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Explaining public preferences for high voltage pylon designs: An empirical study of perceived fit in a rural landscape

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ABSTRACT

In many countries, electricity transmission networks are being upgraded and developed arising from policies aiming to decarbonise energy systems. However, new power lines are often controversial, due to their perceived negative impacts on rural landscapes. Despite the fact that visual impacts are an important element of public objections, to date, little research has analysed public preferences for alternative pylon designs, as well as investigating the social and psychological factors that might explain such preferences. This paper sought to address this gap, informed by research on public acceptance of renewable energy technologies, using a survey conducted with a representative sample of UK adults ($n = 1519$). The findings indicate that the 'T-pylon' design, winner of a recent competition, was most strongly preferred and the one most perceived to fit with a rural landscape, by comparison to the conventional 'A frame' design and a 'Totem' design shortlisted in the competition. Linear regression analyses indicated three factors that explained perceived fit, regardless of the designs: lower levels of educational attainment, positive general attitudes towards transmission lines and higher levels of trust in National Grid were associated with positive perceptions of fit of the pylons in a rural landscape. Finally, findings concerning public support for diverse mitigation measures indicated that the use of alternative designs was less supported than burying new powerlines underground and routing pylons away from homes and schools. The implications of these results for more sustainable grid networks are discussed.

Introduction

In most industrialised societies, electricity supply systems are centralised (Watson and Devine-Wright, 2011) and composed of two main sections. The transmission section ensures that electricity is distributed, at higher voltages, from the sites of energy generation (e.g. usually large-scale infrastructures, like coal fired power plants, wind farms) to substations, these being then responsible for transforming electricity to be provided by the distribution networks, at lower voltages, to industrial, commercial and residential areas (Butler, 2001). However, while the components of the distribution network are arguably those more visible and present in our daily lives, research suggests that 'A frame' high voltage pylons are iconic of electricity networks in the UK (Devine-Wright and Devine-Wright, 2009), often triggering opposition and contestation (Devine-Wright et al., 2010). This is posing a challenge for current national and international agendas on climate change, which aim to streamline changes in power generation from fossil fuels (e.g. gas and coal) to low carbon (e.g. renewable) sources, deal with security of supply and ageing electricity infrastructures (Ellis, 2008; Parliamentary Office of Science and Technology 372, 2011; Renewables Directive, 2009).

There have been calls to simultaneously decarbonise *and* decentralise energy supply systems (e.g. Greenpeace, 2005), amid claims that more localised generation, supply and use can lead to a more sustainable electricity system across economic, environmental and social dimensions (Watson and Devine-Wright, 2011). Nevertheless, at present in the UK, despite some debate at governmental and policy levels (Parliamentary Office of Science and Technology 372, 2011; Ofgem, 2008), the transition towards decarbonisation is mainly being pursued through a process of continuity with the centralised model and representation of electricity systems (Devine-Wright, 2006). Applying this model to the integration of more renewable energy in the electricity system implies that new large-scale sites of power generation, usually in remote rural or coastal areas, will have to be connected with sites of demand, usually in distant urban and industrialised areas.

In the UK, the government aims to source 15% of electricity consumption from renewable energy sources by 2020 (Renewables Directive, 2009) by comparison to current levels of only 7%

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(RenewableUK, 2011). Within a centralised model of the electricity system, this makes it essential to upgrade and develop the current electricity transmission network. Large investments are forecast, estimated at over £100 billion (Department of Energy and Climate Change, 2011). However, recent cases of public opposition to the construction of new power lines (see Cotton and Devine-Wright, 2011; Highlands before pylons, 2008; No Moor Pylons, 2011; Save Our Valley, 2012) suggest that efforts to develop electricity networks will be extremely difficult, unless public perceptions about these infrastructures are better understood and integrated in that process.

Research on the publics' opposition or support for other energy-related technologies, such as wind farms, has shown that one of the most important predictors of attitudes is the perceived visual impact they have in landscapes (Nadai and van der Horst, 2010; Sustainable Energy Ireland, 2003; Wolsink, 2000), and it is therefore suggested that "*if the perceived visual quality of a project is positive, people will probably support it*" (Wolsink, 2000, p. 51). However, perception of landscape amenity is "complex and not yet fully understood" in the literature about facilities for renewable energy (Wustenhagen et al., 2007, p. 2690; Nadai and van der Horst, 2010), since "what is at stake is not simply the social acceptability of a pre-given technology but also judgements about the acceptability of wind generation technologies in *particular places*" (Cowell, 2010, p. 223) or landscapes. In other words, whereas a given infrastructure may be well evaluated per se, when it is to be constructed in a specific place, it may be perceived as not fitting there, while menacing other perceived visual qualities or representations of such places (Devine-Wright, 2009; Tveit et al., 2006). In fact, the literature on landscape perception has demonstrated that the perceived visual quality of landscapes is often positively related with landscapes' degree of naturalness – or closeness to a pre-conceived natural state – and negatively related with disturbance of such landscapes – or lack of contextual fit and coherence between interventions in the landscape and the landscape (Tveit et al., 2006). Disturbance and lack of naturalness are usually associated with the presence of human-made elements and interventions in the landscape and, namely, 'negative' ones, such as roads, factories, or power lines (Arriaza et al., 2004; Sevenant and Antrop, 2010; Soini et al., 2011). Nevertheless, some studies have also demonstrated that landscape preference may vary according with the type of area where people live (e.g. urban or rural), socio-demographic factors, prior experience, environmental attitudes or the type of interests people have in the landscapes (Kaplan, 1985; Kaltenborn and Bjerke, 2002; Sevenant and Antrop, 2010; Yu, 1995).

