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# Identifying predictors of capacity-estimates for onshore wind-power development in a region of the UK: When is enough, enough?

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## Abstract

The level of 'wind-prospecting' presently occurring in the UK is increasing the likelihood that new wind-power developments will conflict with other existing and/or proposed schemes. This study reports multiple-regression analyses performed on survey data obtained in a region of the UK (i.e. Humberhead Levels, near Doncaster) simultaneously subject to nine wind-farm proposals (September 2008). The aim of the analysis was to identify which survey-items were predictors of respondents' estimates of the number of wind turbines they believed the region could reasonably support (i.e. capacity estimates). The results revealed that the majority of respondents would endorse some local development; however, there was substantial variability in the upper level that was considered acceptable. Prominent predictors included general attitude, perceived knowledge of wind power, community attachment, environmental values and issues relating to perceived fairness and equity. The results have implications for Cumulative Effects Assessment (CEA) – and in particular the assessment of Cumulative Landscape and Visual Impacts (CLVI) – and support calls for greater community involvement in decisions regarding proposed schemes.



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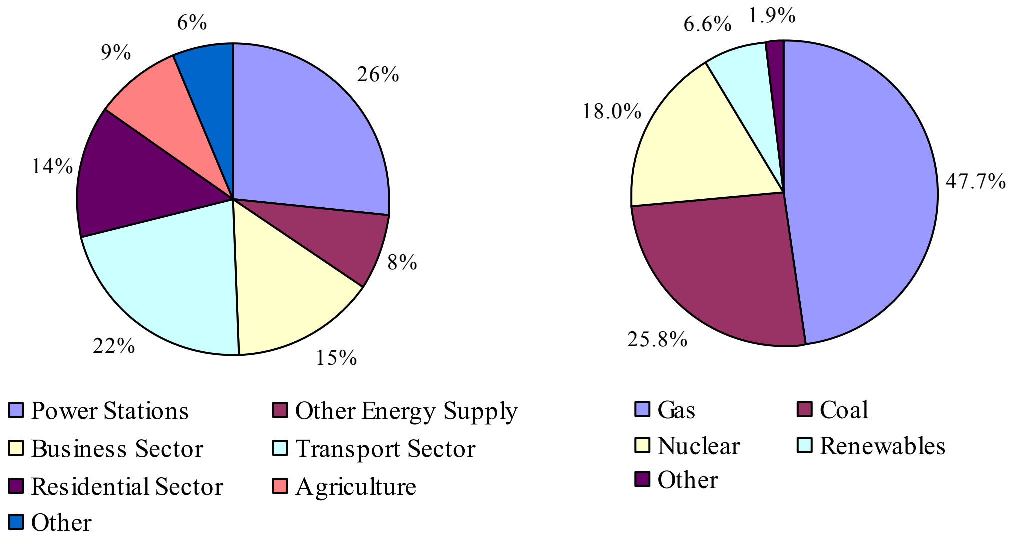
## Key Words

Attitude; Wind farm; Local Opposition; Cumulative Effects

## 1. Introduction

The social, economic and environmental threats posed by climate change are forcing governments worldwide to reduce their nations' greenhouse gas (GHG) emissions. The UK is no exception. Heavily reliant upon fossil fuels to power homes, transport and industry; the UK faces a genuine challenge in making the required cuts in GHG emissions to facilitate the transition toward a sustainable, low-carbon economy.




**Figs. 1a & 1b.** The UK Greenhouse Gas (GHG) emissions by sector in $MtCO_2e$ (2009) and The UK electricity mix (2009-2010) by energy source. *Note*: GHG emissions by sector do not reflect savings arising from Land Use Change (Sources: UK emissions statistics: 2009 UK figures; Fuel mix disclosure data table [2009-2010] - available from http://www.decc.gov.uk).

Electricity generation in the UK remains the biggest single source of GHG emissions (see Figure 1a), principally due to the continued reliance on fossil fuels to meet demand (see Figure 1b). As such, 'decarbonising' this sector is considered a vital element of this transition (see DECC, 2009a). While the proposed reinvestment in nuclear power and the development of carbon capture and storage (CCS) projects (among other things) will go some of the way to achieving this aim; the UK government anticipates that the rapid expansion of renewable generating capacity – and in particular on- and off-shore wind farms – will shoulder much of this responsibility (see DBERR, 2008; DECC, 2009a). In line with this desire, the government recently announced a target of having 28GW of operational wind-power capacity installed by 2020 (14GW each of onshore and offshore) (see DECC 2009b).

In October 2009, the UK had 242 operational onshore and 8 operational offshore wind farms, providing a combined capacity of just 3.8GW (meeting *circa* 2% of electricity demand) (BWEA, 2009; see also DECC, 2009c). As such, meeting government's 28GW target will require a considerable and rapid expansion in deployed wind capacity. While the British Wind Energy Association (now RenewableUK) (2009) remain confident that this target is "eminently achievable"; they do also highlight the threat that planning delays pose to the pursuit of this target (e.g., by undermining investor confidence in this sector).

One of the key factors known to exert a delaying and/or detrimental impact upon the outcomes of wind farm planning applications is the presence of organised public opposition (e.g., Breukers and Wolsink, 2007; McClaren-Loring, 2007; Toke, 2005; Toke et al., 2008), which presses home the importance of research targeting a more complete understanding of the reasons why people oppose local wind-power development (particularly when attitude surveys commonly report high levels of support for wind-power in principle, e.g., BWEA, 2005; Krohn and Damborg, 1999).

While a wealth of research now attests to the many motivators of local opposition to wind-power (and other developments) (e.g. Burningham et al., 2006; Devine-Wright, 2005; Eltham et al., 2008; Graham et al., 2009; Gross, 2007; Jobert et al., 2007; Jones and Eiser, 2009, 2010; Ladenburg, 2009; Walker, 2009; Wolsink, 2000, 2007; Zoeller et al., 2008), traditionally such research has focussed on how attitudes form, function and evolve in response to single projects. To date, considerably less attention has been given to how attitudes might develop in situations where, for example, a specified project interacts with other existing or proposed developments (i.e., the *cumulative effects*; see Ross, 1998; Canter, 1999). Moreover, there continues to be a clear gap in our knowledge about the relationships between people's attitudes towards wind turbines and the number of turbines that exist within the neighbourhood (see Ladenburg and Dahlgaard, 2011; see also Warren et al., 2005).

As wind-turbines become and increasingly common feature on the horizon, gaining a fuller appreciation of how the public will respond to these *cumulative effects* will become ever more important; particularly if objection of the grounds of cumulative impact becomes a key motivator of public opposition.

### 1.3 The present research

The present research aims to increase understanding of some of the factors important in guiding subjective estimates of the *scale* of wind-power development – and more specifically the number of wind turbines – that people will tolerate within their locale (from this point referred to as capacity-estimates). This article reports on regression analyses performed on survey-response data obtained from several communities within the Humberhead levels (HHLs), a region of the UK that, at the time of the survey, was simultaneously subject to no fewer than nine wind farm proposals.

This sample region provided a particularly interesting research context, not only due its historical and continued relationship with power generation (principally fossil fuel power generation) but also because the number and scale of the proposed wind-farms, if developed, stood to fundamentally change the look of the landscape and substantially exceed the turbine density beyond which a negative effect upon attitudes should be expected (i.e., 6-turbines) (see Ladenburg and Dahlgaard, 2011).

## 2. Methods

### 2.1. The sample region

The Humberhead Levels (HHLs) is a large wind-swept region of principally flat, low-lying, open, agricultural farm-land situated to the west of the Humber Estuary (see Figure 1). Occupying the area of the former pro-glacial lake (i.e. Lake Humber), the HHLs includes several large industrial towns (e.g. Doncaster, Goole and Selby); however, more generally settlement comprises scattered villages, small market-towns and farm-holdings. The distinctly level topography of the region means that "views are often long and unbroken to distant horizons, with the sky playing an important part" (Natural England, 2009a, pp.102) (see Figure 2a) and previous industrial development (most notably the development of coal-fired power stations) has had an appreciable and conspicuous impact upon the look of the region (Natural England, 2009a) (see Figure 2b).

