

# Local Attitudes towards Wind Power: The Effect of Prior Experience

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## 1. Introduction

Globally the market for wind power energy is experiencing some of the largest growth rates in history. New markets are emerging and existing markets are expanding. The rural landscape as we know today is thus changing as new, larger and more efficient turbines are erected.

At a general level the positive public acceptance of this change in the landscape appears to be associated with where people have been consulted prior to the instalment, thus acknowledging the potential local opposition towards specific projects. However, several imperative questions remain open. Does the social acceptance and wind power development go hand in hand? Or will the large increase in the wind power capacity have negative repercussions on the attitudes? And if so, is the change in attitude dependent on specific types of characteristics of the wind turbine development, which people gain experience with?

In order to reduce potential negative feedback mechanisms from wind power development on attitudes a look into the “crystal ball” would be helpful. If we *ex ante* can foresee some of the most obvious caveats associated with wind turbine development, we might be able to apply anticipatory planning that may mitigate the negative effects from wind turbine development on the acceptance of wind power. Fortunately, existing attitude surveys contain information, which can be employed to assess how attitude and wind power development will be related in the future. Many of the existing attitude wind power studies have included variables, which account for different types of “experience” that the respondents in the surveys had with wind turbines. These variables often entail information on whether or not the respondents have had a “physical/visual” experience with wind turbines, such as a view to turbines from the residential property, distance to turbines, number of turbines in the local area etc. In Denmark, these prior experience variables represent people who are living in a landscape with more wind turbines than the general population. By examining the attitudes of these specific groups of respondents, we are able to shed light on how attitudes may alter in future landscapes with higher levels of wind turbine densities.

The present chapter therefore provides a review of these studies and discusses the results in relation to what can be “glimpsed” in the crystal ball for the future social acceptance of wind power generation.

## 2. A model for prior experience

Attitude formation towards wind power is far from being straightforward and clear predictions are not easy. The central theme in most of the wind power literature focusing on public attitudes is how turbines under different settings and circumstances can generate opposition (see Gross 2007; Graham et al. 2009; Jobert et al. 2009; Jones & Eiser 2009; Ladenburg 2009 and Hagggett 2011 for some of the more recent papers on this subject).

As mentioned, the aim is to shed light on how prior experience with wind turbines might have an influence on attitude, and most importantly how we relate this to attitudes towards the wind farm landscapes to come in a near future. We therefore need a model that takes prior experience into account. Quantitative analyses of attitudes in previous research on wind power attitude formation and prior experience typically define differences in individual attitudes in a linear form, in which individual  $i$ 's latent attitude  $q_i^*$  is a function of the individual demographics,  $X_i$ , and a set of variables,  $\theta_i$ , representing one or several dimensions of prior experience with wind turbines, see below

$$q_i^* = X_i\beta + \theta_i\varphi . \quad (1)$$

In the assessment of the influence of prior experience,  $\theta_i$  is thus the cornerstone variable. As we will see in the review,  $\theta_i$  represents different types of prior experience definitions, which depend on the information available in the studies. This typically includes information on whether the respondent lives near a wind turbine or has seen a turbine, i.e. during a general visual encounter. However, some of the studies also have more detailed information, such as distance to the wind turbines, number of turbines seen on a daily basis or systematic differences in the experience with wind turbines. All in all, these variables cover different types of experience with wind turbines, which a larger share of the total population of a country will experience in the coming years' wind power landscapes.

Consequently, the information from existing studies provide insights on how attitudes can develop (all things else being equal) if more people in the future are exposed to these types of experiences.

That said, prior experience is only analysed here in the frame of visual/physical encounters with actual wind turbines. Naturally, physical encounters are just one source of prior experience. Prior experience or perhaps more correctly prior information can be obtained from various numbers of sources. Compared to prior experience, which refers to a personal experience, prior information can be obtained through indirect experience, such as relatives' or friends' experience with wind turbines and their expressions thereof. Prior information can also be obtained by reading positive or negative articles in the newspaper, watching the news in television and through other types of media (Kuehn 2005; AMR interactive 2010). This is important to keep in mind when interpreting the results from this review and when we relate these to the wind turbine landscapes in the near future.