Regarding public acceptance of high voltage power lines, while the literature about this topic is relatively scarce (Devine-Wright et al., 2010), it has already highlighted that one of the main reasons for public opposition is the visual impact they have in landscapes and their scenic quality (Cotton and Devine-Wright, 2011; Devine-Wright, in press; Soini et al., 2011). Such visual impacts may also come with other collateral impacts, such as reducing property values, harming fauna and flora and being perceived to threaten health due to electromagnetic fields, which in turn usually also shape negative perceptions about these infrastructures (Elliott and Wadley, 2002; Soini et al., 2011). Recent cases of public opposition to high voltage power lines in the UK further corroborate those findings (e.g. Save Our Valley, 2012).

In the UK, opposition to technological interventions has been related with the cultural significance that rural landscapes occupy. Since the 1920's planning in the countryside – a term widely used in British culture to refer to rural areas (Woods, 2011) – has been essentially restrictive, trying to "preserve an ideal of rural life" (Cosgrove, 1984, p. 264; Cowell, 2010). Landscapes have therefore been the basis of a 'rural idyll' and have become "inseparable from English culture and sense of identity" (Park and Selman, 1995, p. 183), shaping attitudes towards countryside conservation (Woods, 2005). Changes to this landscape are, therefore, often not welcomed (Park and Selman, 1995), with energy infrastructures in the countryside being frequently seen as 'out of place' (Cowell, 2010).

To deal with some of these challenges, in 2011 the UK government launched a competition for new pylon designs, run by the Royal Institute for British Architects for the Department of Energy and Climate Change and National Grid Plc., the company responsible for transmission networks in England and Wales. Architects, designers, engineers and students of these disciplines were invited to "rethink one of the most crucial but controversial features of modern Britain: the electricity pylon" (Royal Institute for British Architects, 2011). Namely, they were asked to propose new pylon designs, set within a prescribed image of the rural countryside and taking into consideration the Holford rules[1] in the design of the pylons. Existing pylons in the UK are still based on the steel lattice tower A-shape design (Fig. 1) which has remained unchanged since the 1920's (Department of Energy and Climate Change, 2011). The competition led to a new pylon design – the 'T-shape' (Fig. 3) – being chosen by a jury panel consisting of UK government, electricity industry and architect representatives.

However, evidence is lacking about public perceptions of pylon designs, and also about other measures that could be taken to mitigate the rural impacts of new powerlines. On one hand, few studies have actually analysed people's preferences between different pylon designs and, more importantly, the factors which may allow us to better understand those preferences and the perception of fit between pylons and landscapes. Moreover, the Pylon Design Competition did not formally take account of public perceptions of new designs, despite the fact that experts and citizens' evaluations of the aesthetic qualities of both infrastructures and landscapes are often contrasting (Bonnes et al., 2007; Vouligny et al., 2009). On the other hand, the research conducted to date on this issue has been mainly focused on examining pylon design changes as a mitigation measure for the impacts of overhead lines in landscapes, therefore neglecting a broader perspective on mitigation measures: both public campaigns against new overhead high voltage lines and the findings of research suggest that the undergrounding of power lines may be perceived as the only solution to alleviate the perceived negative impacts of power lines (Devine-Wright, in press; No Moor Pylons, 2011).

The present research aims, first, to empirically examine UK residents' preferences between current and new pylon designs following the Pylon Design Competition. Then, to analyse, in an exploratory way, the socio-demographic and psychological factors which may explain the perception of visual compatibility or fittingness between different pylons and rural landscapes and, finally, to examine how UK residents evaluate different mitigation measures for the impacts of new overhead power lines in landscapes, including design changes. The implications of these results for a sustainable electricity grid development in the UK will then be discussed.

Public perceptions of high-voltage power lines

Academic interest in socio-psychological aspects of public acceptance of overhead high-voltage powerlines is not new. In the 1980s, Furby et al. (1988) highlighted how opposition to electric power transmission lines began in the USA in the 1950s. After the electrification of most of the country, transmission lines were in many cases no longer synonymous with progress and associated

[1] These rules aim to preserve the amenity value of landscapes when new high voltage power lines are constructed, and have to be followed by the transmission network operator in England and Wales.