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A mast is a mast is a mast…? Comparison of preferences for location-scenarios of electricity pylons and wind power plants using conjoint analysis

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ABSTRACT

Although renewables are supported by the public in general, the rollout of the corresponding infrastructure (e.g. wind turbines, electricity pylons) is often met with protest. Similar results can also be found for other mast types (e.g. mobile phone base stations). However, it is not adequately understood if the protest reflects arguments against infrastructure in general or, rather, mast-specific acceptance patterns. By applying conjoint analyses, we undertook a comparison of siting preferences for electricity pylons and wind power plants. In line with previous studies in this field, distance to masts, location, perceived health hazards, and compensation payments were chosen as attributes which defined the scenarios. Overall, 149 respondents took part in the study. Results show both, mast-independent as well as mast- dependent siting preferences. Independent of the mast type, the most important criterion was alleged health concerns, and the least important characteristic was compensation payments. A closer analysis using choice simulation revealed that placing pylons in the forest is more accepted than the same scenario for wind power plants. The findings are discussed in light of a public communication strategy.

1. Introduction

Acceptance of large-scale infrastructure technologies such as wind turbines, electricity pylons, and mobile phone masts is an important prerequisite for their successful rollout (Sauter and Watson, 2007). However, the term "social acceptance" is often not distinctly defined (Wüstenhagen et al., 2007). Acceptance refers to the positive reception and successful implementation of a technology (Zaunbrecher and Ziefle, 2016). In the renewable energy context, Wüstenhagen et al. (2007) provide a definition that distinguishes three dimensions of social acceptance: socio-political, community, and market acceptance. Socio-political acceptance refers to the general support for (renewable energy) technologies and policies associated with their implementation by the public, key stakeholders, and policy makers. In contrast, community acceptance denotes the local acceptance of specific energy projects by citizens living nearby and local authorities. The third level, market acceptance, can be understood as the positive adoption of a new technology on the market (by consumers, investors, and also concerning the investment behavior of large energy companies). Studying acceptance on the market level is particularly important for innovative product (i.e., small-scale) technologies, e.g., electric vehicles or photovoltaic micro-generation (Wüstenhagen et al., 2007).

Despite the high acceptance of renewables in general (European Commission, 2007), and in Germany in particular (Zoellner et al., 2008), the successful roll-out of renewable energy is often challenged by local opposition or resistance against planned projects such as wind farms or required grid expansions (Bronfman et al., 2012; Devine-Wright, 2013; Cohen et al., 2016). However, local opposition is not restricted to energy infrastructure, but is also observable in other infrastructure technologies, e.g., mobile phone technologies, which face a similar problem: although smartphones and smart watches are constantly used and mobile internet and network connection are taken for granted by many users, the required infrastructure (mobile phone masts) is often rejected (Arning et al., 2014). This "mismatch" between the high socio-political acceptance of a large-scale technology and the often low community acceptance of specific projects is referred to as the "social gap" in acceptance research (Bell et al., 2005).

To make the implementation of large-scale energy technologies a success, it is therefore important to come to an understanding of which factors influence the acceptance of planned projects (e.g., proposed wind farms and power lines) positively or negatively.

Traditional technology acceptance theories and models such as the Technology Acceptance Model (TAM, Davis, 1989) provide a framework of factors influencing the adoption (actual system use) of a technology. The TAM was originally developed for information and communication technologies, i.e., for small scale technologies used in a

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person's job, and it presupposes previous use experience with a technology (in terms of perceived ease of use and perceived usefulness as factors predicting the attitude towards a technology). In this way, large-scale infrastructure technologies differ greatly from small devices since they are not actively used by people and therefore lack previous use experience. Whereas a computer system only affects the person that uses it, a wind farm or a transmission line concerns a large number of citizens living nearby. Furthermore, large-scale technologies cannot be controlled by an individual. It can be assumed that acceptance of large-scale technologies is much more complex than technology acceptance of small devices (Zaunbrecher et al., 2014). Thus, the transferability of traditional technology acceptance models on large-scale technologies may be limited.

Recent research on the acceptance of and opposition to energy resources aims at developing acceptance models that are suitable for the large-scale technology context (e.g., Kowalewski et al., 2014; Huijts et al., 2012). The framework of Huijts et al. (2012) is based on the Theory of Planned Behavior and defines acceptance as a behavioral response to energy technologies, which is predicted by the intention to perform this behavior (i.e., to accept). In this model, the intention to accept is considerably affected by the attitude towards a technology, which in turn is influenced by how people weigh up perceived costs, risks, and benefits associated with the technology. Moreover, Huijts et al. (2012) assume that the attitude is predicted by an affective evaluation (positive or negative feelings towards a technology) and parameters concerning the planning of energy technology projects and the involved actors: trust in stakeholders and perceived fairness. Perceived fairness is conceptualized on two levels: The first level, procedural fairness, refers to an equal distribution of benefits and disadvantages in the population, whereas distributive fairness refers to a transparent planning process that allows for public participation.