## 3. Review

As stressed in the prior experience model, the prior experience relates to a "physical" encounter with wind turbines entails different types of information. In the review below, these differences are addressed and related to the type of wind power development location, i.e. general attitude towards wind power and attitudes towards specific locations of development. Hereby land-based and offshore installations are distinguished.

To increase the accessibility of the review and the subsequent results, the studies obtained from the literature are categorised according to the type of location, i.e. land-based or offshore systems. Within each category, the studies are presented in chronological order by the first author. Besides the name of the study, the table lists, which prior experience variables were included, whether the variables were significant and in that case the direction of the effect (positive or negative). In this relation, “<0” should be read as the prior experience variable having a negative effect and “>0” as having a positive effect on the stated attitude. If the effect of the variables is marked as <sup>NS</sup>, this denotes that the effect is not significant at a 90% level of confidence. A \* denotes significance at least at a 90% level of confidence.

### 3.1 General attitudes towards wind power

Several studies in the literature do not specifically address attitudes towards on-land or offshore wind farms, but elicit attitudes towards wind power in a broader context. Some of which are presented in table 1.

One of the first studies that addressed this issue was the paper by Krohn & Damborg (1999). Based on a Danish study, they reported from a survey carried out in a local area with many turbines. It was found that the distance to the nearest wind turbine and attitude are invariant. Accordingly, the distance to the nearest on-land turbine does not seem to have an influence on the attitude. Indeed they found that respondents who could see between 20-29 turbines from their home and who were living within 500 m from the nearest wind turbine tend to be more positive towards wind power in general. Unfortunately, they did not indicate whether these results were statistically significant.

Study	Focus of the paper	Prior experience variables	Effect of the variables
Krohn & Damborg (1999)	Attitude towards wind power	Living less than 500 m from existing turbines	$\beta_{Distance}^{NS}$
		Number of turbines visible from the residence of the respondents	$\beta_{No. turbines visible}^{NS}$
Ek (2005)	Attitude towards wind energy	Living near turbine(s)	$\beta_{Near turbines}^{NS}$
Meyerhoff et al. (2010)	Perception of the environmental quality	Number of encounters with wind turbines in the past four weeks	$\chi^2_{Wind turbine encounters}^{NS}$

Table 1. General wind power studies that focus on attitude and prior experience (compilation based on Ladenburg & Möller (2010)).

In a Swedish study (Ek 2005) it was tested if respondents who live near wind turbines have a different attitude towards wind power compared to respondents who do not live near turbines. The analysis could not establish such a connection ( $\beta_{Near turbines}^{NS}$ ).

In Germany, Meyerhoff et al. (2010) analysed if there are any significant relationships between the number of wind turbine encounters during the last four weeks and the individual

satisfaction of the regional environmental quality. Controlling for daily encounters, repeatedly encounter, encounter 2-3 times per week, only one encounter and no encounters at all, they find no significant differences in satisfaction. Environmental quality in the region thus appears to be independent of the number of encounters with wind turbines.

### 3.2 Attitudes towards land-based turbines

Table 2 comprises a list of studies that analyse the potential relations between attitudes towards on-land turbines and prior experience with wind turbines.

Focusing on attitudes, and the local intention to oppose turbines, Johansson & Laike (2007) tested in a Swedish study if residential prior experience variables related to the distance to the local turbines and to the view on these turbines. None of the variables are found to be significant in influencing individual perception and possible opposition.

In a Danish study by Ladenburg (2008) the attitude towards more on-land turbines based on a survey from 2003-2004 was analysed. The study included two experience variables, e.g. whether the respondent could see on-land or/and offshore wind farms from the permanent/summer residence. The results suggest that only in the case that the respondent can see both on-land and offshore wind turbines ( $\beta_{View\ On-Land\ and\ Offshore}$ ) prior information seems to influence the attitude towards more on-land turbines. In this particular case, prior information has a negative influence. Accordingly, respondents who have both an on-land and offshore wind farm in their view have a more negative attitude towards the prospect of a further increase of land-based turbines compared to respondent who either do not have a wind turbine in the view shed or have an on-land or offshore wind farm in the view shed from the permanent/summer residence.