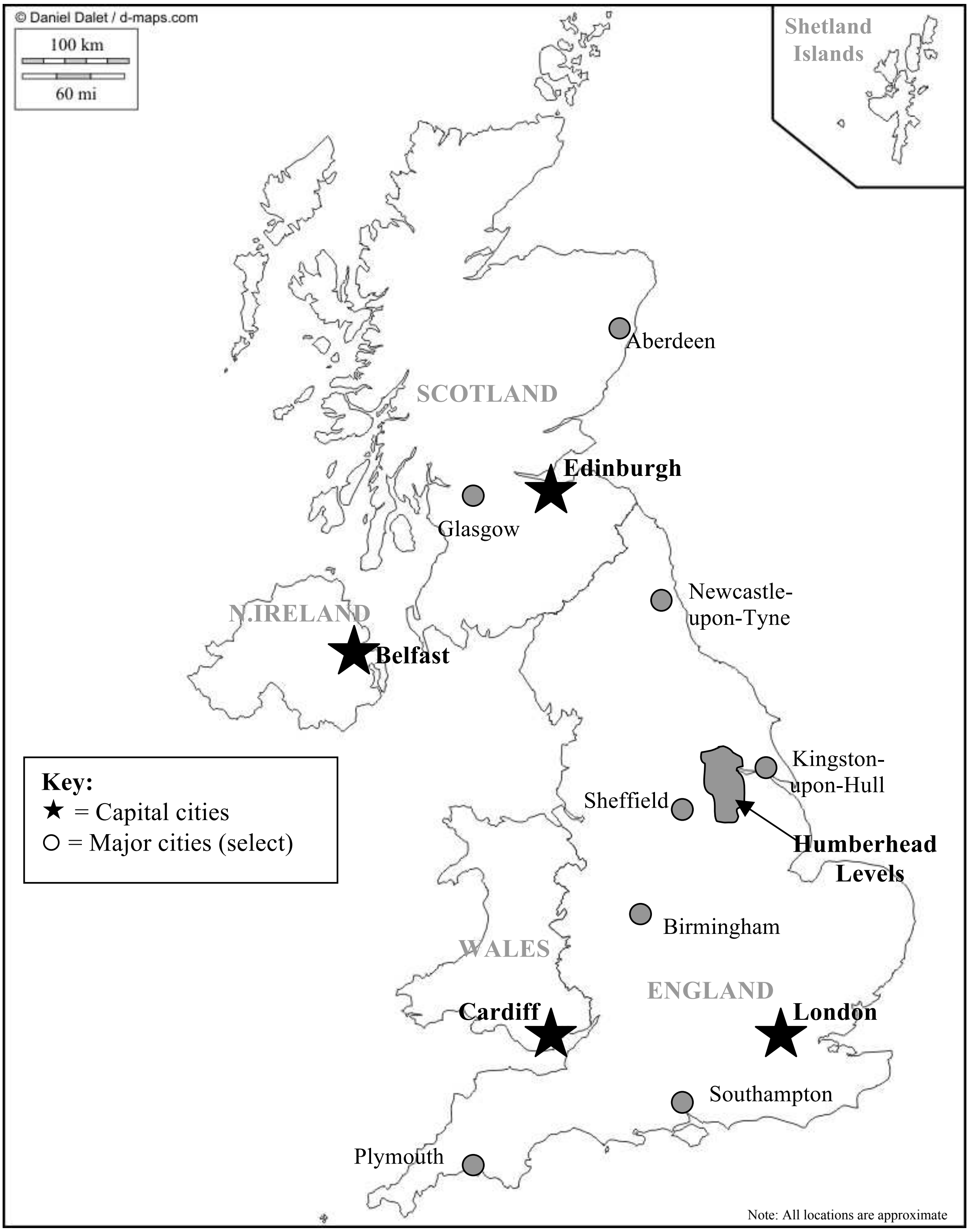



**Figure 1.** Outline map of the United Kingdom highlighting the location of the Humberhead Levels (HHLs) in comparison to select cities. Basic image downloaded from www.d-maps.com locations then added (copyright permission obtained before publication).

**Fig. 2a.** The flat agricultural landscape of the HHL region (Photograph taken by first author, April 2008).

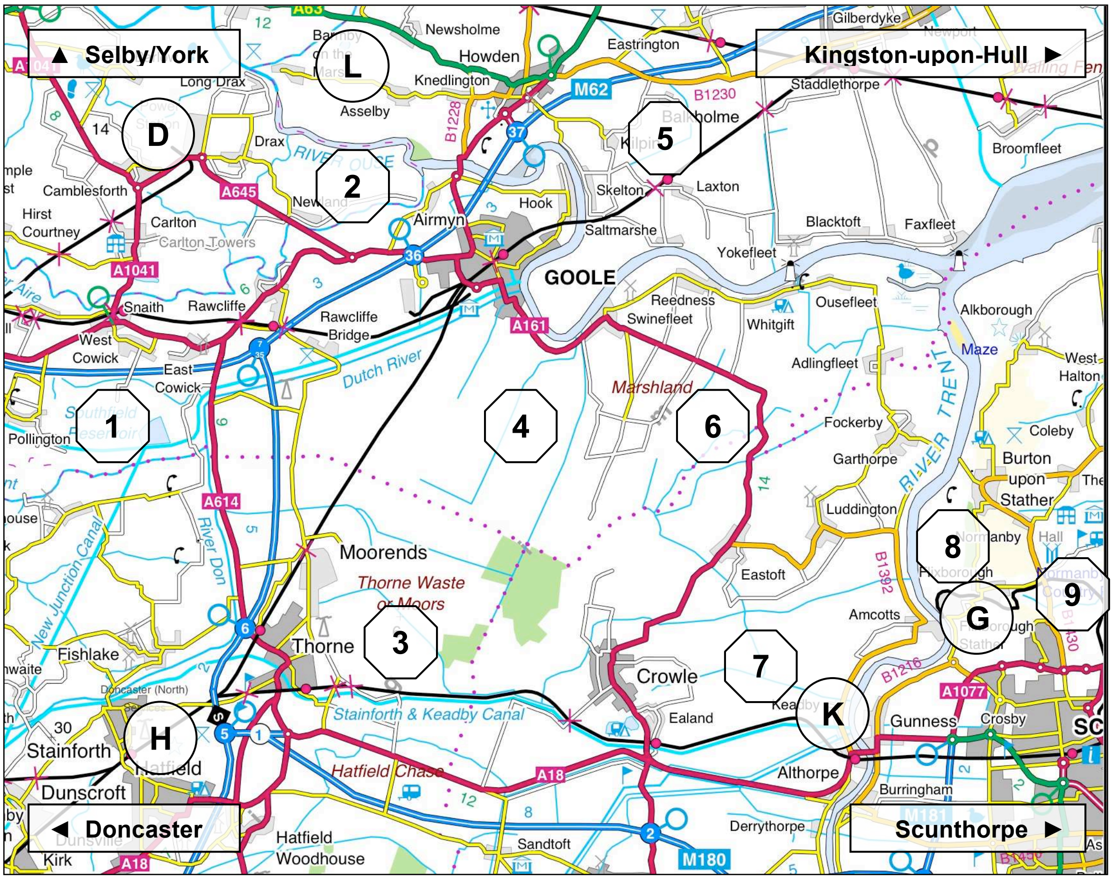
**Fig. 2b.** Drax coal-fired power station (Photograph taken by first author, April 2008).

As a result of (a) the legislative pressures mentioned earlier; (b) the technological maturity and economic competitiveness of onshore wind development; and (c) the open, windswept nature of landscape: the HHLs have become the focus of substantial ‘wind-prospecting’ by energy companies wishing to construct wind-power developments. One area of the HHLs that has received particular attention is towards the heart of the region, situated between the towns of Goole and Howden (north), Scunthorpe (east) and Doncaster (west) (see Figure 3).

At the time of conducting the study, this area (from now on referred to as ‘sample region’) was subject to no fewer than nine individual wind farm proposals (see Figure 3). However, in addition to the sheer scale of proposed development, two further factors made this region an appealing setting for the research:

1) Other than two 2MW turbines associated with a water treatment works at Loftsome Bridge (north), there was no visible large-scale wind development in the area. As such, and bearing in mind the local topography, the nine proposals (totalling 138 turbines) would stand to drastically change the look of the landscape as well as exceeding the threshold for wind development beyond which you would anticipate a negative effect on attitudes (i.e., 6 turbines) (see Ladenburg and Dahlgaard, 2011).

