living in Lund, Sokndal and Bjerkreim. Of those who have become more positive, we find the majority in Hå. This can be explained by the fact that Hå has been exposed by wind power the longest, while Sokndal, Bjerkreim and Lund are new wind power municipalities, and therefore not as used to being exposed.

## 6.3 Hypotheses testing

"Hypothesis tests use data to provide answers to how unreasonable a given hypothesis is" (Foldnes, Grønneberg, & Hermansen, 2018, p. 352). Statistical hypothesis testing involves the statement of the statistical null-and alternative hypotheses, and is used to establish whether the sample data reject the null hypothesis and provide evidence of a difference, as specified by the alternative hypothesis (Sedgwick, 2014). In other words, you first test the null hypothesis, while the alternative hypothesis is true if the null hypothesis is not. After testing the null hypothesis, one must find out if it is statistically significant. If this is the case, the null hypothesis will be rejected and the alternative hypothesis will be accepted (Foldnes et al., 2018). This thesis contains six different dependent Y variables which are:

(1) Affection to wind turbines in their immediate area

(2) Experienced change in affiliation to the immediate area

(3) Uses the local area less for recreation

(5) Attitude towards wind power after being exposed

(6) Willingness to pay extra on electricity bill in order to avoid wind turbines

### 6.3.2 Hypotheses

This thesis is calculated by $H_a$ being the expected effects, with $H_0$ being the opposite. All the independent (X) variables are tested against all the dependent (Y) variables in the regression. Since this thesis contains so many X with different coding, it is decided to only comment on some in the hypothesis testing. The selected hypotheses are the most interesting and relevant in relation to the research question of the thesis. All the hypotheses are based on the principle that everything else is kept constant.

**Hypothesis 1:** (ATTITUDEA = $Y_6$)

"Exposure leads to more negative attitudes".

| $H_0$ | $H_A$ |
|---|---|
| $\beta_{INDIR\_NEGEFF} < 0$ | $\beta_{INDIR\_NEGEFF} > 0$ |
| $\beta_{DIR\_NEGEFF} < 0$ | $\beta_{DIR\_NEGEFF} > 0$ |

The independent variables $\beta_{DIR\_NEGEFF}$ and $\beta_{INDIR\_NEGEFF}$ indicates how much direct and indirect negative effects have affected the probability on developing more negative attitudes against wind power, all else held equal. If the estimated coefficient is significantly larger than zero, the null hypothesis might be rejected. This could indicate that the proposition is accurate.

**Hypothesis 2:** (ALOCALLY = $Y_1$)

“Respondents who experience positive outcomes of wind power feel more positively affected in their immediate area”.

| $H_0$ | $H_A$ |
| --- | --- |
| $\beta_{POS\_EFF} > 0$ | $\beta_{POS\_EFF} < 0$ |

The independent variable $\beta_{POS\_EFF}$ refers to how much the respondent's affection to their immediate area, depends on the positive effects that they are experiencing. The hypotheses can be examined by looking at the sign and significant of its estimated beta coefficient. If it is significantly larger than zero, the null hypothesis might be rejected. Indicating that respondents that are experiencing positive outcomes feel positively affected in their immediate area.

**Hypothesis 3:** (REACTIVITY = $Y_4$)

“Respondents that are indirectly negatively affected by wind power, uses their immediate area less to recreational activities”.

| $H_0$ | $H_A$ |
| --- | --- |
| $\beta_{INDIR\_NEGEFF} > 0$ | $\beta_{INDIR\_NEGEFF} < 0$ |

The independent variable $\beta_{INDIR\_NEGEFF}$ indicates how much the respondents are indirectly negative effected by wind power affect the probability of using the immediate area less for recreational activities, all else held equal. If the hypothesis is rejected, this would indicate that respondents are using the area less for recreational activities due to indirect negative effects.

**Hypothesis 4:** (AFLOCALLY = $Y_3$)

“Visible wind turbines decrease respondent's affiliation to their immediate area”.

| $H_0$ | $H_A$ |
| --- | --- |
| $\beta_{VISIBLE} > 0$ | $\beta_{VISIBLE} < 0$ |

The independent variable $\beta_{VISIBLE}$ refers to how much the dependent deviates when a person can see wind turbines from their home or not. If the test result suggest that the null hypotheses might be rejected, it would seem like visible wind turbines decreases respondent's affiliation to their immediate area.

**Hypothesis 5:** (WTP = $Y_7$)

"Higher income is associated with higher willingness to pay to avoid being exposed to wind power".

| $H_0$ | $H_A$ |
|---|---|
| $\beta_{INCOME} < 0$ | $\beta_{INCOME} > 0$ |

It would be interesting to look at the regression coefficient related to if respondents with higher income (independent variable) will equal higher willingness to pay to avoid being exposed to wind power. The hypotheses above can be conducted in order to investigate whether this has a positive effect on the WTP for avoiding wind turbines. If the estimated coefficient turns out to be significant at a chosen level, the null hypothesis might be rejected.

## 6.4 Correlation analysis

A correlational analysis is conducted to check if there is a strong relationship between the variables. In a regression analysis, all variables should be independent from each other. If some of the variables are too correlated it might not be a good idea to run them both in the regression analysis, as they are too dependent on each other. As an alternative a factor analysis could be completed in order to merge the variables. When conducting correlational analyses with ordinal data, researchers must make an appropriate methodological choice in order to yield the most valid and useful results (Choi, Peters, & Mueller, 2010). When ordinal variables are observed, the strength of the associating between the two variables $X_1$ and $X_2$ is usually measured. Almost all methods for generating ordinal data employ Pearsons correlation as a measure of association (Ferrari & Barbiero, 2012).

Pearsons r is a measure that assesses the association between two continuous or metrical variables. Equation X provides a commonly used formula for calculating Pearsons r,

$$r = \frac{\Sigma\left[\left(\frac{x_i - \bar{x}}{s_x}\right)\left(\frac{y_i - \bar{y}}{s_y}\right)\right]}{n}$$

*Equation 6. Pearsons r*

Where $x_i$ and $y_i$ represents the values of variable $X$ and $Y$, is the $\bar{x}$ mean of the $X$ values, $\bar{y}$ is the mean of the $Y$ values, $S_X$ is the standard deviation of the $X$ values, $S_Y$ is the standard deviation of the $Y$ values, and $n$ represents the number of cases. The values obtained for Pearsons $r$ fall between –1 and 1. The sign of *r* represents the direction of the association, while the absolute value of Pearsons r represents the strength of the association. The closer *r* is to –1 or 1, the stronger the association (Ferrari & Barbiero, 2012).

In the correlation matrix 1, found in Appendix 2 cf. table 19, all Y variables and the selected X variables are included. The correlation between the dependent variables AGENERALLY and ALOCALLY is highly correlated at 0.821, and therefore only ALOCALLY is selected to take part in the regression analysis. This is done on the basis that AGENERALLY and ALOCALLY probably will indicate the same result in the regression, and therefore it is chosen to limit the number of Y-variables.

Further, by running all the positive and negative effects (X-variables) in a correlation analysis, the data will check whether there is a high correlation between the variables. The correlation matrix is presented in Appendix 2 cf. table 20, and we have chosen to look for coefficient values above 0.3. This correlation matrix contains several of values above this criterion, which gives us a basis for performing a factor analysis in an attempt to reduce the number of independent variables into fewer variables.

## 6.5 Factor Analysis

Factor analysis is in this thesis used to reduce the number of variables in the dataset into fewer factors. The independent variables will be checked for underlying factors by extracting maximum common variance from all the variables and puts them into a common score (Baglin, 2014). As an index of all variables, this score is used for further analysis. The factor analysis has been performed in SPSS. In the factor analysis 16 input variables are used. Out of these, 11 of the variables represent negative effects and 5 of the variables represents positive effects regarding wind power preferences. Principal Component Analysis (PCA) is a dimensionality-reduction method that is used to reduce dimensionality of large data set of variables into a smaller one that still contains most of the information in the dataset (Jaadi, 2021). Firstly, a check to see if the dataset is suitable for factor analysis is necessary, this is done by checking that the Kaiser-Meyer-Olkin measure is above 0.6. As seen from table 3 the value is 0.926, so that is good. The Bartletts test also needs to be significant, which in this case it is at 0.000. It can now be stated that the dataset is suitable for factor analysis.

| KMO Measure of Sampling Adequacy | | .926 |
|---|---|---|
| Bartletts Test of Sphericity | Approx. Chi-Square | 3607.455 |
| | df | 120 |
| | Sig. | .000 |

*Table 3. KMO and Bartletts test*

PCA initially extracts 16 factors or "components". Each of the variables has a quality score called an eigenvalue. Only components with high eigenvalues are likely to represent a real underlying factor. A common rule of thumb is to select components whose eigenvalue is at least 1.

| Component | Total | % of Variance | Cumulative % |
|---|---|---|---|
| 1 | 7.581 | 47.381 | 47.381 |
| 2 | 1.995 | 12.471 | 59.852 |
| 3 | 1.282 | 8.015 | 67.867 |
| 4 | .642 | 4.014 | 71.882 |
| 5 | .608 | 3.799 | 75.681 |
| 6 | .540 | 3.376 | 79.057 |
| 7 | .516 | 3.224 | 82.281 |
| 8 | .482 | 3.013 | 85.294 |
| 9 | .447 | 2.791 | 88.085 |
| 10 | .388 | 2.427 | 90.512 |
| 11 | .331 | 2.071 | 92.583 |
| 12 | .326 | 2.038 | 94.621 |
| 13 | .299 | 1.869 | 96.490 |
| 14 | .253 | 1.579 | 98.069 |
| 15 | .193 | 1.205 | 99.274 |
| 16 | .116 | .726 | 100.000 |

*Table 4. Total Variance Explained*

From table 4, applying the simple rule of eigenvalue is at least 1, the 16 variables seem to measure 3 underlying factors. This is because only the first 3 components have an eigenvalue of at least 1. From table 4 it can also be seen that component 1 explains 47,38% of the variance, component 2 explains 12,47% of the variance and component 3 explains 8% of the variance. The other components are having too low-quality score and are therefore not assumed to represent real traits underlying the 16 variables. These components are considered "scree".

The component matrix below shows the Pearson correlations between the items and the components, called the factor loadings.

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| FACTOR8 | .839 | | .380 |
| FACTOR9 | .826 | | .309 |
| FACTOR7 | .823 | | .436 |
| FACTOR11 | .778 | | .332 |
| FACTOR6 | .774 | | |
| FACTOR10 | .770 | | |
| FACTOR2 | .699 | | |
| FACTOR1 | .692 | .387 | |
| FACTOR4 | .667 | .361 | -.371 |
| WORKPLACE | -.615 | .462 | .312 |
| FACTOR5 | .608 | .386 | |
| CLIMATECH | -.606 | .502 | |
| FACTOR3 | .580 | .413 | -.350 |
| TAX | -.536 | .480 | .379 |
| LOW_ELEC | -.554 | .572 | |
| RECREATION | -.512 | .526 | |

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

*Table 5. Component Matrix*

As seen in table 5, in the first component all the factors are above 0.4 and is therefore the most appropriate. By looking at the second component there are lower values, and lastly component 3 has the lowest values. The first and the second components have the best and the strongest interrelationships among these different items.

Ideally, each input variable should measure precisely one factor. That is not the case here. For instance, FACTOR8 correlates with components 1 and 3 and FACTOR4 correlates with all the three components simultaneously. If the variables have more than one substantial factor loading it is called cross loadings, and these complicates the interpretation of the factors. Therefore, a rotated component matrix is made and presented in table 6. The Oblim with Kaizer Normaliation rotation method is used, which tries to redistribute the factor loadings such that each variable measures precisely one factor.

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| FACTOR7 | .949 | | |
| FACTOR8 | .899 | | |
| FACTOR9 | .821 | | |
| FACTOR11 | .819 | | |
| FACTOR6 | .634 | | |
| FACTOR10 | .494 | | |
| TAX | | .839 | |
| WORKPLACE | | .806 | |
| LOW_ELEC | | .793 | |
| CLIMATECH | | .757 | |
| RECREATION | -.387 | .553 | |
| FACTOR4 | | | -.803 |
| FACTOR3 | | | -.792 |
| FACTOR5 | | | -.727 |
| FACTOR1 | | | -.720 |
| FACTOR2 | .344 | | -.486 |

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

*Table 6. Pattern Matrix*

Based on the Pattern Matrix the components are interpreted the following way:

**Component 1:** Factors that affects the respondent negatively in form of degradation of the nature and surroundings, resulting in the new variable "INDIRECT_NEGEFF".

**Component 2:** Factors that affects the respondent positively, resulting in the new variable "POS_EFF".

**Component 3:** Factors that negatively affects the respondents physically/direct, resulting in the new variable "DIRECT_NEGEFF".

It is therefore decided to split the 16 variables into these 3 new variables to use in the regression analysis. The distribution looks like this:

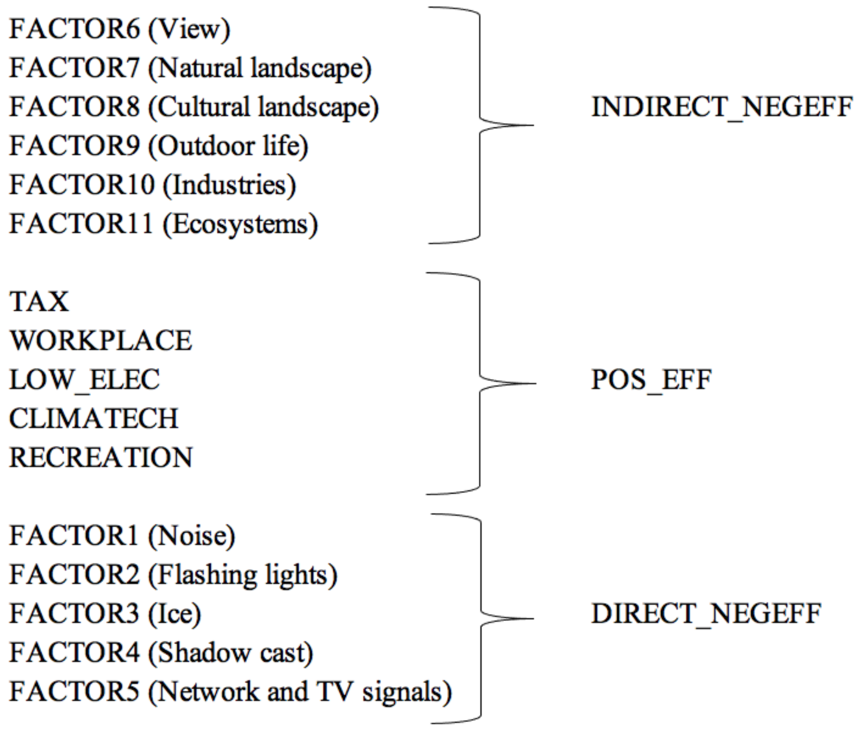



*Figure 22. Distribution of components*

Shown in figure 22, 16 variables are now reduced to only 3 variables which is taken into the regression analysis below.