In a following study, Ladenburg & Dahlgaard (2011) asked respondents about the attitude towards the existing on-land wind turbines. The relationship between attitude and prior experience were analysed by using information on whether the respondent could see on-land or/and offshore wind farms from the permanent/summer residence and the perceived number of wind turbines that each respondent sees on a daily basis. In addition, interactions between having a view shed to a wind turbine and the number of wind turbines seen on a daily basis were also tested. The test of the effect of prior experience showed that having a wind turbine in the view shed did not influence the attitude. Respondents who could see an on-land or/and an offshore wind turbine from their permanent/summer residence were equally positive/negative towards existing on-land wind turbines as the respondents who did not have a wind turbine in the view shed. Interestingly, the number of turbines seen daily had a significant effect on the attitude. More specifically, Ladenburg & Dahlgaard (2011) showed that respondents who see more than 5 turbines/day ( $\beta_{>5\ turbines\ per\ day}$ ) have a more negative attitude compared to respondents, who see fewer turbines (0-5 turbines/day). Among the respondents who see 6-10, 11-20 or more than 20 turbines each day, attitudes are not significantly different between the respondents.

Based on the same data set as Ladenburg & Dahlgaard (2011), Ladenburg et al. (2011) analysed in a complementary study whether the number of land-based wind turbines seen on a daily basis affects the attitude toward more on-land wind turbines. The analysis suggests that having more than 20 turbines in the local area has a significant negative influence on the attitude towards more on-land turbines ( $\beta_{>20\ turbines\ per\ day} < 0$ ). Indeed, they found that the relation between attitude towards more on-land wind turbines and the number of turbines seen on a daily basis is dependent on whether the respondents have a view to on-land turbines or not from the residence. More specifically, the respondents

who have an on-land wind turbine in the view seem to be highly sensitive towards the number of turbines seen daily ( $\beta_{6-20 \text{ turbines per day} | \text{on-land turbine in the view shed}} < 0$  and  $\beta_{> 20 \text{ turbines per day} | \text{on-land turbine in the view shed}} < 0$ ). Furthermore, the negative effects seem to be increasing with the number of turbines seen daily,  $\beta_{6-20 \text{ turbines per day} | \text{on-land turbine in the view shed}} < \beta_{> 20 \text{ turbines per day} | \text{on-land turbine in the view shed}}$ . If the respondent do not have a wind turbine in the view shed, those who saw between 0-5 wind turbines per day were equally positive/negative as the respondents who saw more than 20 turbines,  $\beta_{6-20 \text{ turbines per day} | \text{no on-land turbine the view shed}}^{NS}$  and  $\beta_{>20 \text{ turbines per day} | \text{on-land turbine in the view shed}}^{NS}$ ).

Study	Focus of the paper	Prior experience variables	Effect of the variables
Warren et al. (2005)	Attitude towards two existing wind farms	Distance from residence to wind farm	$\beta_{Distance}^*$ (significance, see text)
Johansson & Laike (2007)	Intention to oppose additional wind turbines	Living at different distances from existing wind turbines	$\beta_{Distance}^{NS}$
Ladenburg (2008)	Attitude towards more on-land turbines	View to on-land turbines from permanent residence or summerhouse	$\beta_{View \text{ on-land}}^{NS}$ $\beta_{View \text{ on-land and offshore}}^* < 0$
		View to on-land turbines from permanent residence or summerhouse	$\beta_{View \text{ On-land}}^{NS}$
Ladenburg & Dahlgaard (2011)	Attitude towards existing on-land turbines	View to offshore turbines from permanent residence or summerhouse	$\beta_{View \text{ Offshore}}^{NS}$
		Number of on-land turbines seen on a daily basis	$\beta_{See \text{ more than 5 turbines/day}}^* < 0$
Ladenburg et al. (2011)	Attitude towards more on-land wind turbines	View to on-land turbines from permanent residence or summerhouse	$\beta_{View \text{ On-land}}^{NS}$
		View to offshore turbines from permanent residence or summerhouse	$\beta_{View \text{ Offshore}}^{NS}$
		Number of on-land turbines seen on a daily basis	$\beta_{See \text{ more than 5 turbines/day}   \text{on-land turbine in view shed}}^* < 0$

Table 2. Attitude and prior experience towards land-based turbines (modified from Ladenburg & Möller (2010)).