2) The region’s conspicuous affiliation with other forms of electricity generation (see Figure 3) raised a number of interesting questions. Specifically, would this affiliation result in greater acceptance of local wind-power development or would local residents feel that they had ‘done their bit’ for power generation in the UK, thus increasing resistance to local wind-power development?

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| Proposed Wind Farms | | | | Other Development | | | |
|---|---|---|---|---|---|---|---|
| **Code** | **Name** | **WT*** | **Status** | **Code** | **Name** | **Type** | **Status** |
| **1** | Aire & Calder | 15 | Planning | **D** | Drax | Coal | Operation |
| **2** | Rusholme | 12 | Accepted | **G** | Glanford | Biomass | Operation |
| **3** | Tween Bridge | 22 | Accepted | **K** | Keadby | Gas | Operation |
| **4** | Goole Fields | 16 | Planning | **H** | Hatfield | CCGT | Accepted |
| **5** | Sixpenny Wood | 10 | Planning | **L** | Loftsome Bridge | Wind (2) | Operation |
| **6** | Twin Rivers | 14 | Accepted | | | | |
| **7** | Keadby Grange | 34 | Accepted | | | | |
| **8** | Grange | 7 | Planning | | | | |
| **9** | Bagmoor | 8 | Accepted | | | | |

*Number of wind turbines (WT)

**Fig. 3.** Map of the sample region including the approximate locations of the nine proposed wind-power developments (hexagons) and other power-generating installations (circles). Brief details of each installation can be found in the adjoining table.

## 2.2. Questionnaire construction

A questionnaire was constructed in order to assess local opinion to the existing and proposed electricity installations in the sample region. The questionnaire included an introduction (providing details about the questionnaire and how to complete it), four experimental sections (assessing a number of factors of theoretical interest with regards to wind-turbine estimates) and a demographics section. Brief details of the main concepts investigated in each section can be observed in Table 1.

**Table 1**

Principal concepts investigated within the questionnaire

| **Concept** | | |
|---|---|---|
| A | **Introduction** | Comprising details of how to complete and return the survey. |
| 1 | **General opinion** | Assessed opinions and knowledge about energy sources being used in the HHL region. |
| 2 | **Regional affiliation to power-generation** | Assessed people's opinions about the region's historical and continued involvement in electricity-generation. |
| 3 | **Proposed wind development** | Assessed knowledge and opinion about the proposed wind farms including assessment of how many turbines would be acceptable, site suitability, equity, and perceived public support. |
| 4 | **Community and Environment** | Assessed respondents' community attachment and identification with the sample region; and their environmental values. |
| 5 | **Demographics** | Assessed age, gender, employment status, ethnicity, voting preference, home-ownership; length of residency, affiliation to the electricity-generation industry, and beliefs in climate change. |

## 2.3. Location selection

Thirty-one settlements were selected for questionnaire distribution (see Appendix A for a list of the distribution towns and villages). Distribution locations included a number of larger towns (e.g. Goole, Thorne), villages (e.g. Crowle, Rawcliffe) and smaller settlements (e.g. Amcotts, Eastoft) and were selected in order to sample a broad demographic and so as to principally incorporate individuals living adjacent to the existent/commissioned electricity-generating facilities in the area (i.e. Drax [coal], Glanford [biomass], Keadby [gas], Hatfield [CCS]) and/or in relative proximity to one or more of the proposed wind-power developments.

## 2.4. Distribution details

In total, 1,420 questionnaires were distributed and collected on a door-to-door basis over a two week period in September 2008 by a team of 9 distributers. Respondents were required to be at least 16 years old and resident in the house to which the questionnaire had been distributed. Face-to-face contact was made with each respondent, enabling the distributor to explain more about the purpose of the study if required. A collection date was agreed with the respondent (typically arranged for 2-3 days after distribution) before the distributer departed. On the agreed collection date, a researcher returned to the address to collect the completed questionnaire.

Respondents who had not completed the questionnaire, or were unavailable at the time of collection, were provided with an additional copy of the questionnaire and a Freepost envelope and asked to return *one* completed questionnaire at their earliest convenience.

## 2.5. Respondents

Of the 1,419 distributed questionnaires a total of 709 were successfully returned. Of these 709 respondents, 655 responded to the key question about wind capacity, yielding a net response rate of 46.2%. The responses of these 655 respondents comprise the dataset for the following analysis.

### *2.5.1. Respondent details*

Of the 655 respondents, 58.5% were male and 38.9% were female (2.6% of respondents failed to answer this question). Respondents ranged from 16 to 87 years old (M = 51.6 years; SD = 14.7 years) (4.0% of respondents failed to answer this question). Length of residency within the sample region ranged from 1 to 86 years (M = 31.0 years; SD = 20.6 years) (4.1% of respondents failed to answer this question). Of the sample, 55.9% were in some form of paid employment (i.e. full-time, part-time or self-employment), 27.6% were retired and 13.6% were either students, home-keepers, seeking work or had 'other' employment arrangements (3.1% of respondents failed to answer this question). Of the respondents, 79.4% either owned or were paying a mortgage on their home (from now on referred to as 'home-owners'), 13.7% lived in rented accommodation and 3.7% had 'other' housing arrangements (3.2% of respondents failed to answer this question). For the effective means and standard deviations of each variable see Table 2.

### *2.5.2. Affiliation to energy industry*

39.1% of respondents (N = 256) noted having some form of past or present affiliation with the energy sector (either through direct employment or the employment of family members), 58.0% had no affiliation to the energy industry or were unsure about any affiliation (2.9% or participants failed to answer this question). Of those holding an affiliation with the energy industry; 213 were affiliated with the coal sector, 44 with the gas sector, 24 with the biomass sector, 23 with the nuclear sector, 22 with the oil sector, 8 with the hydroelectricity sector, 3 with the wind-power sector and 13 with 'other' sectors.[1]

## 3. Results

### 3.1. Awareness of wind projects

The first stage in the analysis was to assess respondents' awareness of the proposed wind-power development in the sample region. Within the survey, respondents were provided with brief information about the 9 proposed wind-power developments (see Figure 3) and asked to report which, if any, of the developments they had heard about before receiving the questionnaire.

The vast majority of respondents (88.1%) demonstrated awareness of at least one of the proposed wind farms (or expressed awareness of an alternative wind-power development proposed for the area) with just 11.6% unaware of any of the proposed development (0.3% of respondents failed to answer this question). Of the respondents registering familiarity with at least one proposal, the majority (66.2%) showed limited awareness of the scale of proposed development for the region (i.e. recognising 1-3 developments), 19.0% had moderate knowledge (i.e. recognising 4-6 developments) and just 2.8% had a good awareness of the scale of proposed development (i.e. recognising 7 or more of the potential developments) (see Table 2 for details about the mean level of 'awareness').

Of the 9 proposals, Goole Fields was the most familiar with 55.1% of respondents noting awareness of this project. This finding is unsurprising considering that this project was the longest-standing proposal in the region. The Tween Bridge (36.6%) and Keadby Grange (35.9%) developments were the next most familiar, consistent with the fact that both these large developments had been subject to a high-profile public inquiry and had recently gained consent (Spring 2008). Awareness of the other 6 developments ranged from 12.4% (Bagmoor) to 24.6% (Aire & Calder).

**3.2. Regional wind-turbine capacity estimates**

Participants were asked to report directly how many wind turbines they believed that the sample region could reasonably support (from now on referred to as 'capacity estimates'). Participants responded by checking one of 8 options; i.e. 0 turbines; 1-25 turbines; 26-50 turbines; 51-75 turbines; 76-100 turbines; 101-125 turbines; 126-150 turbines; 151+ turbines (see Figure 4).