## 6.6 Regression analysis

The closing section of chapter 6 will focus on the regression analysis, before it ends with a look at marginal effects of our data.

### 6.6.1 OLR model

As stated, an OLR model is used to interpret the collected data. The OLR model is interpreted as follows; Y is the ordinal outcome, with J categories. The cumulative probability of Y is P $(Y \leq j)$ equal to or less than a specific category j=1, … , J=1. The odds of the value being equal to or less than a particular category is defined as: $\frac{P(Y\leq j)}{P(Y>j)}$ for j=1, …, J=1 since P (Y > J) = 0 and dividing by zero is undefined. The logit equals the log odds, which gives:

$$\log\frac{P(Y \leq j)}{P(Y > j)} = logit\ (P(Y \leq j))$$

*Equation 7. Logit equals the log odds*

By using the **polr** function in R, the OLR model is parameterized as:

$$logit\big(P(Y \leq j)\big) = \beta_{j0} - \eta_1 x_1 - \cdots - \eta_p x_p$$

*Equation 8. Ordered logit model*

The aim of our regression model is to test our five hypotheses stated in chapter 6.3.2. To do so, OLR will be performed for our data, with different sets of both dependent and independent variables. As our dataset has several dependent variables, different predictors are used in the regression models to get results that can help answer our research question. Robust standard errors are used for all variables in the regression model, since the structure of variation is unknown, to avoid heteroscedasticity in the results, and to strengthen our statistical model.

The results from the OLR analysis are listed in table 7 below. Robust standard errors are used for all beta values in the table. Further, a Chi-squared goodness of fit test were run, to check if the data comes from a specified distribution. For all Y-variables, the p-value is highly significant (and less than 0.05), which means that we can reject the null hypothesis that the variables come from a specified distribution. The table contains several regressions, using all independent variables on each dependent variable.

| | ALOCALLY | | AFLOCALLY | | RECACTIVITY | | ATTITUDEA | | WTP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **beta** | **t-value** | **beta** | **t-value** | **beta** | **t-value** | **beta** | **t-value** | **beta** | **t-value** |
| AFFILIATION | 0.309 | 1.1069 | 0.113 | 0.30271 | 0.462 | 1.48962 | 0.434 | 1.50923 | 0.562 | 1.54350 |
| MUNC | 0.559 | 2.3893 | 0.217 | 0.74542 | -0.219 | -0.90734 | 0.426 | 1.84004 | 0.171 | 0.64681 |
| DISTANCE | -0.013 | -0.6819 | 0.0003 | 0.01310 | 0.019 | 0.92646 | 0.025 | 1.32597 | 0.014 | 0.60528 |
| VISIBLE | 0.178*** | 0.7435 | - 0.402*** | -1.33763 | 0.194*** | 0.77760 | 0.106*** | 0.44621 | -0.024 | -0.08778 |
| LEISUREHOME | -0.283 | -0.8139 | -0.229 | -0.51451 | -0.136 | -0.39103 | -0.231 | -0.60847 | 0.156 | 0.40201 |
| DIR_NEGEFF | 0.258 | 0.9873 | 0.259 | 0.83293 | -0.692 | -2.76197 | -0.012 | -0.04253 | 0.172 | 0.65096 |
| INDIR_NEGEFF | 1.527*** | 7.1181 | 1.648*** | 6.31202 | -1.380*** | -6.66821 | 1.515*** | 7.55469 | 0.750 | 3.41419 |
| AGE | -0.004 | -0.3639 | -0.012 | -0.95576 | 0.011 | 1.00762 | 0.008 | 0.79133 | 0.018 | 1.61019 |
| FEMALE | 0.100*** | 0.4046 | 0.039** | 0.12534 | 0.108*** | 0.42275 | - 0.060*** | -0.24355 | 0.471*** | 1.70322 |
| RETIRED | 0.406 | 0.9387 | 0.324 | 0.60966 | -0.318 | -0.67732 | -0.282 | -0.65068 | -0.151 | -0.31897 |
| FULLTIME | 0.172 | 0.5963 | 0.267 | 0.73748 | 0.098 | 0.32177 | -0.441 | -1.56857 | 0.158 | 0.46897 |
| UNI_EDU | 0.043 | 0.1793 | -0.129 | -0.42623 | 0.305 | 1.20685 | 0.142 | 0.59323 | -0.096 | -0.35443 |
| POS_EFF | - 1.119*** | -4.9217 | -0.925** | -3.29886 | 0.205 | 0.90033 | - 1.636*** | -7.30840 | -0.177 | -0.69533 |
| INCOME | 0.038 | 1.4818 | 0.003 | 0.09844 | -0.002 | -0.07394 | 0.044 | 1.71522 | 0.069 | 2.19016 |
| X-squared | 180.1 | | 190.05 | | 165.84 | | 168.3 | | 2675.9 | |
| df | 4 | | 2 | | 4 | | 4 | | 36 | |
| p-value | < 2.2e-16 | | < 2.2e-16 | | < 2.2e-16 | | < 2.2e-16 | | < 2.2e-16 | |

*Table 7. Regression output*

| Threshold | ALOCALLY | AFLOCALLY | RECACTIVITY | ATTITUDEA |
|---|---|---|---|---|
| (1 → 2) | -1.06332 | -1.58007 | -3.35534 | -2.29776 |
| (2 → 3) | -0.69262 | 1.96720 | -2.23453 | -1.55799 |
| (3 → 4) | 1.49847 | | -1.36272 | 0.60929 |
| (4 → 5) | 2.58021 | | -1.19005 | 1.64302 |

*Table 8. Threshold Parameters*

Threshold parameter estimates the earliest time a failure may occur. When Y = 0, the distribution starts at the origin. If Y > 0, the distribution is located on the right side of the distribution, while with Y < 0 locates the distribution on the left side. For our RECACTIVITY variable, all threshold parameters are located on the left side, telling us that all respondents to some instinct agree with using their local area less for recreational activities. The remaining Y-variables are equally distributed. As shown in table 8 there are three possible values for the $Y_2$ variable, AFLOCALLY. The threshold parameters therefore show the following:

$Y_i = 1$ if $Y^*_i$ is $\leq -1.58007$

$Y_i = 2$ if $-1.58007 \leq Y^*_i \leq 1.96720$

$Y_i = 3$ if $Y^*_i \geq 1.96720$

The same interpretation goes for all Y-variables, with their respective values. WTP is not included in the threshold parameter table, as it is a continuous variable.

From our analysis in table 7, starting with the first dependent variable ALOCALLY, we get that the INDIR_NEGEFF have a 99% significantly positive effect on ALOCALLY, meaning that the stronger negative effects the respondents experience, the more negatively affected they feel by wind power in their immediate area. Further, the same pattern is discovered for the dependent variable ATTITUDEA, where the stronger negative effects the respondents experience, their preferences have changed to being a lot more negative to wind power. We do see similar tendencies for respondents being affected by DIR_NEGEFF, but we do not have statistical evidence to support this theory. This partially supports our first hypothesis that there is a negative shift in attitude towards wind power after being exposed, but only regarding indirect negative effects. Due to lack of evidence regarding direct negative effects, we do not find support for our first hypothesis, neither can the null hypothesis be rejected.

Our POS_EFF variable have a negative 99% significant level on ALOCALLY. This means that respondents who experiences positive effects from wind power, i.e. in terms of local tax revenues, new recreational opportunities, help combat climate change and so on, feel less negatively affected by wind power in their immediate area. Based on this, we can confirm our second hypothesis that respondents experiencing positive outcomes of wind power feel less negatively affected in their immediate area.

For the dependent variable RECACTIVITY, we expected to see a correlation between indirect negative effects (INDIR_NEGEFF) and respondents that use of their immediate for recreational activities. From our data, we find a negative 99% significant correlation between the two variables, telling us that there is statistical evidence between respondents using their immediate area less to recreational activities after the installation of wind turbines. Therefore, we can support our third hypothesis.

Hypothesis four is also supported, as the variable VISIBLE has a highly significant impact on the respondents change in affiliation to their immediate are (AFLOCALLY). Our beta is – 0.402***, meaning that we can support our hypothesis that visible wind turbines decrease respondents' affiliation to their immediate area with 99% statistically security. In other words, the fewer visible wind turbines the respondents see, the more positive affiliation they feel to their immediate are. Therefore, the null hypothesis is rejected.

For our last dependent variable WTP, we see that the only significant independent variable is FEMALE. This indicates that females have a lower willingness to pay to avoid being exposed to wind, than males. Surprisingly, there are no significant effect between income and willingness to pay, based on our research. However, we do see a correlation between the two variables, stating that respondents with higher income, tend to have a higher willingness to pay, but there is not enough statistical evidence to prove it. Therefore, our last hypothesis that higher income equals higher willingness to pay to avoid being exposed to wind power cannot be supported, nor can the null hypothesis be rejected.

The independent variables that are most significant throughout our dependent variables, are VISIBLE, FEMALE and INDIR_NEGEFF. From this it is clear that if respondents can see wind turbines from their homes, it has a negative impact on the respondent's affiliation to their immediate area. These independent variables further creates a negative shift in respondents' attitude towards wind power in their residential area, and they reduce their recreational activities in their local area. In addition, we detect that men have the strongest reactions towards affiliation and change in recreational activities, while women have a more increased negative change in their attitude towards wind power ex post. Finally, indirect negative effects have the largest impact on our dependent variables, expect for WTP. This tells us that respondents' attitude and behavior are most affected by the indirect negative effects.

### 6.6.2 Marginal effects

To further conduct our data, we will next consider marginal effects. All numbers discussed in this section, can be found in Appendix 3 cf. table 21.

The average marginal effects stated in the table, gives an estimated change in probability when X increases by one unit, between 0 and 1. As our model is non-linear, the effect will vary from respondent to respondent. The numbers in our table is computed for each respondent, and then computed to an average. The biggest change in probability of which level of Y the respondents would choose, is found within ATTITUDEA and INDIR_NEGEFF. This shows that the estimated probability of respondents who answered "Neutral" to how affected they feel after being exposed, decreases by 0.348 when the indirect negative effects increase with one unit. Meaning that if respondents feel that the negative indirect effects increase by one unit, they are less likely to have a neutral attitude towards wind power. As the corresponding probabilities for "A little more negative" and "A lot more negative" increases by 0.159 and 0.214 respectively, indicates that by one more unit of indirect negative effects, instead increases the probability of respondent's attitudes becoming more negative after exposure. Generally, INDIR_NEGEFF has the largest marginal change in probability on all the Y-variables relative to the other X variables in the table.

Additionally, some zero-variables are detected when looking at marginal effects. This tells us that there is no estimated change in probability of the respondents to change their beliefs, even if the given independent variable were to increase by one unit. Even though respondents age by one year, the estimated probability for their affection towards wind power in their immediate area do not change from “to a large positive degree” to “to some positive degree”, as the probability equals zero. Furthermore, we detect no estimated probability for respondents to change their affiliation to their immediate area, if the distance from their home to the nearest wind turbine increases by one unit. However, also here the indirect negative effects have an impact. The estimated probability for respondents who answered that their affiliation to their immediate area where unchanged, decreases by 0.227 when indirect negative effects increase with one unit. This means that the probability that their affiliation no longer are unchanged, have increased with 22.7 percent.

Overall, we see that for our X-variables with negative effects, levels 1 – 3 on Y are generally negative, while levels 4 – 5 have positive value. While for X-variables with positive effects, levels 1 – 3 on Y are generally positive, while levels 4 – 5 have negative value. This correlates with our expectations that increased negative effects, decreases probability for a positive attitude from the respondents. As well as increased positive effects, decreases probability for negative attitudes.

# 7.0 Discussion & Conclusion

The purpose of this study was to investigate if peoples wind power attitude and preferences have changed after being exposed to local wind power production. In the following section of the paper, we will discuss our empirical findings and relate them to previously stated literature and theory. Further, both limitations and potential future research will also be discussed. In the final part of this section, our conclusion will be presented.

## 7.1 Discussion

As our survey questions were based on results and findings given by previous literature, we were expecting to get a relatively high level of significance on our results. From table 7 we see that relatively few independent variables have a significant effect on the different dependent variables used in the regression. There could be numerous reasons for this, that will be discussed in this section.

Previous literature presented in chapter 3.0 states that people’s preferences towards wind power are in general positive, but show tendencies to be more negative/skeptical when its wind turbines located in their local area. Our analysis indicates the same pattern, whereas respondents who feels negatively affected by wind power after being exposed, have stated more negative attitudes towards wind power installations. In total 54% of the respondents have developed more negative attitudes after development. This could come from people initially feeling supportive towards renewable energy sources, but after experiencing negative effects, the overall picture changes and they do not longer appreciate the consequences of wind power. On the other hand, for respondents who experience positive effects after being exposed to wind power, the tendencies are different. These respondents feel less negatively affected by the local wind power installations. This constitutes to a total of 9% of the respondents. This could be respondents who leave further away from the nearest wind turbine, and therefore do not experience direct negative effects like noise, light or shadow flicker. It can also be due to higher knowledge amongst our respondents, as most of our respondents have lived in the area for several years and have therefore been exposed over a relatively long period of time. This could help create increased acceptance towards wind power, and further lead to appreciation of the positive consequences. However, our analysis did not conduct any significant results for respondents experiencing direct negative effect from local wind turbines. This result is in opposition to previous studies, where respondents especially react to noise. The variable VISIBLE, i.e., the visual of wind turbines respondents can see from their homes. From our analysis, we find that an increased number of visible turbines, increases the respondents' negative affiliation to their immediate area. This result was expected before the survey was carried out, as previous literature has concluded with the same.

As we expected respondents to be more negative ex post, we were interested to see if respondents were willing to pay an extra amount on their electricity bill to avoid being exposed. Our expectation that respondents with higher income had a higher WTP, did not get statistical support from our data analysis and we can therefore not reject the null hypothesis. However, our analysis show that males have a higher WTP than females, which corresponds with previous research. Males do tend to have a higher income than females, so this can help explain the tendencies, although not significant correlation, between income and WTP from our data.

