



Original research article

Does more wind energy influence the choice of location for wind power development? Assessing the cumulative effects of daily wind turbine encounters in Denmark



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ABSTRACT

An increasing number of studies suggest that the cumulative impacts of wind turbine encounters might have a negative impact on the acceptance of onshore wind power development. In many countries offshore wind resources are seen as the new wind energy resource, though the offshore cost of energy is markedly higher compared to onshore. In the present paper it is tested if the cumulative effect of wind turbines makes people favour offshore wind turbine development to onshore development. The results suggest that the cumulative effects from wind turbine encounters have weak effects on the relative attitude towards more onshore and offshore wind power development. This suggests that increasing onshore wind power development does not make people favour offshore wind power development to a higher extent.

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1. Introduction

The expectations with regard to future wind power development targets are very positive [1,2]. With higher wind power shares, the population can expect more wind turbines in both rural and urban landscapes. Accordingly, the “wind turbine pressure” on the individual will increase. Based on the review in Ladenburg et al. [3], the literature generally points towards that the more turbines people view, the less positive is their attitude towards onshore wind power [3–6]. In the same line of research, Ladenburg [7] finds that view shed experiences from onshore wind farms can increase preferences for other renewable energy sources, whilst view shed experience to offshore wind farms can have different effects on the preferences for other renewable energy sources relatively to wind energy. Specifically, it is noteworthy that Ladenburg and Dahlgaard [4] and Ladenburg et al. [3] find evidence that an increase in the wind power pressure can have a negative impact on the acceptance of additional onshore wind power development. So far, the cumulative effects studies have only shed light on how the wind power pressure influences attitude towards future onshore

wind power development and not additional offshore wind power development!

Though offshore wind power development is preferred to onshore [8], the attractiveness from a generation cost of view is less convincing. The costs of producing wind power offshore are estimated to be twice as high as the costs of onshore production [9]. Accordingly, if the numbers of turbines seen on a daily basis cause people to favour offshore wind power development to a higher degree this could invoke a higher demand for more offshore wind power development relative to onshore development. This, in turn, would lead to higher generation and electricity costs and make it more difficult to plan future onshore and offshore wind power development, as a consequence of the dynamic impacts from wind turbine densities on the acceptance of onshore and offshore wind power development.

The present paper builds on the data in Ladenburg et al. [3] and aims at analysing whether the number of turbines seen daily has an impact on the relative acceptance of onshore and offshore wind power development. Clearly and in the light of Ladenburg [7], it would also have been interesting to test the influence of the daily wind turbine encounters on the relative acceptance for different renewable energy sources. However, that has not been possible with the given data set. The paper is structured as followed. First a presentation of the present study is given, followed by the results and finally a conclusion.

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Table 1
Descriptive statistic of the sample.

Variable	Variable name	%	Coding of variable
Male	Male	53.6	=1 if male, else =0
Age	Age		Continuous, linear
16–24 years		13.9	
25–34 years		16.6	
35–44 years		16.9	
45–54 years		23.0	
55–64 years		18.9	
≥65 years		10.6	
Annual Household Income (DKK)	H. Income		Continuous, linear
<200.000		13.5	
200.000–399.999		26.8	
400.000–599.999		23.5	
600.000–799.999		18.7	
≥800.000		8.8	
Income not available	H. Income N.A.	8.7	=1 if income not stated, else =0
Education			
Maximum seven years in elementary school	Max 7 years Elem. Sch.	4.0	=1 if max seven years in elementary school, else =0
Secondary education	Sec. Education	88.2	=1 if secondary education completed, else =0
Master degree	Master	18.3	=1 if master degree obtained, else =0
View turbines off-shore from residence	View Offshore	4.9	=1 if view from residence or summer house, else =0
View turbines on-land from residence	View On-land	24.2	=1 if view from residence or summer house, else =0
Number of turbines seen daily			
0–5 turbines	No.Turb.0–5	23.6	Reference
6–10 turbines	No.Turb.6–10	13.8	=1 if 6–10 turbines daily, else =0
11–20 turbines	No.Turb.11–20	7.8	=1 if 11–20 turbines daily, else =0
>20 turbines	No.Turb.>20	5.5	=1 if >20 turbines daily, else =0
Do not know the number of turbines	No.Turb. D. K.	49.3	=1 if do not know the number of turbines, else =0
Visit to the beach			
Visit beach at least once or more/week	VB 1/week	9.6	=1 if 1/week daily, else =0
Visit beach at least 1–3/month	VB 1/month	24.3	=1 if 1/month daily, else =0
Visit beach 1/second month	VB 1/second month	24.3	=1 if 1/second month, else =0
Less frequently		58.2	Reference
Travel time to the nearest offshore wind farm (20 percentiles)	WF.Ttime, WF.Ttime ¹ and F.Ttime30		
4–18 min		20.3	Continuous, linear and squared Dummy variable = 1 if Travel time ≤30, else =0
19–43 min		19.8	
44–71 min		20.0	
72–101 min		20.0	
102–241 min		20.0	
Number of turbines in nearest offshore wind farm	WF.N.Turb.		
10		34.4	
11		9.9	
20		44.2	Continuous, linear
72		1.6	
80		9.9	

2. Study

The analysis of the influence of the daily wind turbine encounters on the relative attitude towards future wind power development onshore and offshore utilises the same survey data as Ladenburg et al. [3]. Though the data is from 2006, it is still novel and relevant as no other published studies have addressed the cumulative impact issue in relation to the relative acceptance of onshore and offshore wind power development. Furthermore, the potential relations between wind turbine encounters and the relative attitude towards onshore and offshore wind power development are relevant not only in a Danish perspective, but is also of interest in a planning perspective for the many countries having onshore and offshore wind power resources available.

The relative attitude analysis is based on the general attitude towards three wind power development schemes:

1. More onshore wind turbines (MOWT)
2. Repowering of small onshore wind turbines with larger ones (ROWT)
3. More offshore wind turbines (MOFWT)

The analysis and conclusion in the present paper are based on the general formulation of attitude questions. Though Walter [10] finds that general attitudes can be strong predictors of local attitudes, some other part of the literature find differences in general and local acceptance [11–13] also known as the social gap [10,14]. However, as in Ladenburg et al. [3] and the study of information effects on the acceptance of offshore wind farms in Walker et al. [15] the focus here is on relative attitudes.

The survey was carried out among a randomised sample of 1860 respondents from a nationwide Internet panel consisting of approximately 17,000 people in July 2006. 1076 respondents answered all three attitude questions. The characteristics of the samples are presented in the sample below (Table 1).

Overall, the distribution of males, females and the age categories are representative of the Danish population. The respondents in the sample generally come from households with a relatively high income level and have a higher education compared to average for the Danish population. 5% and 14% of the respondents have an offshore wind turbine/wind farm or an onshore turbine/wind farm in the viewshed from their permanent or summer residence. Apparently, it has been difficult for the respondents to recollect how many

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