Of the 655 respondents, the vast majority (89.0%) believed that the region could support some development; however, estimates of what scale of development the region could support varied. The most popular choice was for a relatively low-level of development (i.e., 1-25 turbines), with 21.2% of respondents selecting this option. Endorsement was then found to tail-off with increasing turbine number. However, there were two notable exceptions to this rule, with comparatively large number of respondents selecting the 76-100 turbine (15.3%) and 151+ turbine (13.7%) options. The first peak in endorsement (76-100) is possibly the result of the fact that - for those supporting a degree of development - this was the central option on the scale and the option which encapsulated an ‘attractive’ ceiling-capacity of 100 turbines. The latter spike (151+ turbines) is maybe due to the greater inclusiveness of this category compared to the other options; one might have expected a smoother tailing-off in endorsement if the scale had continued to increase in 25-turbine increments.[2]

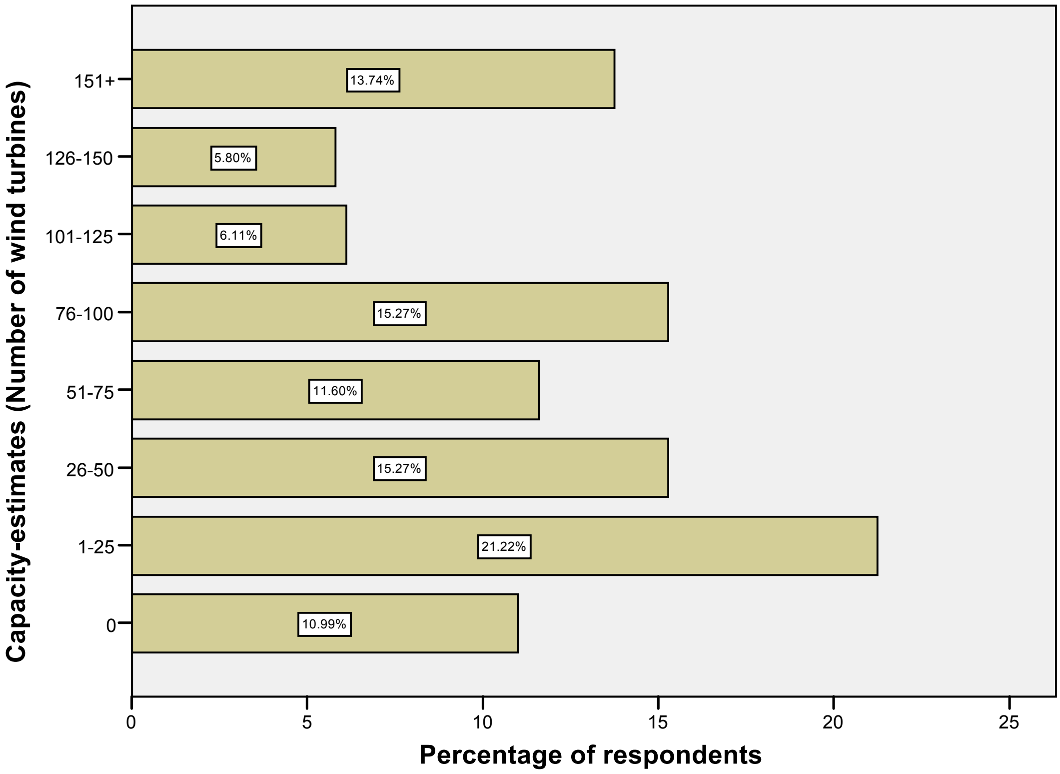


**Fig. 4.** The distribution of maximum ‘capacity estimates’ chosen by participants. Note. The majority of respondents (89.0%) accepted some level of development; however, the most popular option was for a low-level of development (1-25 turbines).

### 3.3. Predicting regional wind-turbine capacity estimates

The next step in the analysis was to establish which variables included within the questionnaire might predict respondents’ regional wind-turbine capacity estimates. A series of six linear regression analyses were conducted in order to establish the extent to which select items present within each section of the questionnaire (see Table 1) were predictive of capacity estimates (see Figure 4).[1]

Within each regression, items present within one of the sections of the questionnaire (i.e. Sections 1–4 and Section B) were examined as predictors of capacity estimates. The results of each analysis can be observed in Table 3 while the effective means and standard deviations for each item used within the analyses can be found in Table 2.

**Table X.**

Means, SDs, and principal coding for capacity estimates (DV), general attitude towards future wind-power development in the sample region, and the key items from each section of the questionnaire.

| Characteristic | Mean | SD | Coding | N |
|---|---|---|---|---|
| **Capacity estimates**[b] | 3.10 | 2.26 | 0 (No turbines) to 7 (150+ turbines) | 655 |
| **General attitude**[c] | 2.64 | 1.43 | 1 (Very unfavourable) to 5 (Very favourable) | 624 |
| **Section 1: General Opinion** | | | | |
| Traditional Coal | 2.31 | 1.16 | 1 (Very unfavourable) to 5 (Very favourable) | 633 |
| Natural Gas | 2.18 | 1.14 | 1 (Very unfavourable) to 5 (Very favourable) | 619 |
| Biomass | 2.91 | 1.03 | 1 (Very unfavourable) to 5 (Very favourable) | 577 |
| CCS | 2.65 | 1.15 | 1 (Very unfavourable) to 5 (Very favourable) | 600 |
| **Section 2: Regional affiliation to power generation** | | | | |
| Pride in involvement | 2.54 | 0.83 | 1 (Strongly disagree) to 5 (Strongly agree) | 615 |
| Desire to expand | 2.33 | 1.06 | 1 (Strongly disagree) to 5 (Strongly agree) | 629 |
| Desire to scale down | 1.78 | 1.01 | 1 (Strongly disagree) to 5 (Strongly agree) | 635 |
| Equity of involvement | 2.21 | 1.09 | 1 (Strongly disagree) to 5 (Strongly agree) | 635 |
| **Section 3: Proposed wind development** | | | | |

| | | | | |
|---|---|---|---|---|
| Concern over scale | 2.06 | 1.33 | 1 (Def. not concerned) to 5 (Definitely concerned) | 648 |
| Fairness of prospecting | 1.95 | 1.15 | 1 (Very unfair) to 5 (Very fair) | 652 |
| Attractiveness of WTs | 1.80 | 1.10 | 1 (Very unattractive) to 5 (Very attractive) | 654 |
| Visual impact on HHL | 1.72 | 1.08 | 1 (Very negative) to 5 (Very positive) | 653 |
| Suitability of region | 2.33 | 1.15 | 1 (Very unsuitable) to 5 (Very suitable) | 652 |
| Community opinion | 1.44 | 0.82 | 1 (Almost all against) to 5 (Almost all in favour) | 546 |
| Recreational use[d] | 0.25 | 0.43 | 1 (Yes); 0 (Other) | 641 |
| **Section 4: Community and environment** | | | | |
| Place identity | 11.68 | 4.21 | Max. 25 (higher score = greater identification) | 594 |
| Community attachment | 21.09 | 5.62 | Max. 40 (higher score = greater attachment) | 606 |
| Environmental values[e] | 21.42 | 5.16 | Max. 40 (higher score = more pro-environmental) | 620 |
| **Section B: Demographics** | | | | |
| Gender | 0.60 | 0.49 | 1 (Male); 0 (Female) | 638 |
| Age | 51.59 | 14.65 | Continuous (years) | 629 |
| Length of Residency | 31.01 | 20.62 | Continuous (years) | 628 |
| Employment | 0.58 | 0.49 | 1 (In paid employment); 0 (Other) | 635 |
| Home-ownership | 0.82 | 0.38 | 1 (Home-owner); 0 (Other) | 634 |
| Affiliation to industry | 0.40 | 0.49 | 1 (Affiliation shown); 0 (Other) | 636 |
| Belief in ACC[a] | 0.90 | 0.30 | 1 (Believe in ACC); 0 (Other) | 623 |
| Awareness of proposals | 2.43 | 1.78 | Number of wind-farms recognised (0-9) | 653 |
| Wind power knowledge | 2.50 | 0.97 | 1 (Know nothing) to 5 (Know a lot) | 638 |

[a] Respondents had choice of 8 options: 0 (no turbines); 1 (1-25 turbines); 2 (26-50 turbines); 3 (51-75 turbines); 4 (75-100 turbines); 5 (101-125 turbines); 6 (125-150 turbines); and 7 (150+ turbines). Item viewed as continuous. See footnote X for reasoning behind this decision.

[b] Denotes respondents' general attitude towards future wind development within the sample region.

[c] Denotes whether respondents use one or more of the proposed sites for recreational purposes.