In terms of non-consumptive values, our analysis reveals a correlation between visible wind turbines and respondents use of their immediate area to recreational activity. This phenomenon can have an impact on the ecosystem of the area, as increased number of wind turbines leads to reduced use of area in terms of recreational activities, can influence the natures function to sustain current life of species and growth. It will further change the products and services that can be extracted from the given area, directly affecting the provisioning services in the area. Moreover, studies show that amongst wildlife, birds risk colliding with the wind turbines, which can be a factor for increased death rates and in worst case endangerment, and will then have an impact on the regulating services. This can have an impact, not only on the natural landscape, but on the cultural landscape. Impact of the supporting services may be the most interesting in this study, as the impact over time can have a high level of influence. As our analysis show tendencies of reduced recreational activities in areas with wind power installations, a parallel can be drawn to the non-use values of the given environment. The areas where these wind turbines are installed, are not all known for special wildlife or beautiful landscape sceneries. However, knowing that possible wildlife and sceneries could be destroyed, can feel like a loss for people and be connected to their negative attitude towards wind power. From this, all categories of the ecosystem services can be affected by installation of wind power.

Overall, most independent variables are insignificant. Even though this is unexpected, it is still interesting. Our survey questions and hypothesis are based on own expectations and previous literature. Due to this, we had a clear vision on what to expect our results to be. Interestingly, we were wrong on several expectations, which could suggest that respondents from Nord-Jæren do not have similar experiences as shown from previous studies in other areas and countries.

### 7.1.1 Limitations

This paper has limitations that can potentially have an impact on our results. Firstly, this survey was sent out to the respondents during the spring of 2021, after approximately a year with the Covid-19 pandemic. It is reasonable to believe that several of the respondents have been spending more time at their home and immediate area, due to enforcement of home office arrangements, cancelled events and social and travel restrictions. Due to this, respondents could feel more exposed when answering the survey, then what they did before the pandemic. This could be a factor that influences the respondents' preferences, and therefore their thoughts and answers to our survey.

Another limitation could be the number of respondents. Our 356 respondents mark a good starting point, and gives us a relatively good insight in how preferences have changed ex ante versus ex post exposure of wind power. However, one group of our respondents live in Sandnes municipality, an area not directly exposed to wind power. These were included as a control group, but could potentially clutter with the results of our data. Furthermore, including several respondents could change our dataset and give a broader understanding of the actual change in preferences throughout Rogaland County. Furthermore, a survey is limited in its design, given zero to little change for the respondents to explain their answers beyond checking a box. To reduce this limitation, textboxes were included in the survey to give respondents the opportunity to further state their thoughts and experiences. An additional limitation could be that some respondents might answer strategically to achieve their own goal, instead of answering according to their true preference.

Answers like “I do not know” and “I do not want to answer” where for the most part avoided in our survey. However, these alternatives were enabled for some of the question in our survey. The data from these alternatives has been altered to fit our model. Therefore, the overall are less precise than what they could have been not giving the respondents the opportunity not to answer.

#### 7.1.2 Future Research

This paper continues the evaluation of wind power installations in Rogaland County. Potential extensions to further research this topic could be done by completing a qualitative research method, by conducting in depth interviews with respondents. By doing so, respondents would be able to give more complementary answers without the limitation of given answer alternatives. This could give a broader insight in the respondents reasoning, and help future research give a more justified and thorough explanation of the results. Further, by incorporating other variables, the results might differ. Additionally, one possibility would be to check the given results with other areas, both in and outside of Norway, to generalize the results and findings in a broader manner. Lastly, research on the natural landscape and animal life could help support or reject the respondents concerns and beliefs.

### 7.2 Conclusion

The purpose of this thesis was to track if peoples' attitudes and preferences towards wind power have changed after being exposed to local wind power production. Hereunder, five hypotheses were created and tested. Based on our model, results show general tendencies of a negative shift in respondents wind power attitudes after being exposed. 54% of the respondents stated that they have become more negative after wind power development. We find strong statistical evidence on affect from indirect negative effect, but only tendencies on affect from direct negative effects. Furthermore, our analysis showed that respondents experiencing positive effects from wind power, feel less affected by the local installations of wind turbines. Our regression analysis revealed significant proof that respondents use their immediate area less as a result of indirect negative effects from wind power. The results further show statistical significance between visible wind turbines and respondents' affiliation to their immediate area. Lastly, there was no significant correlation between income and WTP amongst our respondents. In conclusion, exposure to local wind turbines generates a negative shift in attitude and preferences towards wind power. In spite of these results, we would like to point out that one cannot be sure that this is applicable for all areas, even though we found evidence in this particular study.

# 8.0 References


Aanensen, T. (2021). Wind power generation continues to rise. Retrieved June 7, 2021, from Statistisk Sentralbyrå website: https://www.ssb.no/en/energi-og-industri/artikler-og-publikasjoner/wind-power-generation-continues-to-rise

Andersen, I. (2019). Nå står vindkraft for 14 prosent av Europas elektrisitet . Retrieved June 7, 2021, from TU Energi website: https://www.tu.no/artikler/na-star-vindkraft-for-14-prosent-av-europas-elektrisitet/458696

Baglin, J. (2014). Improving your exploratory factor analysis for ordinal data: A demonstration using FACTOR. *Practical Assessment, Research and Evaluation*, *19*(5).

Bell, W. P., Wild, P., Foster, J., & Hewson, M. (2015). Wind speed and electricity demand correlation analysis in the Australian National Electricity Market: Determining wind turbine generators' ability to meet electricity demand without energy storage. *Economic Analysis and Policy*, *48*, 182–191. https://doi.org/10.1016/j.eap.2015.11.009

Bergek, A. (2010). Levelling the playing field? The influence of national wind power planning instruments on conflicts of interests in a Swedish county. *Energy Policy*, *38*(5), 2357–2369. https://doi.org/10.1016/j.enpol.2009.12.023

Bolund, P., & Hunhammar, S. (1999). Ecosystem services in urban areas. *Ecological Economics*, *29*(2), 293–301. https://doi.org/10.1016/S0921-8009(99)00013-0

Brennan, N., & Van Rensburg, T. M. (2016). Wind farm externalities and public preferences for community consultation in Ireland: A discrete choice experiments approach. *Energy Policy*, *94*, 355–365. https://doi.org/10.1016/j.enpol.2016.04.031

Choi, J., Peters, M., & Mueller, R. O. (2010). Correlational analysis of ordinal data: From Pearson's r to Bayesian polychoric correlation. *Asia Pacific Education Review*, *11*(4). https://doi.org/10.1007/s12564-010-9096-y

Christophersen, K. A. (2009). *Databehandling og Statistisk Analyse med SPSS*. Oslo: Unipub Forlag.

Clifton, K., & Carrasco, J. A. (2018). Workshop Synthesis: Measuring attitudes and perceptions in quantitative surveys. *Transportation Research Procedia*. https://doi.org/10.1016/j.trpro.2018.10.040

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

Dirdal, I. (2019). Fylkesdelplan for vindkraft (2007). Retrieved June 7, 2021, from Rogaland fylkeskommune website: https://www.rogfk.no/vare-tjenester/planlegging/gjeldende-planer-og-strategier/energi-og-klima/fylkesdelplan-for-vindkraft-2007/

Dugstad, A., Grimsrud, K., Kipperberg, G., Lindhjem, H., & Navrud, S. (2020). *Acceptance of national wind power development and exposure: A case-control choice experiment approach*. Retrieved from http://www.ssb.no/en/forskning/discussion-papers

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

Ellis, G., & Ferraro, G. (2016). *The social acceptance of wind energy 2016 Title: Social acceptance of wind energy*. https://doi.org/10.2789/696070

Enevoldsen, P., Permien, F. H., Bakhtaoui, I., Krauland, A. K. von, Jacobson, M. Z., Xydis, G., … Oxley, G. (2019). How much wind power potential does europe have? Examining european wind power potential with an enhanced socio-technical atlas. *Energy Policy*, *132*. https://doi.org/10.1016/j.enpol.2019.06.064

Fast, S., Mabee, W., & Blair, J. (2015). The changing cultural and economic values of wind energy landscapes. *Canadian Geographer*, *59*(2), 181–193. https://doi.org/10.1111/cag.12145

Ferrari, P. A., & Barbiero, A. (2012). Simulating Ordinal Data. *Multivariate Behavioral Research*, *47*(4). https://doi.org/10.1080/00273171.2012.692630

Fisher, M. J., & Marshall, A. P. (2009). Understanding descriptive statistics. *Australian Critical Care*, *22*(2). https://doi.org/10.1016/j.aucc.2008.11.003

Foldnes, N., Grønneberg, S., & Hermansen, G. . (2018). *Statistikk og dataanalyse- en moderne innføring* (1 utg). Cappelen Damm Akademisk Forlag.

Fredriksen, I., Kleppe, K. A., & Figved, S. (2019). Slik er Tellenes vindpark eid. Retrieved June 7, 2021, from TV2 website: https://www.tv2.no/a/10987349/

García, J. H., Cherry, T. L., Kallbekken, S., & Torvanger, A. (2016). Willingness to accept local wind energy development: Does the compensation mechanism matter? *Energy Policy*, *99*, 165–173. https://doi.org/10.1016/j.enpol.2016.09.046

Gipe, P. (1995). *Wind Energy Comes of Age*. Retrieved from https://books.google.no/books?hl=no&lr=&id=8itBNxBL4igC&oi=fnd&pg=PR13&dq=Wind+Energy+Comes+of+Age&ots=HPpyxlOscR&sig=DQeZf3PZb2GxdrwLnZVSRQnN0pc&redir_esc=y#v=onepage&q=Wind Energy Comes of Age&f=false

Grimsrud, K. M., Hagem, C., Lind, A., & Lindhjem, H. (2020). *Efficient spatial allocation of wind power plants given environmental externalities due to turbines and grids*. Retrieved from http://www.ssb.no/en/forskning/discussion-papers

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

Hastik, R., Basso, S., Geitner, C., Haida, C., Poljanec, A., Portaccio, A., … Walzer, C. (2015, August 1). Renewable energies and ecosystem service impacts. *Renewable and Sustainable Energy Reviews*, Vol. 48, pp. 608–623. https://doi.org/10.1016/j.rser.2015.04.004

Heale, R., & Twycross, A. (2015). *Validity and reliability in quantitative studies*. https://doi.org/10.1136/eb-2015-102129

Hersvik, R., Ekren, T. T., & Helvig, L. H. (2011). Myter om vindkraft og vindparken på Høg-Jæren. *Stavanger Aftenblad*. Retrieved from https://www.aftenbladet.no/meninger/i/0g2Gg/myter-om-vindkraft-og-vindparken-paa-hoeg-jaeren

Hicks, R. L. (2002). *A Comparison Of Stated And Revealed Preference Methods For Fisheries Management*. Retrieved from https://ideas.repec.org/p/ags/aaea02/19853.html

Hofstad, K. (2019). vindkraftverk. Retrieved June 7, 2021, from Store norske leksikon website: https://snl.no/vindkraftverk

Holstad, M. (2020). All time high wind power generation in Norway. Retrieved June 2, 2021, from SSB Statistics Norway website: https://www.ssb.no/en/energi-og-industri/artikler-og-publikasjoner/all-time-high-wind-power-generation-in-norway

Howard, D. C., Burgess, P. J., Butler, S. J., Carver, S. J., Cockerill, T., Coleby, A. M., … Scholefield, P. (2013). Energyscapes: Linking the energy system and ecosystem services in real landscapes. *Biomass and Bioenergy*, *55*, 17–26. https://doi.org/10.1016/j.biombioe.2012.05.025

Inderberg, T. H. J., Rognstad, H., Saglie, I. L., & Gulbrandsen, L. H. (2019). Who influences windpower licensing decisions in Norway? Formal requirements and informal practices. *Energy Research and Social Science*, *52*. https://doi.org/10.1016/j.erss.2019.02.004

Jaadi, Z. (2021). A Step-by-Step Explanation of Principal Component Analysis (PCA) . Retrieved June 7, 2021, from Built In website: https://builtin.com/data-science/step-step-explanation-principal-component-analysis

Jacobsen, D. I. (2015). *Hvordan gjennomføre undersøkelser? Innføring i samfunnsvitenskapelig metode* (3rd ed.). Cappelen Damm Akademisk Forlag.

Johannessen, A., Tufte, P. A., & Christoffersen, L. (2006). *Introduksjon til samfunnsvitenskapelig metode* (3rd ed.). Oslo: Abstrakt forlag.

Joshi, A., Kale, S., Chandel, S., & Pal, D. (2015). Likert Scale: Explored and Explained. *British Journal of Applied Science & Technology*, *7*(4), 396–403. https://doi.org/10.9734/bjast/2015/14975

Kipperberg, G., Onozaka, Y., Bui, L. T., Lohaugen, M., Refsdal, G., & Sæland, S. (2019). The impact of wind turbines on local recreation: Evidence from two travel cost method – contingent behavior studies. *Journal of Outdoor Recreation and Tourism*, *25*, 66–75. https://doi.org/10.1016/j.jort.2018.11.004

Korpås, M. (2019). Hvorfor bry oss med å bygge ut vindkraft i Norge? Retrieved June 7, 2021, from Energi og klima website: https://energiogklima.no/kommentar/hvorfor-bry-oss-med-a-bygge-ut-vindkraft-i-norge/

Krekel, C., & Zerrahn, A. (2017). Does the presence of wind turbines have negative externalities for people in their surroundings? Evidence from well-being data. *Journal of Environmental Economics and Management*, *82*, 221–238. https://doi.org/10.1016/j.jeem.2016.11.009

Krohn, S., & Damborg, S. (1999, January 1). On public attitudes towards wind power. *Renewable Energy*, Vol. 16, pp. 954–960. https://doi.org/10.1016/s0960-

1481(98)00339-5

Ladenburg, J. (2009). Stated public preferences for on-land and offshore wind power generation - A review. *Wind Energy*, *12*(2), 171–181. https://doi.org/10.1002/we.308

Lindhjem, H., Dugstad, A., Grimsrud, K., Handberg, Ø. H., Kipperberg, G., Kløw, E., & Navrud, S. (2019). *Vinkraft i motvind - Miljøkostnadene er ikke til å blåse av*. Retrieved from https://www.menon.no/wp-content/uploads/Lindhjem-et-al-2019.pdf

Løkkevik, O. (2019). Derfor skaper vindmøllene konflikt. *VG*. Retrieved from https://www.vg.no/spesial/c/stories/xP793Q

Lusk, J. L., Roosen, J., & Shogren, J. (2011). *The Oxford Handbook of the Economics of Food Consumption and Policy*. Retrieved from https://books.google.no/books?hl=no&lr=&id=0HAWEAAAQBAJ&oi=fnd&pg=PP1&dq=The+Oxford+handbook+of+the+economics+of+food+consumption+and+policy&ots=TM9hn8FRYS&sig=xKZMHluFlTfUY4hgpFiR0lDE0Vw&redir_esc=y#v=onepage&q=The Oxford handbook of the economics of food consumption and policy&f=false

Mariel, P., Meyerhoff, J., & Hess, S. (2015, January 1). Heterogeneous preferences toward landscape externalities of wind turbines - Combining choices and attitudes in a hybrid model. *Renewable and Sustainable Energy Reviews*, Vol. 41, pp. 647–657. https://doi.org/10.1016/j.rser.2014.08.074

Mattmann, M., Logar, I., & Brouwer, R. (2016). Hydropower externalities: A meta-analysis. *Energy Economics*, *57*, 66–77. https://doi.org/10.1016/j.eneco.2016.04.016

Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-being*.