Warren et al. (2005) conducted two surveys on attitude towards existing and planned on-land turbines in two local regions in Scotland and Ireland. Focusing on the Irish study, the attitudes towards two specific wind farms in both Cork and Kerry were cross tabulated with the distance (0-5 km, 5-10 km and 10-20 km) from the residence of the individual respondent to the wind farms. The attitude frequencies point towards that the closer the respondents live to the wind farms, the more positive they are. Using the frequencies from the Warren et al. (2005), Ladenburg & Möller (2010) tested and confirmed these findings. With regard to the attitude towards the first established wind farm in the respective area, respondents living between 0-5 km and 5-10 km from the wind farms (one in Kerry and one in Cork) have similar attitudes. However, when comparing the attitudes between respondents living 0-5 and 10-20 km from the two wind farms, respondents living between 10-20 km from the wind farms were found to be significantly more negative.

### 3.3 Attitudes towards offshore wind farms

In the following section, the attitude studies focusing on offshore wind farms are presented (Table 3).

Study	Focus of the paper	Prior experience variables	Effect of the variables
Bishop & Miller (2007)	Perception of visual impacts from offshore wind farms at 4, 8 and 12 km from the shore	Location of on-land turbines in the neighbourhood	$\beta_{\text{Turbines neighbourhood}_4 \text{ km}} < 0$
			$\beta_{\text{Turbines neighbourhood}_8 \text{ km}}^{\text{NS}}$
Ladenburg (2008)	Attitude towards more offshore turbines	View to offshore turbines from permanent residence or summerhouse	$\beta_{\text{Turbines neighbourhood}_{12 \text{ km}}}^{\text{NS}}$
			$\beta_{\text{View on-land}}^{\text{NS}}$ $\beta_{\text{View offshore}}^{\text{NS}}$
Ladenburg (2009)	Perception of visual impacts from offshore wind farms	View to on-land turbines from permanent residence or summerhouse	$\beta_{\text{View on-land}}^{\text{NS}}$
			View to offshore turbines from permanent residence or summerhouse
Ladenburg (2010)	Attitude towards existing offshore turbines	Systematic differences in prior experience between two samples of respondents	$\beta_{\text{Systematic differences}} < 0$
		View to on-land turbines from permanent residence or summerhouse	$\beta_{\text{View on-land}} > 0$
		View to offshore turbines from permanent residence or summerhouse	$\beta_{\text{View offshore}}^{\text{NS}}$
Ladenburg & Möller (2010)	Attitude towards existing offshore	Number of on-land turbines in the neighbourhood	$\beta_{\text{No. turbines neighbourhood}}^{\text{NS}}$
		Same as Ladenburg (2010) Travel time to the nearest	$\beta_{\text{Traveltime}} < 0$ $\beta_{\text{Traveltime}^2} > 0$

turbines	offshore wind farm	$\beta_{\text{Traveltime}_{30\text{min}}} < 0$
	Number of turbines in the nearest offshore wind farm	$\beta_{\text{Number of turbines}} > 0$
	Distance/height relation of the turbines in the nearest offshore wind farm	$\beta_{\text{Distance/height}}^{\text{NS}}$

Table 3. Attitude and prior experience towards offshore turbines (based on Ladenburg & Möller (2010)).

Bishop & Miller (2007) tested prior information in a study by analysing the visual impact from an 18 turbine offshore wind farm which could be viewed from the coast at different sites from the shoreline at 4, 8 and 12 km respectively. Prior experience was analysed using the approach described in Ek (2005)]. It was investigated whether respondents living in an area with land-based wind farms perceived the visual impacts from offshore wind farms as being more severe when compared to respondents without any contact with wind farms or living in an area with proposed or approved wind farms. The results suggest some influence of prior information, though the prior information effect was ambiguous. Apparently, this effect was found only to be significantly different in the case of visual assessment of the wind farm located at 4 km offshore, but not so, if the farm was viewed further way at 8 and 12 km off the coast.