Perceived risks and drawbacks associated with wind turbines, power lines, and mobile phone masts are, for instance, a negative visual impact on the landscape and the surroundings (Atkinson et al., 2004; Siegrist et al., 2005; Wolsink, 2000) and adverse health effects due to emanating noise or electromagnetic fields (Cousin and Siegrist, 2008; European Commission, 2010; Siegrist et al., 2005; Songsore and Buzzelli, 2014). Findings from previous studies indicate that perceived visual impact depends on the type of landscape in which the infrastructure element is set (e.g., Johansson and Laike, 2007; Wolsink, 2000). Also, research has found that wind turbines and power lines are believed to cause negative consequences for nature and animals (e.g., Baxter et al., 2013; Burger, 2012; Cotton and Devine-Wright, 2013). Thus, siting of wind farms, power lines, and mobile phone masts has to be carefully considered in terms of location and distance to residential areas and important ecosystems to ensure social acceptance of planned projects.

Operators often offer compensation payments to local residents as a fast and easy though costly way to cope with public opposition to planned projects, although research findings on the effect of monetary compensation on local acceptance are contradictory (e.g., Cohen et al., 2016; Ferreira and Gallagher, 2010; Groothuis et al., 2008; Kermagoret et al., 2016; Zaal et al., 2014).

For wind turbines, already a number of studies has used conjoint analyses or choice experiments to examine preferences for their siting. Frequently included attributes are number of turbines and turbine height (e.g., Álvarez-Farizo and Hanley, 2002; Dimitropoulos and Kontoleon, 2009; Ek, 2002). In addition, the distance between wind turbines and residential areas (e.g., Brennan and Van Rensburg, 2016; Drechsler et al., 2011; Meyerhoff et al., 2008) have been considered in previous choice experiments. The question which location is perceived as adequate for wind turbine installation was included, for instance, in the choice experiments by Ek (2002), Ek and Persson (2014), and Dimitropoulos and Kontoleon (2009). Furthermore, many studies on preferences for wind turbine installations have covered financial aspects. Some chose to focus on compensation payments such as annual subsidies (Dimitropoulos and Kontoleon, 2009) or discounts in annual electricity bills (e.g., Brennan and Van Rensburg, 2016), whereas others considered increases in electricity bills due to renewable energy (e.g., Drechsler et al., 2011; Ek and Persson, 2014; Meyerhoff et al., 2008). Location of infrastructure was also studied in the mobile phone context (Dohle et al., 2010; Arning et al., 2014). Both works have included a location attribute in terms of the building type on which the mast shall be installed. Dohle et al. (2010) also considered a distance attribute with the levels “center of village,” “on the outskirts,” and “outside of village” and Arning et al. (2014) used compensation payments in their choice scenarios.

2. Questions addressed and logic of procedure

The aim of the study is to examine preferences for the siting of both electricity pylons and wind turbines in a single study as an opportunity for direct comparison. In addition, the question will be answered if preferences follow a generic logic to be applied for both (different) technologies or reflect specific requirements for electricity pylons on the one and wind turbines on the other hand.

By applying conjoint methodology, this study seeks to find out which siting factor is most important when evaluating a chosen site for the installation of wind turbines and electricity pylons: location, distance to one's own house or frequency of subjective health complaints related to the turbine or pylon. To test whether compensation payments are really capable of weighing up for perceived drawbacks of siting decisions, we additionally include compensation payments as a fourth attribute.

This study is a validation and extension of a previous study by Zaunbrecher et al. (2015) in which preferences for location scenarios of electricity pylons were analyzed. In Zaunbrecher et al. (2015), results of acceptance-relevant characteristics of pylon locations were compared to Arning et al.’s (2014) study which used similar characteristics in the mobile phone base station context. Although striking similarities in the results between the two studies were found, they had been based on different samples so that the comparability was restricted.

In this current study, participants chose preferred scenarios first in a pylon, then in a wind farm setting. Having choice data for both scenarios from the same sample allows to a) validate the results of previous studies on location preferences for pylons, b) directly compare preferences between a wind power and a pylon scenario and c) thus allows to draw conclusions about the general similarities with regard to acceptance in three different technological scenarios (mobile phone base stations, electricity pylons and wind power plants).

3. Conjoint study on location scenarios for energy-related infrastructure

In this study, participants were presented with location-scenarios of a wind power and a pylon setting, both of which required participants to state preferences with regard to siting decisions. To do so, a choice-based conjoint (CBC) – survey was applied.

3.1. Method

Conjoint analysis was developed by Luce and Tukey (1964) and is mostly used for marketing purposes. Recently, conjoint analyses have also been used in different contexts in acceptance research (Arning and Ziefle, 2015; Zaunbrecher et al., 2015; Álvarez-Farizo and Hanley, 2002; Dimitropoulos and Kontoleon, 2009). In a conjoint study, participants are presented with scenarios that consist of several attributes. Each attribute can occur in different levels. Several scenarios which contain the same attributes but differ in the levels used are presented to the participants. They are then asked to choose the scenario they prefer. By completing this task several times with different combinations of scenarios, it is possible to calculate which