Ministry of  Petroleum and Energy. (2016). Renewable energy production in Norway . Retrieved June 7, 2021, from regjeringen.no website: https://www.regjeringen.no/en/topics/energy/renewable-energy/renewable-energy-production-in-norway/id2343462/

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*, 269–278. https://doi.org/10.1016/j.apenergy.2011.11.001

Navrud, S., & Bråten, K. G. (2007). Consumers' preferences for green and brown electricity: A choice modelling approach. *Revue d'Economie Politique*, *117*(5), 795–811.

https://doi.org/10.3917/redp.175.0795

Norsk Vind. (n.d.). Høg-Jæren vindkraftverk. Retrieved June 7, 2021, from https://www.vindenergi.no/project/hog-jaeren-vindpark

NTB. (2017). Seks vindparker åpner i Rogaland på to år. *Dagsavisen*. Retrieved from https://www.dagsavisen.no/rogalandsavis/nyheter/2017/09/20/seks-vindparker-apner-i-rogaland-pa-to-ar/

NVE. (2020a). Electricity Certificates. Retrieved June 7, 2021, from NVE website: https://www.nve.no/energy-supply/electricity-certificates/

NVE. (2020b). Vindkraft. Retrieved June 2, 2021, from https://www.nve.no/energiforsyning/kraftproduksjon/vindkraft/?ref=mainmenu

NVE. (2020c). Vindkraftdata. Retrieved June 13, 2021, from NVE website: https://www.nve.no/energiforsyning/kraftproduksjon/vindkraft/vindkraftdata/

NVE. (2021). Nasjonal ramme for vindkraft. Retrieved June 7, 2021, from https://www.nve.no/nasjonal-ramme-for-vindkraft/

NWCC. (2014). Wind turbine interactions with birds, bats and their Habitats: A summary of research results and priority questions. In *National Wind Coordinating Collaborative*.

Perman, R. J., Ma, Y., Common, M., Maddison, D., & McGilvray, J. W. (2011). *Natural resource and environmental economics*. Pearson Education.

Phillips, K. A., Johnson, F. R., & Maddala, T. (2002). Measuring what people value: A comparison of "attitude" and "preference" surveys. *Health Services Research*, *37*(6), 1659–1679. https://doi.org/10.1111/1475-6773.01116

Regjeringen. (2020, June 19). Vindkraft på land — Endringer i konsesjonsbehandlingen. Retrieved June 8, 2021, from https://www.regjeringen.no/no/dokumenter/meld.-st.-28-20192020/id2714775/

Rygg, B. J. (2012). Wind power-An assault on local landscapes or an opportunity for modernization? *Energy Policy*, *48*, 167–175. https://doi.org/10.1016/j.enpol.2012.05.004

Saidur, R., Rahim, N. A., Islam, M. R., & Solangi, K. H. (2011). Environmental impact of wind energy. *Renewable and Sustainable Energy Reviews*, Vol. 15. https://doi.org/10.1016/j.rser.2011.02.024

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students Fifth Edition*. Retrieved from https://books.google.no/books?hl=no&lr=&id=u-txtfaCFiEC&oi=fnd&pg=PA2&dq=research+methods+for+business+students+5th+edition&ots=DxGXDkM99O&sig=6WhIAuNLvPSFOjiWNP37gHfZots&redir_esc=y#v=onepage&q=research methods for business students 5th edition&f=false

Sedgwick, P. (2014). Understanding statistical hypothesis testing. *BMJ (Online)*, Vol. 348. https://doi.org/10.1136/bmj.g3557

Selfors, A. (1994). *QUANTIFICATION OF ENVIRONMENTAL IMPACTS OF VARIOUS ENERGY TECHNOLOGIES*.

Stavanger Turistforening. (n.d.). Fakta om vindkraft. Retrieved June 7, 2021, from Stavanger Turistforening website: https://www.stf.no/fakta/?_ga=2.54785955.929985561.1603993507-1740111322.1500898492&_gac=1.222156266.1600413981.Cj0KCQjwtZH7BRDzARIsAGjbK2aCSGe5Y0HjMl6fxArIzQGbvvglq0L8cxBYGANiJbTpfmxibWCbILQaAm9wEALw_wcB

Stewart, G., Kamata, A., Miles, R., Grandoit, E., Mandelbaum, F., Quinn, C., & Rabin, L. (2019). Predicting mental health help seeking orientations among diverse Undergraduates: An ordinal logistic regression analysis☆. *Journal of Affective Disorders*, *257*, 271–280. https://doi.org/10.1016/j.jad.2019.07.058

Tatchley, C., Paton, H., Robertson, E., Minderman, J., Hanley, N., & Park, K. (2016). Drivers of public attitudes towards small wind turbines in the UK. *PLoS ONE*, *11*(3), e0152033. https://doi.org/10.1371/journal.pone.0152033

Vorkinn, M., & Riese, H. (2001). *ENVIRONMENTAL CONCERN IN A LOCAL CONTEXT The Significance of Place Attachment*.

Wolsink, M. (2000). Wind power and the NIMBY-myth: Institutional capacity and the limited significance of public support. *Renewable Energy*, *21*(1), 49–64. https://doi.org/10.1016/S0960-1481(99)00130-5

Wolsink, M. (2006, March). Invalid theory impedes our understanding: A critique on the persistence of the language of NIMBY. *Transactions of the Institute of British Geographers*, Vol. 31, pp. 85–91. https://doi.org/10.1111/j.1475-5661.2006.00191.x

Zerrahn, A. (2017). Wind Power and Externalities. *Ecological Economics*, *141*, 245–260. https://doi.org/10.1016/j.ecolecon.2017.02.016

# 9.0 Appendices

## Appendix 1. Descriptive Statistics

| *Variable | | Explanation |
|---|---|---|
| $X_9$ | FACTOR1 | Noise |
| $X_{10}$ | FACTOR2 | Flashing lights |
| $X_{11}$ | FACTOR3 | Ice |
| $X_{12}$ | FACTOR4 | Shadow cast |
| $X_{13}$ | FACTOR5 | Interference in network and TV signals |
| $X_{14}$ | FACTOR6 | Deteriorating view |
| $X_{15}$ | FACTOR7 | Deteriorating natural landscape |
| $X_{16}$ | FACTOR8 | Deteriorating cultural landscape |
| $X_{17}$ | FACTOR9 | Deteriorating outdoor life |
| $X_{18}$ | FACTOR10 | Deteriorating of other industries |
| $X_{19}$ | FACTOR11 | Deteriorating ecosystems (animals and plants) |

*Table 9. Description of factors*

| ID | Name | Description | Coding |
|---|---|---|---|
| $Y_1$ | ALOCALLY | Affection to wind turbines in their immediate area | 1 = In large positive degree<br>2 = To some positive degree<br>3 = Neutral<br>4 = To some negative degree<br>5 = In large negative degree |
| $Y_2$ | AGENERALLY | Affection to wind turbines in general | 1 = In large positive degree<br>2 = To some positive degree<br>3 = Neutral<br>4 = To some negative degree<br>5 = In large negative degree |
| $Y_3$ | AFLOCALLY | Experienced change in affiliation to the immediate area | 1 = Yes, in a positive way<br>2 = No, it is not changed<br>3 = Yes, in a negative way |
| $Y_4$ | RECACTIVITY | Uses the local area less for recreation as a result of local wind power developments. | 1 = Totally agree<br>2 = Partly agree |

| | | | |
|---|---|---|---|
| | | | 3 = Neutral<br>4 = Partly disagree<br>5 = Totally disagree |
| $Y_5$ | ATTITUDEB | Attitude towards wind power before being exposed. | 1 = Very negative<br>2 = A little negative<br>3 = Neutral<br>4 = A little positive<br>5 = Very positive |
| $Y_6$ | ATTITUDEA | Attitude towards wind power after being exposed. | 1 = A lot more positive<br>2 = A little more positive<br>3 = Neutral<br>4 = A little more negative<br>5 = A lot more negative |
| $Y_7$ | WTP | Willingness to pay extra on electricity bill in order to avoid wind turbines. | Continuous variable in NOK |
| $X_1$ | AFFILIATION | Affiliation to immediate area | 0 = Weak<br>1 = Strong |
| $X_2$ | MUNC | Municipalities where wind power installations were developed in year. | 0 = Old (Hå, Time)<br>1= New (Bjerkreim, Lund, Sandnes, Sokndal, Egersund, Gjesdal) |
| $X_3$ | DISTANCE | Indicates the distance between housing and the nearest wind park. | Continuous variable in km |
| $X_4$ | YEARLIVED | Indicates how many years the respondent have lived in the area | Continuous variable in years |
| $X_5$ | VISIBLE | Visible wind turbines from housing. | 1 = More than 1 wind turbine<br>0 = Non |

| | | | |
|---|---|---|---|
| $X_6$ | LEISUREH | Leisure housing in proximity of wind turbines. | 1 = Yes<br>0 = No |
| $X_7$ | DIR_NEGEFF | Sum of all direct negative effects (FACTOR1-5) | 1= Not at all<br>2 = In small degree<br>3 =To some degree<br>4 = In large degree |
| $X_8$ | INDIR_NEGEFF | Sum of all indirect negative effects (FACTOR6-11) | 1= Not at all<br>2 = In small degree<br>3 =To some degree<br>4 = In large degree |
| $X_9$ | FACTOR1 | Experiencing noise | 1= Not at all<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{10}$ | FACTOR2 | Experiencing flashing lights | 1 = Not at all<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{11}$ | FACTOR3 | Experiencing ice | 1 = Not at all<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{12}$ | FACTOR4 | Experiencing shadow cast | 1 = Not at all<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{13}$ | FACTOR5 | Experiencing interference in | 1 = Not at all<br>2 = In small degree |

| | | | |
|---|---|---|---|
| | | network and TV signals | 3 = To some degree<br>4 = In large degree |
| $X_{14}$ | FACTOR6 | Experiencing deteriorating view | 1= Not at all<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{15}$ | FACTOR7 | Experiencing deteriorating natural landscape | 1 = Not at all<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{16}$ | FACTOR8 | Experiencing deteriorating cultural landscape | 1= Not at all<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{17}$ | FACTOR9 | Experiencing deteriorating outdoor life | 1= Not at all<br>2 =In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{18}$ | FACTOR10 | Experiencing deteriorating of other industries | 1= Not at all<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{19}$ | FACTOR11 | Experiencing deteriorating ecosystems (animals and plants) | 1= Not at all<br>2 = In small degree<br>3 = To some degree |

| | | | |
|---|---|---|---|
| | | | 4 = In large degree |
| $X_{20}$ | AGE | Respondent's age | Continuous variable in years |
| $X_{21}$ | AGE^2 | Respondent's age squared. | |
| $X_{22}$ | FEMALE | Respondent's gender | Female = 1<br>Male = 0 |
| $X_{23}$ | INCOME | Respondents' income | Continuous variable in NOK |
| $X_{24}$ | INCOME^2 | Respondents' income squared. | |
| $X_{25}$ | RETIRED | Respondent are retired. | 1 = Yes<br>0 = No |
| $X_{26}$ | FULLTIME | Respondent are working fulltime | 1 = Yes<br>0 = No |
| $X_{27}$ | UNI_EDU | University Education | 0 = No university degree<br>1 = University degree |
| $X_{28}$ | POS_EFF | Sum of all positive effects | 1 = Non degree<br>2 = In small degree<br>3 = To some degree<br>4 = In large degree |
| $X_{29}$ | TAX | Provides local tax revenues. | 1 = Not at all<br>2 = To a small degree<br>3 = To some degree<br>4 = In a large degree |
| $X_{30}$ | RECREATION | Provides new recreational opportunities. | 1 = Not at all<br>2 = To a small degree<br>3 = To some degree<br>4 = In a large degree |
| $X_{31}$ | WORKPLACES | Creates local business activity and new jobs | 1 = Not at all<br>2 = To a small degree |

| | | | |
|---|---|---|---|
| | | | 3 = To some degree<br>4 = In a large degree |
| $X_{32}$ | CLIMATECH | Helps to combat climate change. | 1 = Not at all<br>2 = To a small degree<br>3 = To some degree<br>4 = In a large degree |
| $X_{33}$ | LOW_ELEC | Provides lower electricity prices. | 1 = Not at all<br>2 = To a small degree<br>3 = To some degree<br>4 = In a large degree |

*Table 10. Variables with coding*

| | | Municipalities | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TOTAL | Bjerkreim | Hå | Eigersund | Gjesdal | Time | Sokndal | Sandnes | Lund |
| N | 356 | 10 | 65 | 56 | 48 | 77 | 5 | 82 | 13 |
| 0 – 1 years | 2% | 0% | 2% | 4% | 0% | 0% | 40% | 2% | 0% |
| 1 – 3 years | 4% | 0% | 2% | 0% | 8% | 3% | 0% | 5% | 23% |
| 3 – 6 years | 8% | 0% | 5% | 4% | 6% | 13% | 0% | 7% | 23% |
| 6 – 10 years | 8% | 0% | 6% | 5% | 4% | 10% | 0% | 15% | 8% |
| 10 – 20 years | 15% | 20% | 17% | 14% | 13% | 16% | 0% | 15% | 8% |
| 20 – 40 years | 22% | 40% | 19% | 20% | 27% | 20% | 20% | 23% | 15% |
| Over 40 years | 17% | 20% | 19% | 29% | 13% | 18% | 20% | 11% | 15% |
| My whole life | 24% | 20% | 32% | 25% | 29% | 21% | 20% | 22% | 8% |
| TOTAL | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Table 11. Table of number of years lived in municipality*