Ladenburg (2007) analysed the attitude towards future offshore wind farms in Denmark. The paper includes prior experience information related to variables controlling for whether the respondents have a view shed to on-land and/or offshore wind turbines. The results suggest that prior experience does not influence the attitude towards future offshore wind farms ( $\beta_{\text{View On-Land}}^{\text{NS}}$ ,  $\beta_{\text{View Offshore}}^{\text{NS}}$ ).

However, in a complementary study, Ladenburg (2009) modelled prior information as a function of view to on-land and offshore wind farms from permanent residence or summer homes. This analysis combined controls for prior information by sampling respondents with distinctively different levels of experience with visual impacts from offshore wind farms. That was done by a selective sampling approach in which only respondents living close to Nysted I and Horns Rev I offshore wind farms along the Danish North Sea were sampled. The distinctly different levels of visual experience are obtain, as the offshore wind farms at Nysted and Horns Rev are located at approximately 6-9.5 km and 14-20 km off the shore, respectively. Whilst the wind farm at Nysted is very visible, the wind farm at Horns Rev is difficult to see during fair weather conditions due to the location far off the coast.

Analysing the prior experience variables (view on land-based or offshore wind turbines) separately for the respondents from the Nysted and Horns Rev samples, the variables are not significant ( $\beta_{\text{View On-Land}}^{\text{NS}}$  and  $\beta_{\text{View Offshore}}^{\text{NS}}$ ). Thus, people who can see an on-land or offshore wind farm from their permanent or summer residence do not have a significantly different perception of the visual impacts compared to respondents who do not have a wind turbine in their view shed. However, when Ladenburg (2009) compared the perceptions of the visual impacts between the two sample locations, a strong prior experience effect seems to be present. More specifically, the results point towards that experience with relatively large visual impacts from offshore wind farms (Nysted I sample) has a rather negative influence on the perception of visual intrusion from offshore wind farms on the landscape, in contrast to people who have experience with offshore wind farms (Horns Rev I) with fewer/weaker visual impacts.

In Ladenburg (2010) the analysis of prior information was extended by including variables controlling for the perceived number of daily encounters with on-land wind turbines, i.e. number of turbines in the neighbourhood, where the respondents live. It was found that having a view to on-land turbines had a significantly positive influence on attitude ( $\beta_{View\ On-Land} > 0$ ). The respondents, who had an on-land wind turbine in the view, thus were more positively inclined towards offshore wind farms, compared to the respondents who did not. The number of turbines and view to offshore wind farms were not found to have any significant impact on the attitude.

In a final study, Ladenburg & Möller (2010) use the travel time from the residence to the nearest offshore wind farm as an indirect proxy for a prior experience in terms of a physical/visual encounter with the nearest offshore wind farm. Analysing the effect of prior experience on attitude towards existing offshore wind farms in Denmark, an ordered logit analysis suggests that the travel time has a significant influence on the attitude towards offshore wind farms. Generally, the farther away the respondents live from one of the six offshore wind farms in this survey, the more negative are the respondents towards existing offshore wind farms ( $\beta_{Traveltime} < 0$ ), though at a decreasing rate ( $\beta_{Traveltime2} > 0$ ). However, the results denote that people living within 30 minutes of travelling to the nearest offshore wind farm are significantly more negative towards the offshore wind farms ( $\beta_{Traveltime\_30min} < 0$ ), suggesting some kind of negative proximity effect.

Controlling for the number of turbines and the distance/height relation (the smaller the distance/height relation is, the larger visual impacts and vice versa), it was also found that if the nearest wind farm contained many wind turbines, the respondents were more positive towards offshore wind farms ( $\beta_{Number\ of\ turbines} > 0$ ). However, the distance/height relation did not appear to have an influence on the attitude ( $\beta_{Distance/height}^{NS}$ ).