[d] Calculated from responses to a shortened version of the New Ecological Paradigm (Dunlap et al., 2000)

[e] Belief in Anthropogenic Climate Change (ACC): Dichotomised variable: 1 = respondents believing in

climate change and feeling that humans are either fully or partially responsible (N = 559); 0 = respondents not believing in climate change or believing that humans are not responsible (N = 64).

*3.3.1. Regression 1: General attitude towards future wind-power development in the region*

Regression 1 established the impact that respondents' general attitudes towards future onshore wind-power development had on capacity estimates (i.e. *general attitude*). General attitude was found to be a strong positive predictor of capacity estimates, explaining 34% of the variance ($p < .001$). In short, respondents with more favourable attitudes towards future onshore wind-power development within the sample region showed a greater tendency towards endorsing more turbines (see Table 3). This finding was of particular note considering that the majority of respondents (62.9%) were generally in favour of *some* regional wind-power development (vs. 23.3% generally unfavourable; 12.1% ambivalent; and 1.7% 'no opinion').

*3.3.2. Regression 2: Attitudes towards other existing power generation in the region*

Regression 2 assessed the impact of respondents' attitudes towards the other forms of generation either present in (i.e. traditional coal, biomass and natural gas) or proposed for (i.e. CCS) the sample region on capacity estimates.

Only attitudes towards existing traditional-coal and natural gas generation were included within the regression analysis due to the fact that initial correlations revealed that attitudes towards the existing biomass and proposed CCS developments were not significantly correlated with capacity-estimates ($ps \geq .165$).

Attitudes towards traditional coal and natural gas were both retained as negative predictors of capacity estimates (see Table 3). That is, participants who held more favourable attitudes towards the existing coal and/or gas-powered generation activity within the sample region tended to endorse fewer wind turbines.

**Table 3**

Regressions examining the impact of items from the six relevant sections of the questionnaire (Sections 1–4 and Section B) on respondents' capacity estimates.

| Independent Variables | Mean (SD) | *ß* | *t* | Sig. |
|---|---|---|---|---|
| **Regression 1: General attitude towards future wind-power development in the region** | | | | |
| General attitude | 2.64 (1.43) | .59 | 18.01 | < .001*** |
| | *Adjusted $R^2$ = .34, F (1, 622) = 324.21, p < .001* | | | |
| **Regression 2: Attitudes towards other existing power generation in the region** | | | | |
| Traditional Coal | 2.31 (1.16) | -.13 | 3.13 | = .002** |
| Natural Gas | 2.18 (1.43) | -.14 | 3.26 | = .001** |
| | *Adjusted $R^2$ = .05, F (2, 610) = 17.02, p < .001* | | | |
| **Regression 3: Items relating to regional involvement in power generation** | | | | |
| Pride in involvement | 2.54 (0.83) | - .10 | 2.42 | = .016* |
| Desire to expand | 2.33 (1.06) | .36 | 6.73 | < .001*** |
| Desire to scale down | 1.78 (1.01) | - .13 | 2.50 | = .013* |
| Equity of involvement | 2.20 (1.09) | - .06 | 1.21 | = .227 |
| | *Adjusted $R^2$ = .16, F (4, 604) = 29.66, p < .001* | | | |
| **Regression 4: Items relating to wind-power development in sample region** | | | | |
| Concern over scale | 2.06 (1.33) | - .26 | 4.84 | < .001*** |
| Fairness of prospecting | 1.95 (1.15) | .18 | 3.86 | < .001*** |
| Visual attractiveness | 1.80 (1.10) | .12 | 2.39 | = .017* |
| Visual impact on region | 1.72 (1.08) | .03 | 0.58 | = .576 |
| Suitability of region | 2.33 (1.15) | .20 | 4.00 | < .001*** |

| | | | | |
|---|---|---|---|---|
| Community opinion | 1.44 (0.82) | .02 | 0.55 | = .582 |
| Recreational use | 0.25 (0.42) | .00 | 0.07 | = .946 |
| | | | | *Adjusted $R^2$ = .46, F (7, 517) = 64.44, p < .001* |
| **Regression 5: Identity, attachment and environmental value factors** | | | | |
| Place Identity | 11.68 (4.21) | .02 | 0.34 | = .736 |
| Community Attachment | 21.09 (5.62) | - .21 | 4.67 | < .001*** |
| Environmental Values | 21.42 (5.16) | .12 | 2.97 | = .003** |
| | | | | *Adjusted $R^2$ = .05, F (3, 576) = 10.77, p < .001* |
| **Regression 6: Demographics** | | | | |
| Gender | 0.60 (0.49) | .06 | 1.33 | = .185 |
| Age | 51.59 (14.65) | -.11 | 2.23 | = .026* |
| Length of residency | 31.01 (20.62) | -.01 | 0.14 | = .889 |
| Employment status | 0.58 (0.38) | .01 | 0.20 | = .843 |
| Home-ownership | 0.82 (0.38) | -.04 | 0.97 | = .331 |
| Affiliation to industry | 0.40 (0.49) | -.04 | 1.00 | = .319 |
| Belief in ACC | 0.90 (0.30) | .02 | 0.42 | = .677 |
| Awareness of proposals | 2.43 (1.78) | -.13 | 3.10 | = .002** |
| Knowledge of wind power | 2.50 (0.97) | .11 | 2.61 | = .009** |
| | | | | *Adjusted $R^2$ = .04, F (9, 600) = 3.67, p < .001* |

*Code for statistical significance:* * > .05; ** > .01; *** > .001

*Note.* In each case the values exclude participants utilising ‘don’t know/no opinion’ options. All regressions are linear, use an ‘enter’ method and exclude missing values using pairwise deletion. In each case the dependent variable (i.e., capacity estimates) is treated as continuous.

### *3.3.3. Regression 3: Regional involvement in electricity generation*

Regression 3 assessed the impact of respondents’ opinions about the sample region’s historical and continued involvement in electricity generation on capacity estimates.

Responses to four items were of perceived importance to this analysis: (1) The extent to which respondents' agreed that they were proud of the role that the region had played in generating electricity for the UK (*pride in involvement*); (2) The extent to which they agreed that they were happy to see an expansion in the contribution made by the region to meeting the electricity demands of the UK (*desire to expand*); (3) The extent to which they agreed that the region's involvement in electricity-generation should be scaled down (*desire to scale down*); and (4) The extent to which they agreed that it was fair for that the rest of the UK to benefit from the power stations operating in the sample region (*equity of involvement*).

Of the four items, *pride in involvement*, *desire to expand* and *desire to scale down* were retained as significant predictors of capacity estimates ($ps \leq .016$). *Equity of involvement* failed to reach conventional levels of significance ($p = .227$). Of the retained items, *pride in involvement* and *desire to scale down* shared a negative relationship with capacity estimates. Thus, the more proud respondents were with their regional involvement in power generation and/or the more they believed that such involvement should be scaled down, the fewer turbines they would tend to endorse. Conversely, *desire to expand* shared a positive relationship with capacity estimates. Thus, the greater the respondents' desire for expansion in regional power generation activities, the more turbines they would tend to endorse. Logically, it was this latter item (i.e. desire to expand) that accounted for most unique variance in capacity estimates ($p < .001$).

### *3.3.4. Regression 4: Wind development in the sample region*

Regression 4 focussed on factors relating specifically to the proposed wind-power development in the sample region. Seven items were of theoretical interest in this section: (1) The extent to which people were concerned with the number of wind farm proposals; (2) The extent to which people felt it was fair that the region should be subject to so much interest from developers; (3) Respondents' assessments of the visual attractiveness of wind turbines; (4) Respondents' assessments of the impact that development would have on the appearance of the region; (5) The perceived suitability of the region for wind farms; (6) The perceived opinion of others within the community (*community opinion*); and (7) Self-reported use of proposed sites for recreational pursuits (e.g. walking, horse riding) (*recreational use*).

Items 1, 2, 3 and 5 were retained as significant predictors of capacity estimates ($ps \leq .017$). Item 1 shared a negative relationship with capacity estimates, i.e., the greater the concern that respondents had for the scale or proposed development, the fewer turbines they would tend to endorse. By contrast, Items 2, 3 and 5 shared positive relationships with capacity estimates. In short, the less fair respondents believed the level of local 'wind prospecting' to be, the less visually attractive that respondents rated wind turbines to be and/or the less suitable respondents considered the sample region to be for wind farm development, the fewer wind turbines they would tend to endorse. Of the retained items, it was Item 1 (i.e., *concern over scale*) that accounted for most unique variance in capacity estimates ($p < .001$)

*3.3.5. Regression 5: Place identity, community attachment, environmental values*

Regression 5 investigated the extent to which respondents' identification with the sample region, attachment to their community and environmental values influenced capacity estimates.