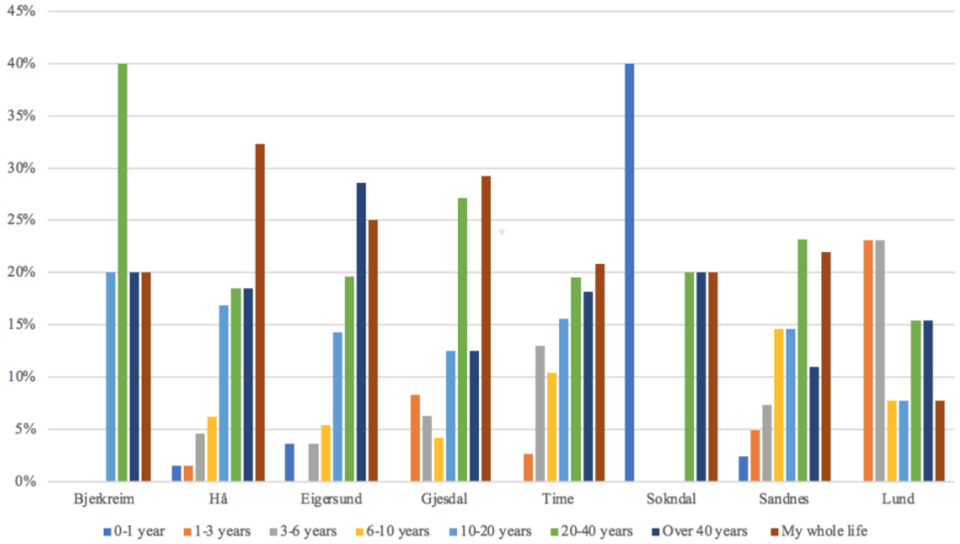


*Figure 23. Figure of numbers of years lived in municipality*

| | | Municipalities | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TOTAL | Bjerkreim | Hå | Eigersund | Gjesdal | Time | Sokndal | Sandnes | Lund |
| N | 356 | 10 | 65 | 56 | 48 | 77 | 5 | 82 | 13 |
| Totally disagree | 1% | 0% | 2% | 0% | 0% | 1% | 0% | 2% | 0% |
| Partly disagree | 5% | 0% | 5% | 2% | 4% | 7% | 0% | 9% | 0% |
| Neutral | 15% | 20% | 12% | 7% | 13% | 17% | 0% | 20% | 23% |
| Partly agree | 27% | 10% | 26% | 20% | 38% | 27% | 20% | 26% | 39% |
| Totally agree | 53% | 70% | 55% | 71% | 46% | 48% | 80% | 44% | 39% |
| TOTAL | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Table 12. Strong affiliation to immediate area*

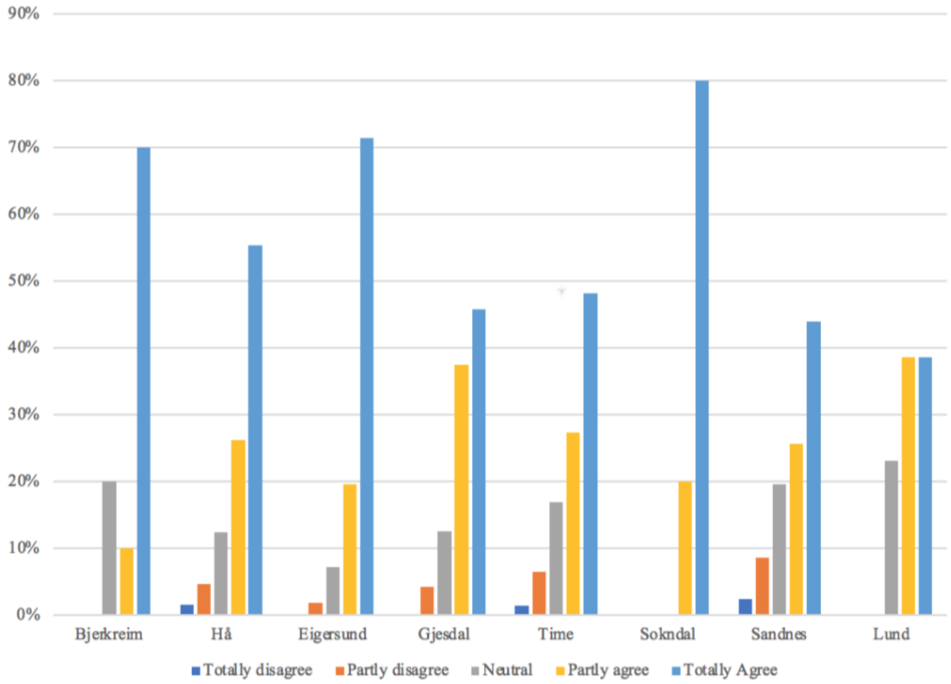



*Figure 24. Strong affiliation*

| | | Municipalities | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TOTAL | Bjerkreim | Hå | Eigersund | Gjesdal | Time | Sokndal | Sandnes | Lund |
| N | 356 | 10 | 65 | 56 | 48 | 77 | 5 | 82 | 13 |
| In large positive degree | 7% | 20% | 11% | 5% | 6% | 12% | | 2% | |
| To some positive degree | 7% | | 9% | 9% | 2% | 3% | | 11% | 8% |
| Neutral | 33% | 20% | 34% | 36% | 33% | 30% | 60% | 37% | 23% |
| To some negative degree | 28% | 30% | 28% | 23% | 31% | 30% | 20% | 28% | 31% |
| In large negative degree | 21% | 30% | 19% | 25% | 27% | 22% | 20% | 11% | 39% |
| Not relevant | 4% | | | 2% | | 4% | | 11% | |
| TOTAL | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Table 13. To which degree do you feel affected by wind power in immediate area*

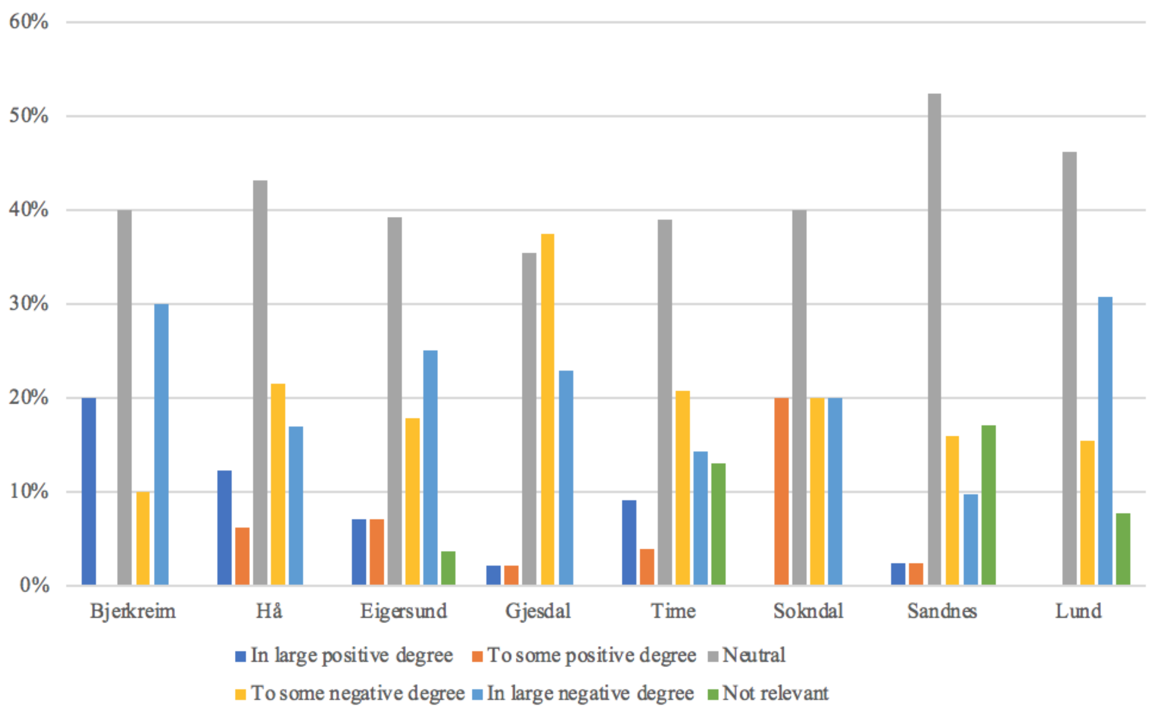



*Figure 25. To which degree do you feel affected by wind power*

| | | Municipalities | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **TOTAL** | **Bjerkreim** | **Hå** | **Eigersund** | **Gjesdal** | **Time** | **Sokndal** | **Sandnes** | **Lund** |
| N | 356 | 10 | 65 | 56 | 48 | 77 | 5 | 82 | 13 |
| 0-50 | 2% | 0% | 2% | 0% | 0% | 3% | 0% | 5% | |
| 50-100 | 10% | 0% | 9% | 0% | 6% | 9% | 0% | 21% | 23% |
| 100-150 | 16% | 10% | 17% | 16% | 8% | 17% | 0% | 23% | 8% |
| 150-200 | 16% | 10% | 12% | 14% | 19% | 23% | 40% | 12% | 8% |
| 200-250 | 16% | 20% | 19% | 14% | 29% | 12% | 20% | 12% | 8% |
| 250-300 | 12% | 10% | 12% | 11% | 17% | 8% | 0% | 12% | 23% |
| 300-350 | 11% | 20% | 14% | 14% | 6% | 9% | 0% | 9% | 23% |
| 350-400 | 5% | 10% | 6% | 4% | 6% | 7% | 0% | 1% | 0% |
| 400-450 | 5% | 20% | 5% | 5% | 6% | 5% | 20% | 1% | 0% |
| 450-500 | 2% | 0% | 2% | 5% | 0% | 1% | 20% | 0% | 0% |
| Over 500 | 6% | 0% | 3% | 16% | 2% | 7% | 0% | 4% | 8% |
| TOTAL | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Table 14. Estimate on how many existing wind turbines*

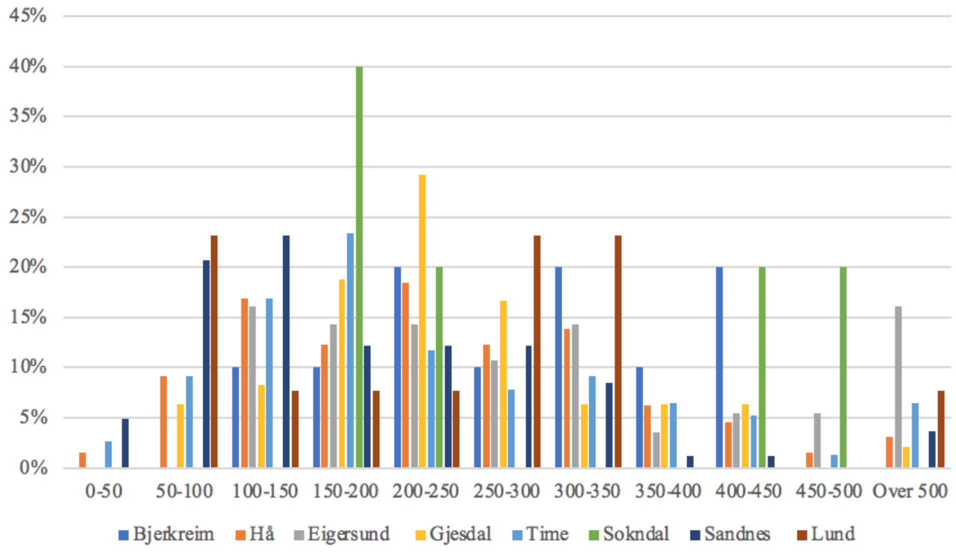



*Figure 26. Estimate on how many existing wind turbines*

| | Noise | Flashing lights | Ice | Shadow cast | Interference in network and TV signals | Deteriorating view | Deteriorating natural landscape | Deteriorating cultural landscape | Deteriorating outdoor life | Deteriorating of other industries | Deteriorating ecosystems | Other negative effects |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Not at all | 64% | 58% | 80% | 75% | 78% | 51% | 30% | 32% | 40% | 49% | 35% | 43% |
| In small degree | 20% | 19% | 14% | 17% | 15% | 14% | 17% | 16% | 15% | 28% | 23% | 25% |
| To some degree | 11% | 15% | 4% | 6% | 5% | 19% | 23% | 25% | 26% | 17% | 24% | 19% |
| In large degree | 6% | 8% | 3% | 3% | 3% | 16% | 31% | 27% | 19% | 6% | 18% | 13% |

*Table 15. Experienced effects*

| In large degree | Bjerkreim | Hå | Eigersund | Gjesdal | Time | Sokndal | Sandnes | Lund |
|---|---|---|---|---|---|---|---|---|
| Noise | 0% | 5% | 9% | 8% | 7% | 0% | 1% | 23% |
| Flashing lights | 10% | 9% | 14% | 8% | 9% | 20% | 0% | 23% |
| Ice | 0% | 3% | 2% | 4% | 1% | 0% | 1% | 23% |
| Shadow cast | 0% | 5% | 4% | 4% | 1% | 0% | 1% | 15% |
| Interference in network and TV signals | 0% | 5% | 2% | 4% | 3% | 0% | 1% | 8% |
| Deteriorating view | 10% | 15% | 21% | 21% | 18% | 20% | 9% | 23% |
| Deteriorating natural landscape | 30% | 25% | 39% | 44% | 29% | 40% | 21% | 46% |
| Deteriorating cultural landscape | 30% | 23% | 34% | 35% | 29% | 40% | 15% | 46% |
| Deteriorating outdoor life | 30% | 22% | 21% | 19% | 16% | 20% | 13% | 31% |
| Deteriorating of other industries | 0% | 5% | 4% | 13% | 8% | 0% | 1% | 23% |
| Deteriorating ecosystems | 20% | 15% | 18% | 23% | 22% | 20% | 11% | 39% |
| Other negativ effects | 20% | 9% | 20% | 19% | 9% | 20% | 6% | 39% |