#### 4. Prior experience and implications for the future development of wind farms

In the previous sections, the potential influences of prior experience with wind turbines on the attitude towards different aspects of wind power development were presented. In this section, the results from this review are elaborated and discussed in relation to which information the studies indicate for the future development of wind farms. The discussion will focus specifically on the type of experience, such as number of turbines seen daily, having wind turbines in a view shed, etc.

##### 4.1 Number of turbines

One of the fundamental wind power planning aspects is, how many wind turbines an area can contain without having too negative impacts on the local acceptance of wind power. Focusing on Ladenburg & Dahlgaard (2011) and Ladenburg et al. (2011), there seems to be a relationship between attitude towards land-based wind turbines in general and the total number of wind turbines in the local area. Apparently, higher numbers of turbines reduces acceptability of both existing and future planned increase of land-based wind turbines. However, the results also point to the triggers that cause the negative relation. The negative effects of seeing many turbines on a daily basis are tightly linked to having an on-land wind turbine in the direct view shed. Accordingly, many wind turbines in an area might not be a problem, as long as the number of respondents who have a direct view shed to turbines are minimised. In general, the cumulative effects of the total number of turbines on the individual attitude towards development pertains mainly to on-land turbines. As found in



Ladenburg & Möller (2010), attitude towards on-land wind turbines appears to be positively related to the number of wind turbines per wind farm. In contrast, in the offshore regions, people might actually prefer the turbines to be located in large wind farms as opposed to on-land turbines.

However, several studies did not find a significant effect of the number of wind turbines (see Krohn & Damborg, 1999; Ladenburg, 2010; Meyerhoff et al., 2010), but some of the applied parameters of prior experience might be too weak to establish an effect, such as the measure in Meyerhoff et al. (2010). In addition, the results in Krohn & Damborg (1999) might also be influenced by the fact that 58% of the respondents were co-owners of a wind turbine (see Ladenburg & Dahlgard (2011) for a more detailed discussion of this issue). However, it is important to stress that the cumulative effects of existing wind turbine as described only have been statistically tested in several Danish studies, so it is difficult to generalise from the found cumulative effects. Since prior experience is difficult to capture, but highly relevant for spatial planning and management of rural areas, more research is needed.

#### **4.2 View to wind turbines**

Whether having an on-land or/and offshore wind turbine in the view shed from the permanent or summer residence or not, seems to have heterogeneous effects on the individual attitude. In general, having a wind turbine in the view shed seems to have some effects on the perception of wind farming. Having a view to on-land (and offshore) turbines or having a view to on-land turbines and seeing many turbines per day seems to reduce acceptability of a even stronger future expansion of on-land wind power systems (Ladenburg 2008; Ladenburg et al. 2011). On the other hand, having a view to on-land turbines can increase acceptability of offshore wind farms (Ladenburg, 2010). Interestingly, having a view to offshore wind farms appears not influence attitude towards offshore wind power (Ladenburg, 2008; 2009; 2010). This could point towards offshore wind power development becoming an increasing acceptable substitute for land-based wind power systems, if the future on-land development cannot be kept out of the view shed of peoples' residence. These first results from the offshore studies suggest that the present level of offshore wind power development does not seem to influence the attitude among the respondents who have offshore wind farms in the view. Accordingly, more offshore wind power development seems feasible from an attitude point of view.

#### **4.3 Distance to turbines**

The distance to wind turbines captures several dimensions of prior experience. If wind turbines are more common in the landscape, the distance captures the potential subjectivity to the impacts from the wind turbines. If people live close to a wind turbine, they might be more disturbed by visual intrusion, noise impact etc. compared to a respondent, who lives far from a wind turbine. However, if wind turbines are a relatively scarce commodity, such as the current offshore wind farms in Denmark, the distance captures a measure of the potential experience with a wind turbine, i.e. the further away people live from a wind turbine the lower is the probability that they have actually ever seen a wind turbine. Such effects could explain some of the observed distance effects in the reviewed studies.