Place identity was assessed by adapting 5-items from the place attachment measure developed by Williams and Vaske (2003) (Max. score = 25; higher score means greater identification). Community attachment was assessed using 6-items adapted from the 'sense of community index' (Chavis et al., 1986; see also McMillan and Chavis, 1986; Lima and Castro, 2005) and a further 2-items; one of which was a more explicit measure of community attachment (i.e. *"I feel attached to my local community"*) and a second that assessed respondents' 'willingness to move' (i.e. *"I would be willing to move from my local community at any time"*) (see Vorkinn and Riese, 2001) (Max. score = 40; higher score means greater attachment). Environmental value scores were calculated in accordance with responses made to a shortened (i.e. 8-item) version of the New Environmental Paradigm (NEP) (see Dunlap et al., 2000) (Max. score = 40; higher scores mean greater endorsement of NEP) (see Appendix B for a more complete description of each scale).

Of these 3 items, both community attachment and NEP scores were retained as significant predictors of capacity estimates. Community attachment showed a negative relationship with capacity, such that the more attached respondents felt to their local community, the fewer turbines they would endorse. Conversely, the more readily respondents endorsed values compatible with the NEP (see Dunlap et al., 2000), the fewer wind turbines more turbines they would tend to endorse. Of the retained predictors, community attachment accounted for most unique variance in capacity estimates ($p < .001$).

Place identity was not retained as a significant predictor of capacity estimates. It is possible that the relative size and inclusiveness of the HHL region as a referent for place identity reduced the predictive strength of this item in this study (e.g., Devine-Wright, 2005).

*3.3.6. Regression 6: Demographics*

The final analysis established whether the demographic factors measured by the survey were predictive of capacity estimates. The items selected for inclusion were: (1) Age; (2) Gender; (3) Length of residency in sample region (*length of residency*); (4) Employment status; (5) Home-ownership (6) Past or current affiliation to the energy industry (*affiliation to industry*); (7) Belief in anthropogenic climate change (ACC); (8) Awareness of the scale of proposed development (*awareness of proposals*); and (9) Self-claimed knowledge about how wind power is used to generate electricity (*knowledge of wind power*);.

Of these 9 items, only age, *awareness of proposals* and *knowledge of wind power* were retained as significant predictors of capacity estimates. Age and *awareness of proposals* demonstrated a negative relationship with capacity estimates, such that the older people were and/or the greater awareness they had of the scale of proposed development, the fewer wind turbines they would tend to endorse. By contrast, *knowledge of wind power* shared a positive relationship with capacity estimates, such that those who claimed to know more about wind power had a tendency to endorse a greater number of turbines. Of the retained predictors, *awareness of proposals* and *knowledge of wind power* were found to account for most unique variance in capacity estimates (*ps* ≤.009).

*3.3.7. Final Model Generation*

The previous series of distinct regression analyses identified 15 key variables that were ostensibly making a significant unique contribution to respondents' capacity estimates. As a final step in the analysis we directly compared the impact of these 15 retained variables using stepwise regression.

**Table 7**

Stepwise regression examining the effect of retained items on capacity estimates.

| **Independent Variables** | ***ß*** | ***t*** | **Sig.** |
|---|---|---|---|
| 1. Concern over scale | - .25 | 4.99 | < .001 |
| 2. Suitability of region | .14 | 3.00 | = .003 |
| 3. General attitude | .13 | 2.56 | = .011 |
| 4. Fairness of prospecting | .12 | 2.75 | =.006 |
| 5. Community attachment | - .11 | 3.54 | < .001 |
| 6. Knowledge of wind power | .09 | 1.87 | =.004 |
| 7. Environmental values | .08 | 2.65 | = .008 |
| 8. Visual attractiveness | .10 | 2.25 | = .025 |
| 9. Desire to scale down | - .07 | 2.24 | = .026 |

*Method*: Stepwise. *ß*: standardised beta coefficient.

The stepwise regression produced a 9 factor model explaining 49% of the variance in capacity estimates, Adjusted $R^2 = .49$, $F\,(9, 563) = 61.22$, $p < .001$ (see Table X). The variables omitted from the regression model were *awareness of proposals* ($p = .331$), age (*p* = .749), *pride in involvement* (*p* = .733), *desire to expand* (*p* = .836) and attitudes towards the traditional coal (*p* = .132) and natural gas (*p* = .069).

A Principal Component Analysis (PCA) was then conducted to identify any broad themes amongst the 9 remaining variables. The PCA produced a simple two-factor solution comprising the following components:

**Component 1**

- **6 Variables:** Concern over scale (*Item 1*); Suitability of the region (*Item 2*); General attitude (*Item 3*); Fairness of prospecting (*Item 4*); Visual attractiveness (*Item 8*); and Desire to scale down (*Item 9*).
- **Variance explained:** 42.3%
- **Description:** Component comprising items relating specifically and directly to respondents' evaluation of aspects relating to the proposed regional wind-power development; notably centred upon issues of equity and fairness, perceived site suitability and the perceived visual attractiveness of wind turbines.

**Component 2**

- **3 Variables:** Community attachment (*Item 5*); Knowledge of wind power (*Item 6*); and Environmental values (*Item 7*).
- **Variance explained:** 13.1%
- **Description:** Component comprising more general affiliated issues not necessarily restricted to wind-power development in the local context (i.e., value, knowledge and attachment based items).

## 4. Discussion

Whilst at present wind-power development in the UK remains relatively meagre (see Toke et al., 2008); government's ambitious renewable targets (i.e., generating 31% of electricity from renewables by 2020), coupled with the technological maturity of wind turbines, is resulting in increased prospecting for suitable sites for onshore wind-power development in the UK. This level of 'wind-prospecting' will inevitably increase the likelihood that new projects will be proposed in the vicinity of other existing and/or proposed schemes, making the consideration of *cumulative effects* (e.g. Ross, 1998) evermore pertinent.

This research sought to address a clear gap in our knowledge about the relationships between people's attitudes towards wind turbines and the number of turbines that exist within the neighbourhood (see Ladenburg and Dahlgaard, 2011) by seeking to identify predictors of the scale of development that people would be willing to accept within their locale (in this case defined as the number of wind-turbines and referred to as *capacity estimates*).

### 4.1. Estimations of regional wind-turbine capacity estimates

The vast majority of respondents believed that some regional development would be acceptable (89.0%). The most popular choice was for a relatively moderate level of development (1-25 turbines), which is consistent with existing research suggesting that people are most favourable to small numbers or clusters of turbines (e.g., Ladenburg and Dahlgaard, 2011; Sustainable Energy Ireland, 2003; see also Devine-Wright, 2005). However, while most respondents favoured a moderate level of development, there was substantial variation in respondents' *capacity estimates* reflecting the considerable subjectivity that exists within this domain, and confirming that there is "…great diversity of opinion about when 'enough is enough', when a landscape is 'full up'" (Warren et al., 2005, p.870, citing Campbell, 2004).

**4.2. Identifying the predictors of regional wind-turbine capacity estimates**

Regression analyses uncovered 9 significant predictors of capacity estimates within this context, categorised under 2 general themes: (1) aspects apparently relating to wind-power development within the *local* context (including general attitude towards future regional development, perceived regional suitability and issues pertaining to fairness and equity); and (2) *general* affiliated issues (including self-rated knowledge about wind-power and respondents' environmental values and community attachment). The implications for each of these components will be discussed in turn.

*4.2.1. Component 1: Wind-power development in the local context.*

The results conclude that the less suitable people perceived the region to be for wind-power development, and the less fair and equitable they perceived the level of 'wind-prospecting' to be, the fewer wind turbines they would endorse.