*Table 16. Experiencing negative effects in large degree*

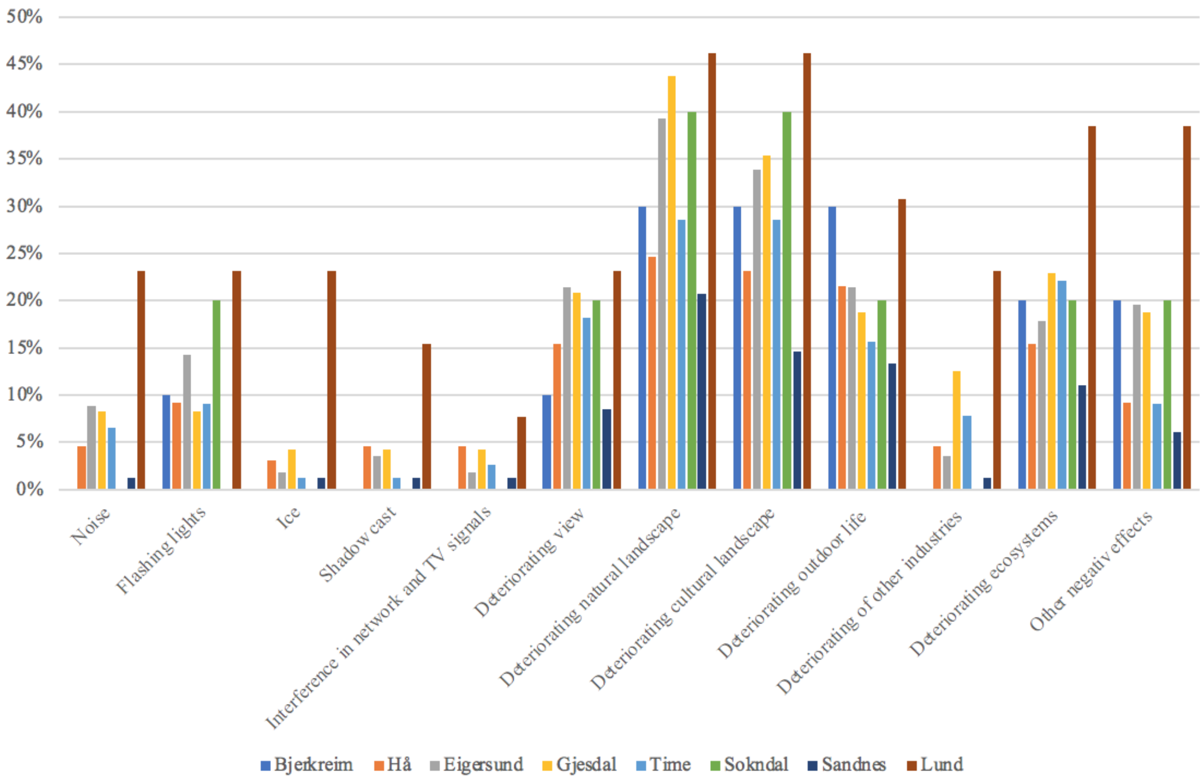



*Figure 27. Experiencing negative effects in large degree*

| | | Municipalities | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **TOTAL** | **Bjerkreim** | **Hå** | **Eigersund** | **Gjesdal** | **Time** | **Sokndal** | **Sandnes** | **Lund** |
| N | 356 | 10 | 65 | 56 | 48 | 77 | 5 | 82 | 13 |
| Very negative | 13% | 20% | 11% | 14% | 15% | 13% | 0% | 11% | 23% |
| A little negative | 14% | 10% | 9% | 13% | 19% | 14% | 0% | 16% | 15% |
| Neutral | 42% | 30% | 45% | 39% | 46% | 40% | 80% | 43% | 31% |
| A little positive | 17% | 20% | 14% | 18% | 15% | 13% | 20% | 22% | 31% |
| Very positive | 14% | 20% | 22% | 16% | 6% | 20% | 0% | 9% | 0% |
| TOTAL | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Table 17. General attitude towards wind power BEFORE local development*

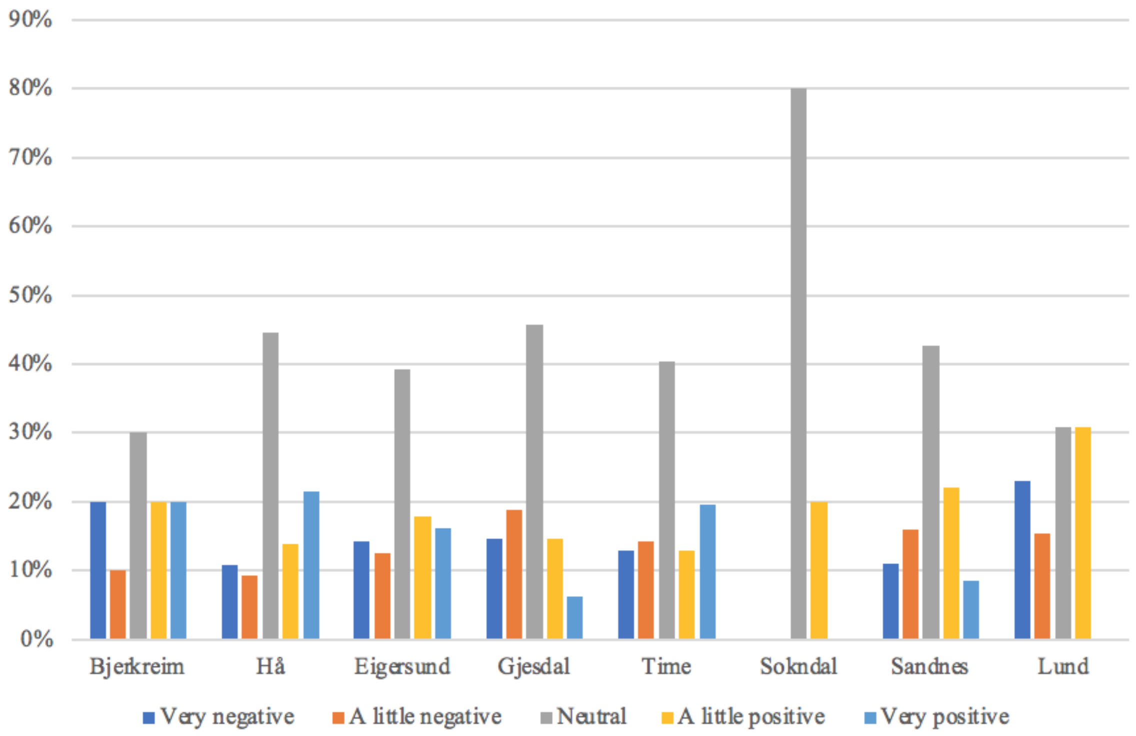



*Figure 28. General attitude towards wind power BEFORE local development*

| | | Municipalities | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TOTAL | Bjerkreim | Hå | Eigersund | Gjesdal | Time | Sokndal | Sandnes | Lund |
| N | 356 | 10 | 65 | 56 | 48 | 77 | 5 | 82 | 13 |
| A lot more positive | 3% | 0% | 5% | 4% | 2% | 4% | 0% | 1% | 0% |
| A little more positive | 6% | 0% | 9% | 4% | 2% | 9% | 20% | 2% | 8% |
| Neutral, no change | 38% | 50% | 37% | 32% | 38% | 34% | 20% | 49% | 23% |
| A little more negative | 23% | 10% | 23% | 27% | 25% | 25% | 20% | 22% | 8% |
| A lot more negative | 31% | 40% | 26% | 34% | 33% | 29% | 40% | 26% | 62% |
| TOTAL | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Table 18. Attitude AFTER local development*

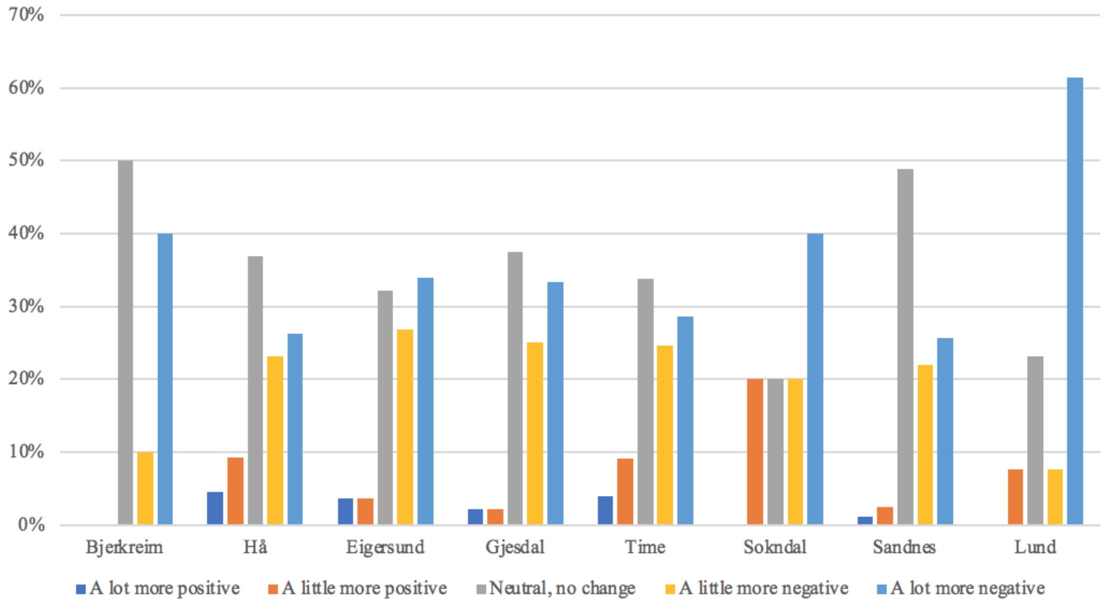


*Figure 29. Attitude AFTER local development*

# Appendix 2. Correlation Matrix

| | ALOCALLY | AGENERALLY | AFLOCALLY | REACTIVITY | ATTITUDEB | ATTITUDEA | WTP | AGE | FEMALE | VISIBLE | AFFILIAT-ION | UNI_EDU | LEISURE HOME | MUNC | YEARL-IVED | INCOME | DISTANCE | FULLTIME | RETIRED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALOCALLY | 1 | .821** | .578** | -.489** | -.479** | .660** | .244** | -0,022 | 0,002 | 0,090 | .127* | 0,065 | .130* | 0,106 | -0,027 | -0,004 | -0,023 | 0,063 | 0,000 |
| AGENERALLY | .821** | 1 | .584** | -.496** | -.491** | .704** | .241** | 0,061 | -0,050 | .120* | .107* | 0,007 | 0,094 | 0,056 | 0,000 | -0,027 | -0,001 | 0,032 | 0,044 |
| AFLOCALLY | .578** | .584** | 1 | -.526** | -.390** | .553** | .214** | -0,056 | 0,019 | 0,012 | 0,084 | 0,014 | .141** | 0,065 | -0,031 | -0,017 | -0,001 | 0,060 | -0,028 |
| REACTIVITY | -.489** | -.496** | -.526** | 1 | .372** | -.480** | -.242** | 0,074 | -0,002 | -0,073 | -0,023 | 0,051 | -.177** | -0,060 | 0,106 | 0,080 | 0,063 | -0,003 | 0,026 |
| ATTITUDEB | -.479** | -.491** | -.390** | .372** | 1 | -.315** | -.161* | 0,090 | 0,001 | -0,022 | -0,046 | .135* | -.114* | -0,088 | 0,098 | 0,080 | 0,026 | -0,024 | 0,033 |
| ATTITUDEA | .660** | .704** | .553** | -.480** | -.315** | 1 | .279** | 0,050 | -0,019 | 0,087 | .159** | 0,055 | .128* | 0,092 | -0,010 | -0,012 | 0,029 | -0,001 | 0,043 |
| WTP | .244** | .241** | .214** | -.242** | -.161* | .279** | 1 | 0,085 | -0,018 | 0,001 | .154* | 0,001 | 0,106 | -0,002 | 0,114 | 0,118 | 0,033 | -0,008 | 0,078 |
| AGE | -0,022 | 0,061 | -0,056 | 0,074 | 0,090 | 0,050 | 0,085 | 1 | -.332** | 0,072 | .181** | 0,061 | -.114* | -0,066 | .439** | -0,027 | -0,029 | -.291** | .685** |
| FEMALE | 0,002 | -0,050 | 0,019 | -0,002 | 0,001 | -0,019 | -0,018 | -.332** | 1 | -.107* | 0,036 | .160** | 0,022 | 0,083 | -0,062 | -0,053 | 0,100 | -0,028 | -.214** |
| VISIBLE | 0,090 | .120* | 0,012 | -0,073 | -0,022 | 0,087 | 0,001 | 0,072 | -.107* | 1 | .118* | -.115* | 0,032 | -.181** | 0,042 | 0,073 | -.225** | -0,045 | 0,103 |
| AFFILIATION | .127* | .107* | 0,084 | -0,023 | -0,046 | .159** | .154* | .181** | 0,036 | .118* | 1 | 0,069 | 0,016 | 0,021 | .117* | 0,080 | -0,042 | -0,072 | 0,064 |
| UNI_EDU | 0,065 | 0,007 | 0,014 | 0,051 | .135* | 0,055 | 0,001 | 0,061 | .160** | -.115* | 0,069 | 1 | 0,040 | 0,014 | 0,025 | .121* | .163** | .105* | 0,022 |
| LEISUREHOME | .130* | 0,094 | .141** | -.177** | -.114* | .128* | 0,106 | -.114* | 0,022 | 0,032 | 0,016 | 0,040 | 1 | 0,013 | -0,016 | .131* | -0,057 | .159** | -.169** |
| MUNC | 0,106 | 0,056 | 0,065 | -0,060 | -0,088 | 0,092 | -0,002 | -0,066 | 0,083 | -.181** | 0,021 | 0,014 | 0,013 | 1 | -0,006 | -.123* | .118* | -0,016 | -0,010 |
| YEARLIVED | -0,027 | 0,000 | -0,031 | 0,106 | 0,098 | -0,010 | 0,114 | .439** | -0,062 | 0,042 | .117* | 0,025 | -0,016 | -0,006 | 1 | 0,043 | -0,091 | -.122* | .292** |
| INCOME | -0,004 | -0,027 | -0,017 | 0,080 | 0,080 | -0,012 | 0,118 | -0,027 | -0,053 | 0,073 | 0,080 | .121* | .131* | -.123* | 0,043 | 1 | -0,082 | .343** | -.202** |
| DISTANCE | -0,023 | -0,001 | -0,001 | 0,063 | 0,026 | 0,029 | 0,033 | -0,029 | 0,100 | -.225** | -0,042 | .163** | -0,057 | .118* | -0,091 | -0,082 | 1 | -0,079 | -0,053 |
| FULLTIME | 0,063 | 0,032 | 0,060 | -0,003 | -0,024 | -0,001 | -0,008 | -.291** | -0,028 | -0,045 | -0,072 | .105* | .159** | -0,016 | -.122* | .343** | -0,079 | 1 | -.518** |
| RETIRED | 0,000 | 0,044 | -0,028 | 0,026 | 0,033 | 0,043 | 0,078 | .685** | -.214** | 0,103 | 0,064 | 0,022 | -.169** | -0,010 | .292** | -.202** | -0,053 | -.518** | 1 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