Findings from the literature thus stress the role of distance, though the results are nonetheless ambiguous. In Warren et al. (2005) acceptance of on-land wind turbines decreases with distance. In Ladenburg & Möller (2010), this is also the case, however only to

some extent. They find that respondents living within a 30-minute-drive from the nearest offshore wind farm are more negative. These results thus suggest an effect of living relatively close to wind farms. It is though important to note however that the measures of distance in the two studies are quite different. In Warren et al. (2005), the maximum distance the respondents live from the wind farm is 20 km. Compared to the analysis of distance in Ladenburg & Möller (2011), 20 km must be assumed to be within the 30 minutes of travelling time to the nearest offshore wind farm. Another distinct difference between the two studies is that Warren focuses on specific wind farms and does as such not control for the distances to other wind farms. In Ladenburg & Möller, the distance measure is to the nearest offshore wind farm, thus are not wind farm specific. This might also make it difficult to compare the results from the two studies. This stresses the difficulty to infer systematic relations in the effect of distance on attitude. This discussion should also be seen in the light of the results in Johansson & Laike (2007), who do not find an effect of distance.

#### **4.4 Attributes of wind turbines**

Conditional on having experience, it can be expected that the type of experience with the wind turbines has an impact on attitude. Ladenburg & Möller (2010) argue that the individual perception and actual exposure to wind turbines via the distance to the turbine(s), the size of the turbine(s) or the number of turbines in the vicinity might be very different between respondents. Accordingly, respondents living close to several large turbines are expected to have a completely different experience with wind turbines compared to respondents living near one single turbine, though both would state that they live close to a wind turbine. Some of these aspects were elaborated in the previous sections. However, to identify the links between the physical characteristics in terms of how different attributes of wind turbines and wind farms influence the individual attitude of a local resident remains to be a challenge. For instance, several studies have pointed out, that specific attributes of wind farms are preferred by the individual, such as locating wind farms offshore compared to on-land locations (Ek, 2005; McCartney, 2005), minimising the visual impacts from offshore wind farms etc. (Ladenburg & Dubgaard, 2007; Krueger et al., 2010 and number and size of wind turbines (Meyerhoff et al., 2010). However, the systematic influence of different wind farm characteristics on attitude has only been explored in a few studies to date. Though many studies analyse the effects from wind farms on the local community, to date only Ladenburg & Möller (2010) and Ladenburg (2009) have explicitly analysed if the variations in the wind farms affect the attitude of individuals within a local community differently.

Interestingly, there are systematic differences in offshore wind farm attributes. For instance, in Ladenburg (2009), differences in the visual impacts from offshore wind farms appear to have a significant impact on the attitude. If the offshore wind farms generate higher levels of visual impacts (the wind farm is located close to shore relative to the height of the wind turbines) more negative attitudes are generated. Apparently, differences in the size of the nearest offshore wind farm influence attitude, so that larger wind farms generate a more positive attitude. Interestingly, these results point towards that how (offshore) wind farms are planned and designed can have an positive influence on the acceptance of the wind farms. Hence, the results suggest that offshore wind farms should be located at relative large distances and should have rather more turbines in order to mitigate negative attitudes.

## 5. Conclusion

Prior experience with wind turbines is found to be a significant determinant of individual attitude towards wind farms in many studies. With the increasing level of wind power development on a global scale, this information can be of particular importance. The information entailed in the impacts from prior experience can thus serve as a guideline for policy planners and wind generation developers to increase the wind power capacity in an effective manner, so that opposition or negative attitudes towards wind power are minimised in future wind power landscapes.

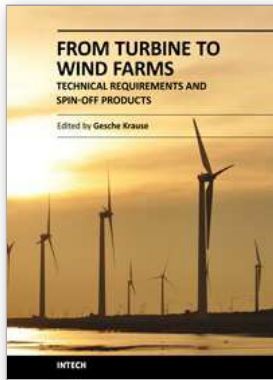
Based on the significant prior experience effects, the review of the studies points towards that increasing number of turbines on-land can reduce the acceptance of future wind power development at even small additions to the current numbers of wind turbines. This is particularly evident if wind turbines cannot be kept out of the view shed from the individual residence. It could be shown that a solution to this increasing problem of local acceptance is apparently to move the future development offshore. Offshore, people seem to be less sensitive to view shed issues and the number of turbines. However, locating offshore wind farms too close to the shore might trigger even more negative attitudes.

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