*Regional Suitability:* Whilst it is not possible to entirely rule out selfish motives (i.e., NIMBYism) as part of the reason for the retention of perceived site-suitability as a predictor of capacity estimates (see, e.g., Hubbard, 2006); we would argue that the impressive biodiversity and recognised historical importance of the region (see Natural England, 2009a, 2009b) offer a suitable alternative explanation. In short, not only does the HHL region support the "largest extent of remnant raised mire in England" (Natural England, 2009a, p.103) but it is also home to a number of rare species of plant, animal and bird (including the Nightjar) (Natural England, 2009b). Thus, notwithstanding continuing debates about the utility of NIMBYism as an explanation for local opposition ( ), we would argue that within the current context the recognised historical and ecological importance of the local region, rather than selfish motives *per se*, led to the retention of perceived site-suitability as a predictor of capacity estimates. Such a conclusion would be consistent with Devine-Wright's (2009) conceptualisation of opposition to localised development as protective action resulting from a perceived threat to place and identity.

*Fairness and Equity:* The retention of factors such as: (1) 'general attitude towards future wind-power development in the sample region'; (2) 'concern over the scale of proposed development'; (3) 'a desire to down-scale regional involvement in electricity generation'; and (4) 'the perceived fairness over local wind-prospecting', pressed home the importance that respondents placed upon the issues of fairness and equity within this study.

Fairness and equity relate to the broader concept of *environmental justice*, which has been previously shown to relate to the likelihood that individuals will take action against proposed facilities, including wind-farms (e.g., Gross, 2007; Wolsink, 2007, see also Been, 1992, Brulle and Pellow, 2006; Bryant, 1995). Both sub-facets of environmental justice (i.e., *distributive justice* and *procedural justice*, see Gross, 2007; Kuehn, 2000) are likely to have been important within the present context.

The issue of *distributive justice* is clearly pertinent due to the sheer number and scale of the proposed schemes; while *procedural justice* is likely to be important due to the continuing tendency for wind developers in the UK to employ relatively autocratic top-down approaches to planning (i.e., *decide-announce-defend* planning strategies, see Walker, 2009).

Whilst some questions remain over the optimal means by which to engage in deliberations with host communities (see, e.g., Chilvers, 2009; Petts, 2003), a burgeoning literature now speaks to the many benefits yielded by participatory planning strategies, in part due to the increased perceptions of procedural fairness that come associated with such strategies (e.g., Devine-Wright, 2005; Gross, 2007; Jobert, et al., 2007; Lange and Hehl-Lange, 2005; McClaren-Loring, 2007; Toke et al., 2008; Walker and Devine-Wright, 2008; Warren and McFadyen, 2010; see also Inhaber, 1998; Beierle and Cayford, 2002). As such, the results or this study clearly support calls for more participatory planning strategies (e.g., *engage-deliberate-decide*, see Walker, 2009) in order to: (a) facilitate the likelihood and speed with which proposed schemes achieve planning success; and (b) perhaps also increase the scale of local development that host communities will be willing to accept.

*Visual attractiveness of turbines:* The retention of subjective evaluations of the attractiveness of wind turbines as a predictor of capacity estimates is perhaps unsurprising considering the noted importance of perceived visual intrusion in guiding attitudes towards wind-power development and intentions to oppose development (e.g., Devine-Wright, 2005; Jones and Eiser, 2010; Wolsink, 2000; 2007). It is also possible that this item was also retained in part due to the flat regional topography, where the levels of approved and anticipated development hold the potential to exert a large and conspicuous impact that will be difficult conceal and/or blend into the surrounding landscape (see Johansson and Laike, 2007).

*4.1.2. Component 2: Affiliated general issues*

The results of this study suggest that the less that people reasoned they knew about wind-power, the less ‘environmentally focussed’ they were (according to NEP scores), and the more attached to their community they felt, the fewer wind turbines they would be endorse in their local vicinity.

*Perceived knowledge of wind-power:* The results of this study apparently link knowledge about wind power to capacity estimates, thus ostensibly supporting the use of educational strategies (e.g. educational packages for local schools) as a means of fostering acceptance for local development. While not taking issue with the utility of education as part of a broader participatory planning approach (see above), it should not be assumed that such strategies will necessarily translate into the willingness to accept more turbines. Not only do interventions based upon a presumed ‘knowledge deficit’ have notable weaknesses (see, e.g., Bauer et al., 2007; Hagendijk, 2004; Irwin and Wynne, 1996) but there is also no guarantee that increased knowledge will always impact positively upon attitudes (e.g., Frewer et al., 1998). Further, and perhaps most importantly, it should be remembered that ‘knowledge’ within the current context was self-assessed and thus not necessarily reflective of absolute knowledge about turbines.

*Environmental values:* The results revealed a positive relationship between respondents’ NEP scores (Dunlap et al., 2000) and capacity estimates. That is, the more readily respondents endorsed statements consistent with an ecological worldview, the greater the level of local development they would endorse. It could be argued that this relationship between pro-ecological orientation and perceived capacity for wind-power development is logical; however, it should be noted that wind turbines do provide a test of people's pro-environmental beliefs.

Indeed, whilst at a general level investment in wind turbines could be viewed as symbolic of efforts to avert a major ecological catastrophe (i.e. climate change); at a local level the impacts that wind turbines have upon the landscape and ecology could be seen as less environmentally friendly (see, e.g., Peel and Lloyd, 2007; Toke and Strachan, 2006). This conflict between global benefit vs. local impact has resulted in what some have called a 'green-on-green' debate (e.g., Warren et al., 2005; although see Groothuis et al., 2008)

In some respects, the results of this study could be taken to illustrate a resolution of this 'green-on-green' debate. That is, respondents' capacity estimates could be seen as perhaps indicative of the point at which the perceived costs to the more immediate environment begin to outweigh the broader environmental benefits perceived to be associated with wind power. We feel that this is a suggestion that warrants further investigation within a more controlled experimental setting.

*Community attachment:* The results of the present research suggest that the more attached respondents' felt to their *community*, the fewer wind turbines they would be willing to accept (for more discussion of definitions of community, see, e.g., Kasarda and Janowitz, 1974; McMillan and Chavis, 1986; Scannell and Gifford, 2010). The retention of this factor is perhaps unsurprising considering role that community attachment has been identified as playing within several studies investigating how people respond to and evaluate local development, e.g., tourism initiatives (Simpson and Bretherton, 2009) and quarrying (Göncüolu-Eser et al., 2004).

The concept of community attachment is thought to relate to the broader concept of place attachment, defined as a "…multifaceted concept that characterizes the bonding between individuals and their important places" (Scannell and Gifford, 2010, p.1). When considered in these more general terms, and if conceptualising resistance to proposed development as a form of place-protective action fuelled by anticipated threat to the local physical and/or social environment (see Devine-Wright, 2009; see also Twigger-Ross and Uzzell, 1996; Twigger-Ross et al., 2003), it is perhaps easy to see why community attachment was retained as a predictor within this study.

In addition to adding support to calls for more considered community involvement in planning activity (see above), this finding would also suggest that efforts to work with communities to promote and adopt sustainable practices and 'green' identities (e.g. Hounsham, 2006) *could* help to encourage greater acceptance of local renewable energy initiatives.[1] Moreover, in contexts like the HHLs where attitudes towards wind development have the potential to be strongly influenced by identification with other

[1] This conclusion is tentative as it rests upon the assumptions that: (a) wind turbines are classified as environmentally beneficial; (b) that the global benefits presumed to follow construction outweigh the perceived costs to the local environment; and (c) that 'green' identities necessarily promote pro-environmental behaviour. None of these assumptions can be assumed (e.g., Etherington, 2009; Uzzell et al., 2002; Whitmarsh and O'Neill, 2010).

forms of power generation; we would argue that efforts to emphasise how proposed development will complement or augment, rather than threaten, these ongoing activities could prove beneficial by limiting the perceived threat to existing identities.

At a more general level, we feel that the retention of community attachment as a predictor of capacity estimates indicates that importance of not losing sight of the "symbolic, affective and socially constructed aspects" (Devine-Wright, 2005, p.126) of a proposed development(s), even when it is ostensibly appears that the physical attributes of such development(s) (e.g., the number of turbines or developments) are most pertinent to discussion and, hence, most likely to influence opinion.