*Table 19. Correlation Matrix 1*

| | FACTOR 1 | FACTOR 2 | FACTOR 3 | FACTOR 4 | FACTOR 5 | FACTOR 6 | FACTOR 7 | FACTOR 8 | FACTOR 9 | FACTOR 10 | FACTOR 11 | TAX | RECREA-TION | WORK PLACE | CLIMATE CHANGE | LOW_ ELEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FACTOR1** | 1 | .561** | .536** | .635** | .541** | .521** | .420** | .495** | .533** | .534** | .517** | -.282** | -.133* | -.305** | -.242** | -.231** |
| **FACTOR2** | .561** | 1 | .461** | .482** | .484** | .602** | .527** | .509** | .510** | .491** | .488** | -.269** | -.229** | -.331** | -.357** | -.259** |
| **FACTOR3** | .536** | .461** | 1 | .621** | .481** | .398** | .341** | .355** | .426** | .469** | .362** | -.202** | -.120* | -.224** | -.236** | -.155** |
| **FACTOR4** | .635** | .482** | .621** | 1 | .560** | .476** | .388** | .434** | .494** | .522** | .402** | -.266** | -.165** | -.322** | -.274** | -.263** |
| **FACTOR5** | .541** | .484** | .481** | .560** | 1 | .415** | .392** | .429** | .419** | .510** | .396** | -.234** | -.121* | -.304** | -.207** | -.148** |
| **FACTOR6** | .521** | .602** | .398** | .476** | .415** | 1 | .661** | .665** | .678** | .493** | .581** | -.331** | -.341** | -.369** | -.388** | -.367** |
| **FACTOR7** | .420** | .527** | .341** | .388** | .392** | .661** | 1 | .870** | .796** | .639** | .716** | -.311** | -.454** | -.405** | -.418** | -.391** |
| **FACTOR8** | .495** | .509** | .355** | .434** | .429** | .665** | .870** | 1 | .796** | .634** | .715** | -.309** | -.411** | -.411** | -.450** | -.416** |
| **FACTOR9** | .533** | .510** | .426** | .494** | .419** | .678** | .796** | .796** | 1 | .582** | .685** | -.321** | -.395** | -.395** | -.386** | -.362** |
| **FACTOR10** | .534** | .491** | .469** | .522** | .510** | .493** | .639** | .634** | .582** | 1 | .669** | -.361** | -.284** | -.398** | -.386** | -.294** |
| **FACTOR11** | .517** | .488** | .362** | .402** | .396** | .581** | .716** | .715** | .685** | .669** | 1 | -.283** | -.392** | -.358** | -.380** | -.320** |
| **TAX** | -.282** | -.269** | -.202** | -.266** | -.234** | -.331** | -.311** | -.309** | -.321** | -.361** | -.283** | 1 | .411** | .612** | .491** | .517** |
| **RECREATION** | -.133* | -.229** | -.120* | -.165** | -.121* | -.341** | -.454** | -.411** | -.395** | -.284** | -.392** | .411** | 1 | .432** | .454** | .491** |
| **WORKPLACE** | -.305** | -.331** | -.224** | -.322** | -.304** | -.369** | -.405** | -.411** | -.395** | -.398** | -.358** | .612** | .432** | 1 | .592** | .530** |
| **CLIMATECHANGE** | -.242** | -.357** | -.236** | -.274** | -.207** | -.388** | -.418** | -.450** | -.386** | -.386** | -.380** | .491** | .454** | .592** | 1 | .604** |
| **LOW_ELEC** | -.231** | -.259** | -.155** | -.263** | -.148** | -.367** | -.391** | -.416** | -.362** | -.294** | -.320** | .517** | .491** | .530** | .604** | 1 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

*Table 20. Correlation Matrix 2*

## Appendix 3. Marginal Effects

| | | AFFILIATION | MUNC | DISTANCE | VISIBLE | LEISUREHOME | DIR_NEGEFF | INDIR_NEGEFF | AGE | FEMALE | RETIRED | FULLTIME | UNI_EDU | POS_EFF | INCOME |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALOCALLY | ≥ 1 | -0.006 | -0.010 | 0.000 | -0.003 | 0.005 | -0.004 | -0.025 | 0.000 | -0.002 | -0.006 | -0.003 | -0.001 | 0.018 | -0.001 |
| | ≥ 2 | -0.005 | -0.009 | 0.000 | -0.003 | 0.005 | -0.004 | -0.023 | 0.000 | -0.002 | -0.006 | -0.003 | -0.001 | 0.017 | -0.001 |
| | ≥ 3 | -0.057 | -0.105 | 0.003 | -0.035 | 0.052 | -0.050 | -0.298 | 0.001 | -0.019 | -0.083 | -0.034 | -0.008 | 0.219 | -0.008 |
| | ≥ 4 | 0.049 | 0.088 | - 0.002 | 0.029 | -0.045 | 0.041 | 0.245 | -0.001 | 0.016 | 0.065 | 0.028 | 0.007 | -0.179 | 0.006 |
| | ≥ 5 | 0.019 | 0.036 | - 0.001 | 0.012 | -0.017 | 0.017 | 0.102 | 0.000 | 0.007 | 0.030 | 0.011 | 0.003 | -0.075 | 0.003 |
| AFLOCALLY | ≥ 1 | -0.001 | -0.002 | 0.000 | 0.004 | 0.002 | -0.002 | -0.015 | 0.000 | 0.000 | -0.003 | -0.002 | 0.001 | 0.008 | 0.000 |
| | ≥ 2 | -0.015 | -0.030 | 0.000 | 0.056 | 0.030 | -0.036 | -0.227 | 0.002 | -0.005 | -0.048 | -0.037 | 0.018 | 0.128 | 0.000 |
| | ≥ 3 | 0.016 | 0.032 | 0.000 | -0.059 | -0.032 | 0.038 | 0.242 | -0.002 | 0.006 | 0.051 | 0.039 | -0.019 | -0.136 | 0.000 |
| RECACTIVITY | ≥ 1 | -0.015 | 0.006 | -0.001 | -0.005 | 0.004 | 0.019 | 0.038 | 0.000 | -0.003 | 0.010 | -0.003 | -0.008 | -0.006 | 0.000 |
| | ≥ 2 | -0.060 | 0.026 | -0.002 | -0.024 | 0.017 | 0.084 | 0.168 | -0.001 | -0.013 | 0.041 | -0.012 | -0.037 | -0.025 | 0.000 |
| | ≥ 3 | -0.039 | 0.022 | -0.002 | -0.019 | 0.013 | 0.070 | 0.140 | -0.001 | -0.011 | 0.029 | -0.010 | -0.031 | -0.021 | 0.000 |
| | ≥ 4 | 0.005 | -0.001 | 0.000 | 0.001 | -0.001 | -0.005 | -0.009 | 0.000 | 0.001 | -0.003 | 0.001 | 0.002 | 0.001 | 0.000 |
| | ≥ 5 | 0.109 | -0.053 | 0.005 | 0.047 | -0.033 | -0.169 | -0.336 | 0.003 | 0.026 | -0.076 | 0.024 | 0.074 | 0.050 | 0.007 |
| ATTITUDEA | ≥ 1 | -0.002 | -0.002 | 0.000 | 0.000 | 0.001 | 0.000 | -0.007 | 0.000 | 0.000 | 0.001 | 0.002 | -0.001 | 0.007 | 0.000 |
| | ≥ 2 | -0.006 | -0.005 | 0.000 | -0.001 | 0.003 | 0.000 | -0.019 | 0.000 | 0.001 | 0.004 | 0.005 | -0.002 | 0.020 | -0.001 |
| | ≥ 3 | -0.099 | -0.097 | -0.006 | -0.024 | 0.053 | 0.003 | -0.348 | -0.002 | 0.014 | 0.065 | 0.101 | -0.033 | 0.376 | -0.010 |
| | ≥ 4 | 0.051 | 0.046 | 0.003 | 0.011 | -0.027 | -0.001 | 0.159 | 0.001 | -0.006 | -0.032 | -0.046 | 0.015 | -0.172 | 0.005 |
| | ≥ 5 | 0.056 | 0.058 | 0.004 | 0.015 | -0.031 | -0.002 | 0.214 | 0.001 | -0.008 | -0.038 | -0.062 | 0.020 | -0.231 | 0.006 |

*Table 21. Marginal Effects*

## Appendix 4. Literature table

| Study | Focus of study | Sample | Valuation Method | Econometric Method | Major findings |
|---|---|---|---|---|---|
| Bell et al (2015) | Determining wind turbine generator's ability to meet electricity demand. | Australia. 23 housing wind farms | Correlation analysis | - | Small increase in correlation between electricity demand and wind speed. |
| Bergek (2010) | The influence of national wind power planning instruments on conflicts of interests in a Swedish county | Östergötland in Sweden. | Interviews. | Single case study | Planning target made local planning officials even more inclined to treat wind power as a private rather than a public interest and that the method used to identify areas of national interest of wind power forced wind power to compete with the combined strengths of all other public interest. |
| Brennan & Van Rensburg (2016) | Wind farm externalities and public preferences for community consulations in Ireland | Ireland. Face-to-face survey of 36 local residents. In additon a questionare from 350 households | DCE | RUM, Multinominal logit model | Majority of respondents are willing to make tradeoffs to allow for wind power initiatives. |
| Dimitropoulos & Kontoleon (2009) | Assessing the determinants of local acceptability of wind-farm investment | Greek Aegaen Islands. 212 collected questionnaries | CE | RUM, Mixed logit model | Governance characteristics of the planning procedure are the most important determinants of local community welfare. The physical attributes appear to be less of importance. |
| Dugstad et al (2020) | Acceptance of wind power | Web panel survey. | DCE | RUM, Mixed Logit Model | Exposure lowers acceptance. Exposed people are unwilling to pay as much to increase production. Decreasing marginal |

| | | | | | |
|---|---|---|---|---|---|
| | development and expssure | Rogaland and Oslo. 821 respondents | | | benefit of avoiding installation of more turbines. |
| Ek (2005) | Public and private attitudes towards green electricity | Postal survey from 547 Swedish house owners. | Stated preference. Attitude survey | Binary Logit model | The public is generally positive towards wind power. Higher age and income decrease individual support. Do not support NIMBY-hypothesis. |
| García et al (2016) | WTA local wind energy development: Does the compensation mechanism matter | Norway. On-line survey with 802 respondents | CE | RUM, Mixed logit model | Wind Park imposes welfare loss to residents and non-local recreational users, with about 35% of these losses corresponding to non-use values. Findings show that households prefer public compensation to private compensation, with households WTA being lower with public compensation. |
| Fast et al (2015) | The changing cultural and economic values of wind energy landscapes | Canada. | Interviews. Property assessment data | - | Participants often perceive rural landscapes as devoid of human activity. Property value reductions tentatively suggest more frequent than expected reductions for recreational properties and for properties within 2 km to 5 km of turbines but not within 1 km of turbines. |
| Gipe (1995) | Wind energy comes of age: Wind power attitudes | Europe and US | Attitude survey | - | Those in favour of renewables and wind power in general are more positive about local turbines. |
| Gross (2007) | Community perspectives of wind energy: Fairness framework to increase social acceptance | Taralga in Australia.12 community members | Semi-strucutred interviews | Adaptive theory. Theoretical explanatory framwork | Perceptions of fairness do influence how people perceive the legitimacy of the outcome. The fairer process will increase acceptance. Different sections of a community are likely to be influenced by different aspects of justice. |

| | | | | | |
|---|---|---|---|---|---|
| Kipperberg et al (2019) | The impacts of wind turbines on local recreation | Norway. 280 participants. | Travel cost method, Contingent behaviour | Pseudo-panel. MPG regression | Consumer surplus estimates in the range of NOK 70-155 per trip and indicated that the wind turbines would have negative impacts. |
| Krekel & Zerrahn (2017) | Does the presence of wind turbines have negative externalities for people in their surroundings? | Germany. Novel panel dataset on 20,000 installations | Life satisfaction approach | Linear regression model | Construction of wind turbines close to households exerts significant negative external effects on residential well-being. |
| Krohn & Damborg (1999) | Public attitudes towards wind power | Europe and US | Sum of main conclusion from different attitude surveys | - | Cross country public support for renewable energy sources in general and for wind power is very high. The level of public support varies, however, with people's local experience with wind power. |
| Lindhjem et al (2019) | Vindkraft i motvind– Miljøkostnadene er ikke til å blåse av | Web panel survey. Stavanger and Oslo. 821 respondents | DCE | Mixed logit model | Clear preferences against wind power onshore due to environmental effects. Negative about increased exposure in own region. |
| Mariel et al (2015) | Heterogeneous preferences toward landscape externalities of wind turbines | Germany. Survey with 40 choice sets | DCE, Hybrid CM | RUM | Respondents would be willing to pay a surcharge in order to move wind turbines away from residential areas. |
| Mattmann et al (2016) | Hydropower externalities | 81 observations from 29 studies | Meta-analysis | Meta regression model | Finds evidence for public aversion towards deteriorations of landscape, vegetation and wildlife. |

| | | | | | |
|---|---|---|---|---|---|
| Molnarova (2012) | Visual preferences for wind turbines: Location, numbers | Czech Republic. Photographic assessment questionnaire. 337 respondents | CV | Mixed logit model | Physical attributes of the landscape influenced more than socio-demographic and attitudinal factors. Receive better acceptance in unattractive landscapes, away from settlements. |
| Navrud & Bråten (2007) | Consumers preferences for green and brown electricity | Norwegian households | CE | RUM, Multinominal logit models | Prefer more wind farms, thus negative aesthetic impacts on landscape. Prefer few large wind farms instead of many smaller ones. Observe NIMBY effect. |
| Rygg (2012) | Wind power—An assault on local landscapes or an opportunity for modernization? | Norway. 13 communities. | Interview data | - | Most of the arguments in favor of wind power development addressed local concerns regarding economy, modernization and employment opportunities. |
| Vorkin & Riese (2001) | The significant of place attachment in environmental concern. | Skjåk community in Norway. 305 respondents | Postal surveys | Multiple linear regression | Place attachment explained more of the variables in attitudes than the sociodemographic variables all together. |
| Wolsink (2000) | Wind power and the NIMBY-myth: institutional capacity and the limited significant of public support | US and Netherlands | Multivariate techniques | OLS-regression | Other barriers to wind power implementation exist beyond attitudes. Institutional factors have a greater impact on wind energy facility siting. |
| Wolsink (2006) | Invalid theory impedes our understanding: a critique on the persistence of the language of NIMBY. | - | Literature review | - | Focus has shifted to how public facility patterns can be configured in order to balance the local concerns of host communities with the city- or nationwide concerns of the users of the public facilities. |

| | | | | | |
|---|---|---|---|---|---|
| Zerrahn (2017) | Wind power and externalities | Europe | Literature review | - | Wind turbines lower quality of life through noise and electricity system. Employment, output, and security is affected. |

*Table 22. Literature table*

# Appendix 5. Survey

## OM DENNE UNDERSØKELSEN

**Din mening er viktig!**

Takk for at du hjelper oss med denne undersøkelsen som er en del av samfunnsøkonomisk forskning på Handelshøgskolen ved Universitetet i Stavanger.

I løpet av de siste 10 årene har det vært en stor vekst i vindkraftutbygginger i flere fylker i Norge, så også i Rogaland. Svarene du gir i denne undersøkelsen vil hjelpe både forskere og myndigheter i få en bedre forståelse av hvordan folk i Rogaland opplever vindkraft og om lokalbefolkningens preferanser har endret seg over tid.

Det tar 5-10 minutter å fylle ut hele skjemaet. Som deltaker i undersøkelsen er du anonym.