**4.3. Implications**

In addition to emphasising the recognised broader need for participatory planning in the context of wind-power development, the research holds specific implications for current Environmental Impact Assessment (EIA) practice. In short, despite the recent (but overdue) publication of guidance notes on EIA for onshore wind-power development by the UK government (see Entec, 2008); the assessment of certain impacts, e.g., cumulative effects and in particular those relating to Cumulative Landscape and Visual Impacts (CLVIs), remains inadequate (for discussion of the historical inadequacies of cumulative effects assessment in the UK, see Piper, 2001, Cooper and Sheate, 2002).

CLVIs are described as "…changes to *landscape and visual amenity* caused by the proposed development in conjunction with other developments (associated with or separate to it) or actions that have occurred in the past, present or are likely to occur in the foreseeable future" (Landscape Institute/Institute of Environmental Management and Assessment, 2002, pp.85, *italics added*). Whilst some guidance on the assessment of CLVIs does exist (e.g. ETSU, 2000; Scottish Natural Heritage, 2005), at present this guidance remains rather limited (see Entec, 2008).

Part of the reason for the lack of adequate guidance on CLVI assessment in the context of wind-farm development relates to the diversity of factors that can give rise to such impacts. Not only must such assessment give consideration to the *scale* (e.g., number of turbines) and *coherence* (e.g., positioning of turbines) of a proposed wind-farm, but also consider how such a development will interact with existing and prospective development of both a similar and differing nature. Moreover, being as public assessments of visual impact are both subjective and highly context-dependent (e.g., Krohn and Damborg, 1999) there is no guarantee that the formal assessments reached by landscape professionals will match those reached by the public (i.e., where evaluations will be based upon less 'formative' assessments of impact).

Our results shed light upon some of the key subjective factors that are likely to influence public perceptions of CLVI (and perhaps other cumulative effects), in a context where such impacts are likely to be particularly contentious, i.e., a flat, principally agricultural landscape of historical and ecological importance; supporting conspicuous existing power generating infrastructure (although little wind-power development); and simultaneously subject to multiple wind-farm applications (from different developers and utilising different types and numbers of turbines). It is our hope that the findings of this study will help to improve current assessment practices regarding CLVI by highlighting factors other than those which are objectively quantifiable which might influence perceptions of such impacts.

**5. Conclusions**

Wind-power development is anticipated to be at the forefront of efforts to decarbonise electricity generation in the UK (e.g. DECC, 2008a; 2008b). This research used multiple regression analysis to identify and discuss predictors of the *scale* of development (in this case defined as the number of wind-turbines) that people would tolerate within part of the Humberhead Levels (HHL) region of the UK.

The results indicated that whilst the majority of respondents would accept *some* local development, upper 'capacity estimates' differed markedly. Prominent predictors of these estimates included general attitude, perceived knowledge of wind power, community attachment and environmental values; however, notably, many of the retained predictors related to issues of perceived fairness and equity. We feel that this adds further weight to calls for a shift towards more participatory forms of planning, not only to facilitate the deployment of specific projects, but also to potentially increase the scale of local development that is deemed acceptable (or will be tolerated) within a given context.

However, while we feel the results yielded by this survey confirm the importance of early, sustained and in-depth collaboration between developers and host-communities to order to reduce opposition to proposed development; we feel that further research is warranted into the manner in which such engagement can be optimised in situations where communities are simultaneously subject to a number of (competing) proposals from several different developers.

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**Footnotes**

[1] Only 26.6% of the respondents who had an affiliation to the energy industry stated that this affiliation was current. Some respondents shared affiliations with more than one energy sector, hence the larger total *N* for the breakdown of affiliation by sector.

[2] It should be noted that the 1-25 turbine option had the potential to incorporate the 2-turbine development at Loftsome Bridge and so endorsement of this option does not necessarily in itself reflect the desire for further development within the region.

## Appendices

### Appendix A: Sample settlements

The names of the 31 towns and villages within the sample region that were visited by the research team (listed in alphabetical order). To locate each settlement within the sample region, see Figure 3.

| | | |
|---|---|---|
| 1. Adlingfleet | 12. Eastoft | 23. Moorends |
| 2. Airmyn | 13. Fishlake | 24. Normanby |
| 3. Althorpe | 14. Flixborough | 25. Old Goole |
| 4. Amcotts | 15. Frodingham | 26. Rawcliffe |
| 5. Burton-upon-Stather | 16. Goole | 27. Thorne |
| 6. Carlton | 17. Gunness | 28. Snaith |
| 7. Crowle | 18. Hatfield | 29. Stainforth |
| 8. Drax | 19. Hook | 30. Swinefleet |
| 9. Dunscroft | 20. Howden | 31. West Cowick |
| 10. Ealand | 21. Keadby | |
| 11. East Cowick | 22. Luddington | |

**Appendix B: Place identity, community attachment and NEP scales**

*Place identity:* Measurement of respondents' identification with the sample region was achieved by adapting 5-items from the 6-item place attachment measure developed by Williams and Vaske (2003). Respondents were required to register their level of agreement with each of the following items (1 strongly agree; 2 agree; 3 neither agree nor disagree; 4 disagree; 5 strongly disagree):

a) I feel that the HHL region is part of who I am.

b) The HHL region is very special to me

c) I identify strongly with the HHL region

d) I am very attached to the HHL region

e) The HHL region means a lot to me

The sixth item from the Williams and Vaske (2003) inventory (i.e. "Visiting 'X' says a lot about who I am") was not adapted and used in this instance due to the fact that respondents were resident within the region of study. Due to the modified nature of the scale, a Cronbach's Alpha test was conducted to assess the internal consistency of the items. This test revealed that the modified scale had 'excellent' reliability ($\alpha$ = .951) (see George and Mallery, 2003).

*Community attachment:* Measurement of respondents' attachment to their community was achieved via the use of an 8-item scale, comprising 6-items (a-f) adapted from the 'sense of community index' (see Lima and Castro, 2005) and a further 2-items; one of which (g) was an explicit measure of attachment to the local community; and one (h) which assessed 'willingness to move' (see Vorkinn and Riese, 2001). Respondents were required to register their level of agreement with each of the following items (1 strongly agree; 2 agree; 3 neither agree nor disagree; 4 disagree; 5 strongly disagree):

a) I feel good in this community

b) In this community people get along with each other

c) I think that this community is a good place to live

d) Few of my neighbours recognise me (r)

e) I hope to live in this community a long time

f) I know most of the people in this community

g) I feel attached to my local community

h) I would be willing to move from my local community at any time (r)

(r) = reverse coded items

Due to the modified nature of the scale, a Cronbach's Alpha test was conducted to assess the internal consistency of the items. This test revealed that the modified scale had 'good' reliability ($\alpha = .876$) (see George and Mallery, 2003).

*New Ecological Paradigm:* Due to restrictions on space, a shortened version (i.e. 8-item) of the revised NEP scale (Dunlap et al., 2000) was preferred for use in this survey. Respondents were required to register their level of agreement with each of the following items (1 strongly agree; 2 mildly agree; 3 unsure; 4 mildly disagree; 5 strongly disagree):

a) We are approaching the limit of the number of people the earth can support

b) Humans have the right to modify the natural environment to suit their needs (r)

c) When humans interfere with nature it often produces disastrous consequences

d) Humans are severely abusing the planet

e) The so called “ecological crisis” facing humankind has been greatly exaggerated (r)

f) The earth is like a spaceship with very limited room and resources

g) The balance of nature is very delicate and easily upset

h) If things continue on their present course, we will soon experience a major ecological catastrophe.

(r) = reverse coded items

Due to the fact that we were using a shortened version of the NEP scale (which typically comprises 15-items) a reliability analysis (i.e. Cronbach’s alpha test) was conducted to check the internal consistency amongst the selected items. This test confirmed that the shortened scale had ‘acceptable’ reliability ($\alpha = .751$) (see George and Mallery, 2003).

[1] We conceive of frequency or capacity estimates as continuous constructs even though - in keeping with common practice in social psychological and survey research - we assess these constructs by means of rating scales consisting of discrete categories. It is also is common practice to treat measures derived from rating scales of the kind used here as interval scores, thus justifying the use of linear regression and other parametric techniques. We acknowledge that such assumptions of linearity may not always be fully met, and hence that any derived statistics may only be approximate. However, our interest here is in the relative, rather than absolute, strength of the different predictors and there is no reason to suppose that these would have been seriously distorted by the forms of analysis we employed