1. Hva er ditt beste anslag på hvor mange vindturbiner det finnes i Rogaland per dags dato?

| | |
|---|---|
| 0-50 | |
| 50-100 | |
| 100-150 | |
| 150-200 | |
| 200-250 | |
| 250-300 | |
| 300-350 | |
| 350-400 | |
| 400-450 | |
| 450-500 | |
| Over 500 | |

2. Hvilke av disse vindkraftanleggene i Rogaland har du hørt om? [Kryss av de du har hørt om.]

| | |
|---|---|
| Bjerkreim Vindkraftverk | |
| Egersund Vindkraftverk | |
| Høg-Jæren Energi Park | |
| Karmøy Hywind vindkraftverk | |

| | |
|---|---|
| Måkaknuten vindkraftverk | |
| Røyrmyra vindkraftverk | |
| Skurvenuten vindkraftverk | |
| Stigafjellet vindkraftverk | |
| Storøy vindpark | |
| Svåheia vindkraftverk | |
| Tellenes vindkraftverk | |
| Tindafjellet vindkraftverk | |
| Utsira vindpark | |
| Vardafjellet vindkraftverk | |
| Åsen II vindkraftverk | |

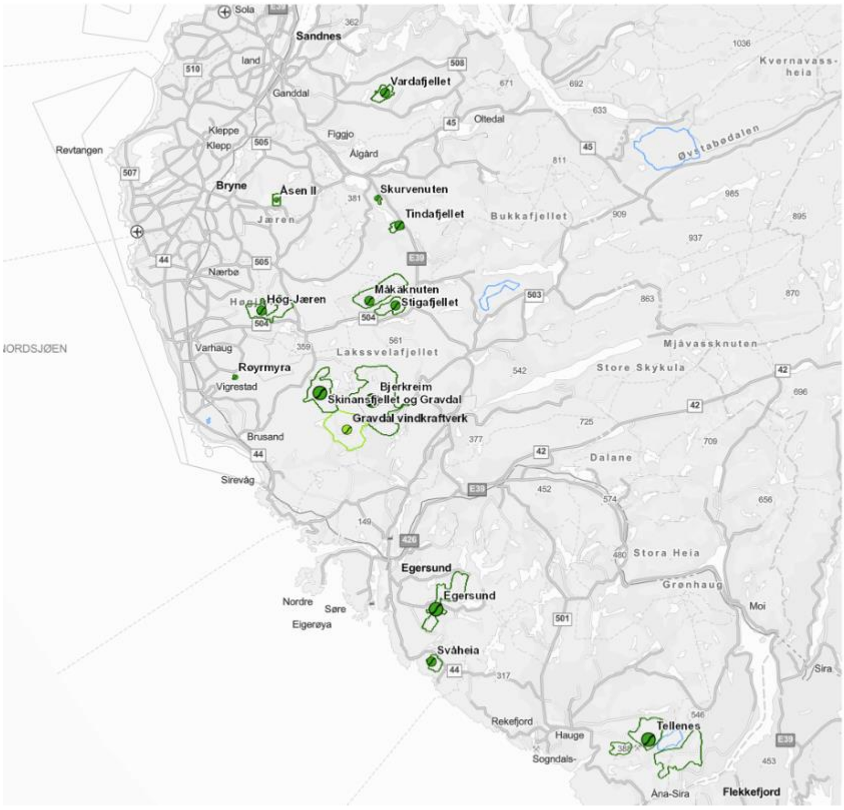
3. På hvilket postnummer bor du?

| | |
|---|---|
| Postnummer | |

4. Hvor mange år har du bodd i det området du bor nå (enten i samme eller omliggende kommune). (Velg ett alternativ)

| | |
|---|---|
| 0 – 1 år | |
| 1 – 3 år | |
| 3 – 6 år | |
| 6 – 10 år | |
| 10 – 20 år | |
| 20 – 40 år | |
| Over 40 år | |
| Har bodd her hele livet | |

5. Hvilket av følgende vindkraftanlegg er nærmest ditt nåværende bosted (kryss av det mest relevante alternativet) ( https://temakart.nve.no/tema/vindkraftverk )




| | |
|---|---|
| Bjerkreim Vindkraftverk | |
| Egersund Vindkraftverk | |
| Høg-Jæren Energi Park | |
| Måkaknuten vindkraftverk | |
| Røyrmyra vindkraftverk | |
| Skurvenuten vindkraftverk | |
| Stigafjellet vindkraftverk | |
| Svåheia vindkraftverk | |
| Tellenes vindkraftverk | |
| Tindafjellet vindkraftverk | |
| Vardafjellet vindkraftverk | |
| Åsen II vindkraftverk | |
| jeg bor i nærheten av et annet vindkraftanlegg | |
| Ingen av disse – jeg bor ikke i nærheten av vindkraftanlegg | |

6. Omtrent hvor langt fra nærmeste vindkraftanlegg er ditt nåværende bosted? (Velg ett alternativ)

| | |
|---|---|
| 0 – 1 km | |

| | |
|---|---|
| 1 – 2 km | |
| 2 – 3 km | |
| 3 – 5 km | |
| 5 – 10 km | |
| 10 – 15 km | |
| 15 – 20 km | |
| Mer enn 20 km | |

7. Hvor mange vindturbiner kan du se fra din bolig når været er klart? (Velg ett alternativ)

| | |
|---|---|
| 0 - Jeg ser ingen vindturbiner fra min bolig | |
| 1- 4 | |
| 5 – 10 | |
| 11 – 35 | |
| Flere enn 35 | |

8. I hvilken grad føler du deg berørt av vindkraftutbygginger i området der du bor? (Velg ett alternativ)

| | |
|---|---|
| I stor positiv grad | |
| I noe positiv grad | |
| Nøytral – jeg er hverken positivt eller negativt berørt | |
| I noe negativ grad | |
| I stor negativ grad | |
| Ikke relevant – har ikke vindkraft i nærheten av der jeg bor | |

9. I hvilken grad føler du deg berørt av vindkraftutbygginger i livet generelt? (Velg ett alternativ)

| | |
|---|---|
| I stor positiv grad | |
| I noe positiv grad | |
| Nøytral – jeg er hverken positivt eller negativt berørt | |
| I noe negativ grad | |
| I stor negativ grad | |

| | |
|---|---|
| Ikke relevant – har ikke vindkraft i nærheten av der jeg bor | |

10. Hvor uenig eller enig er du i disse utsagnene om din tilknytning til området der du bor?

| | Helt uenig | Delvis uenig | Nøytral | Delvis enig | Helt enig |
|---|---|---|---|---|---|
| Jeg har en sterk tilknytning til mitt nærområde | | | | | |
| Jeg kan lett flytte til et annet sted hvis det forbedrer mine arbeids- og/eller levevilkår | | | | | |
| Jeg setter større pris på å utføre friluftsaktiviteter i mitt eget nærområde enn i andre områder | | | | | |

11. Har vindkraftutbygginger påvirket din tilknytning til området der du bor? (Velg ett alternativ)

| | |
|---|---|
| Ja, på en positiv måte | |
| Ja, på en negativ måte | |
| Nei, den er uendret | |
| Ikke relevant – har ikke vindkraft i nærheten av der jeg bor | |

12. Har du tilgang til fritidsbolig i nærheten av et eksisterende eller planlagt vindkraftanlegg? (Velg ett alternativ)

| | |
|---|---|
| Ja, har tilgang til fritidsbolig nært et eksisterende vindkraftanlegg | |
| Ja, har tilgang til fritidsbolig nært et planlagt vindkraftanlegg | |
| Nei, har tilgang til fritidsbolig, men ikke nært et eksisterende eller planlagt vindkraftanlegg | |
| Nei, har ikke tilgang til fritidsbolig | |

13. I hvilken grad har du opplevd følgende mulige negative effekter fra vindkraft i nærheten av der du bor eller har fritidsbolig?

| | Ikke i det hele tatt | I liten grad | I noen grad | I stor grad |
|---|---|---|---|---|
| Støy | | | | |
| Lysblink | | | | |
| Iskast | | | | |
| Skyggekast | | | | |
| Forstyrrelser på nett/TV-signaler | | | | |
| Forringet utsikt | | | | |
| Forringet naturlandskap | | | | |
| Forringet kulturlandskap | | | | |
| Forringet friluftsliv | | | | |
| Negative effekter på andre næringer | | | | |
| Skader på dyre- og planteliv | | | | |
| Andre negative effekter | | | | |

14. Hvor enig eller uenig er du i følgende utsagn: "*Jeg bruker området der jeg bor MINDRE til fritidsaktiviteter som følge av lokale vindkraftutbygginger*". (Velg ett alternativ)

| | |
|---|---|
| Helt uenig | |
| Delvis uenig | |
| Nøytral | |
| Delvis enig | |
| Helt enig | |
| Ikke relevant – har ikke vindkraft i nærheten av der jeg bor | |

15. I hvilken grad er du uenig eller enig i følgende utsagn relatert til vindkraftutbygginger i Norge?

| | Helt uenig | Delvis uenig | Nøytral | Delvis enig | Helt enig |
|---|---|---|---|---|---|
| Jeg foretrekker satsing på vindkraft til havs | | | | | |
| Vindkraft er et godt alternativ til ikke-fornybare energikilder | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Jeg syntes ikke det er verdt for Norge å investere i vindkraft | | | | | |
| Jeg syntes vindturbiner er fine å se på | | | | | |
| Det er bra å øke norsk strømproduksjon | | | | | |
| Norsk vindkraft vil bidra til at Europa bruker mindre ikke-fornybar energi | | | | | |
| Vindkraft i Norge gir store landskapsødeleggelser | | | | | |
| Vindkraft vil ikke bidra tilstrekkelig i kampen mot klimaendringer | | | | | |
| Det burde ikke settes opp flere vindkraftanlegg på land i Norge | | | | | |
| Jeg foretrekker andre energikilder enn vindkraft | | | | | |
| Vindkraft vil bidra til å holde strømprisene lave | | | | | |

16. Hva var din generelle holdning til vindkraft **FØR** det kom vindkraft i nærheten av der du bor? (Velg ett alternativ)

| | |
|---|---|
| Svært negativ | |
| Litt negativ | |
| Nøytral – hverken negativ eller positiv | |
| Litt positiv | |
| Svært positiv | |

17. Er du mer positiv eller negativ til vindkraft **ETTER** at det kom vindkraft i nærheten av der du bor? (Velg ett alternativ)

| | |
|---|---|
| Mye mer negativ | |
| Noe mer negativ | |
| Nøytral – ingen endring | |
| Noe mer positiv | |
| Mye mer positiv | |

18. I hvilken grad mener du at vindkraft i Rogaland har følgende **POSITIVE** effekter?

| | Ikke i det hele tatt | I liten grad | I noen grad | I stor grad |
|---|---|---|---|---|
| Gir lokale skatteinntekter | | | | |
| Gir nye rekreasjonsmuligheter | | | | |
| Skaper lokal næringsaktivitet og nye arbeidsplasser | | | | |
| Bidrar til å bekjempe klimaendringer | | | | |
| Gir lavere strømpriser | | | | |

| | |
|---|---|
| 18-a. Opplever du andre positive effekter av vindkraft i Rogaland? Vennligst skriv disse inn i kommentarfelt: | |

19. I hvilken grad mener du at vindkraft i Rogaland har følgende **NEGATIVE** effekter?

| | Ikke i det hele tatt | I liten grad | I noen grad | I stor grad |
|---|---|---|---|---|
| Truer dyre- og planteliv | | | | |
| Ødelegger uberørt/lite berørt natur | | | | |
| Gir kostbare areabeslag | | | | |
| Ødelegger friluftslivet | | | | |
| Truer folks helse | | | | |

| | |
|---|---|
| 19-a. Opplever du andre negative effekter av vindkraft i Rogaland? Vennligst skriv disse inn i kommentarfelt: | |

20. Omtrent hva er din husstands gjennomsnittlige strømregning per måned? (Velg ett alternativ)

| | |
|---|---|
| Min husholdning betaler ikke strøm | |
| Under 400 kroner per måned | |
| 400 – 800 | |
| 800 – 1200 | |
| 1200 – 1600 | |
| 1600 – 2000 | |

| | |
|---|---|
| 2000 – 2400 | |
| 2400 – 2800 | |
| Over 2800 kroner per måned | |

21. Hvor stor prosentandel av strømregningen hadde du vært villig til å betale ekstra, for å unngå å være berørt av vindturbiner i nærområdet? (Velg ett alternativ)

| | |
|---|---|
| 0 % | |
| Under 5 % | |
| 5 – 8 % | |
| 9 – 12 % | |
| 13 – 16 % | |
| 17 – 20 % | |
| Over 20 % | |
| Vet ikke | |

22. Hva er din alder? (Velg ett alternativ)

| | |
|---|---|
| 18 - 25 år | |
| 25 - 30 år | |
| 30- 40 år | |
| 40 - 50 år | |
| 50 - 60 år | |
| 60 - 70 år | |
| 70 – 80 år | |
| Over 80 år | |

23. Er du mann eller kvinne? (Velg ett alternativ)

| | |
|---|---|
| Mann | |
| Kvinne | |
| Annet | |

24. Omtrent hva var din husholdnings samlede brutto årsinntekt i 2020? (Velg ett alternativ)

| | |
|---|---|
| 0 – 200.000 NOK | |

| | |
|---|---|
| 200.000 - 400.000 NOK | |
| 400.000 - 600.000 NOK | |
| 600.000 - 800.000 NOK | |
| 800.000 - 1.000.000 NOK | |
| 1.000.000 - 1.500.000 NOK | |
| 1.500.000 - 2.000.000 NOK | |
| 2.000.000 - 2.500.000 NOK | |
| 3.000.000 - 3.500.000 NOK | |
| 3.500.000 - 4.000.000 NOK | |
| Mer enn 4.000.000, vennligst spesifiser:__________ | |

25. Hva er din hovedarbeidssituasjon? (Velg ett alternativ)

| | |
|---|---|
| Jobb fulltid | |
| Jobb deltid | |
| Student | |
| Hjemmeværende | |
| Pensjonist | |
| Jobbsøker | |
| Permittert | |
| Annen | |

26. Hva er din høyeste fullførte utdanning? (Velg ett alternativ)

| | |
|---|---|
| Grunnskole | |
| Videregående | |
| Fagbrev | |
| Universitet/Høyskole 1 – 4 år (bachelor/cand.mag) | |
| Universitet/Høyskole 4 + år (master/profesjonsutdanning) | |
| Doktorgrad (PhD) | |

27. Avslutningsvis:

| | |
|---|---|
| Har du noe andre meninger om vindkraft du ønsker å tilføye? Vennligst skriv inn i kommentarfelt | |

Takk for at du tok deg tid til å svare på denne undersøkelsen.