SURVEY OF THE VISUAL IMPACTS AND ACCEPTABILITY TO COUNCILLORS OF WIND FARMS IN BRITAIN

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The report of the project may be downloaded from the following website:
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Cover photo: Trysglwyn Wind farm, Angelsey, Wales

SURVEY OF THE VISUAL IMPACTS AND ACCEPTABILITY TO COUNCILLORS OF WIND FARMS IN BRITAIN

EXECUTIVE SUMMARY

KEY FINDINGS

- Compared with the English and Welsh, Scottish respondents gave the highest ratings of scenes without wind farms and the lowest ratings of scenes with wind farms.
- Of the English respondents, 63% found wind farms acceptable, but in Wales the figure was 49% and in Scotland, 34%. This suggests that the threshold of acceptability of wind farms has been passed in Scotland and is approaching it for Wales.
- The highest proportion opposed to wind farms was in north and south Scotland, both 55%, followed by south Wales, 50%, and north Wales, 43%.
- While 70% of local councillors and 61% of country councillors strongly supported wind farms, only 41% of staff were in favour.
- While 12% of local councillors and 7% of country councillors opposed wind farms, 31% of staff opposed them.
- While both local and county councillors generally found wind farms acceptable, many of staff rated the wind farms as very unacceptable; 33% of the staff found them very unacceptable compared with 11% of county councillors and 9% of local councillors.
- The respondent's attitudes towards wind farms, whether positive or negative, shaped their ratings of scenes with and without wind farms. Those opposed to wind farms rated scenes without them the highest and scenes with them, the lowest, a difference in ratings of nearly 6. Conversely for those in favour of wind farms, the difference in rating was only 0.6. This conclusively showed that attitudes affect ratings.
- Attitudes toward wind farms also shaped their acceptability by respondents, with those in favour finding most wind farms acceptable while those against them finding virtually all wind farms unacceptable.

INTRODUCTION

Wind farms have become a key renewable energy source of electricity in Britain with a large number of wind farms onshore and offshore. In 2018, wind power contributed 18% of the total electricity generation in United Kingdom compared with 14% for Europe.

A significant issue is their likely impact on the landscape – their visual impact. This has been the dominant objection to wind farm proposals.

The author has completed two previous studies of the visual impact of wind farms in Australia, and in 2019, the opportunity arose to carry out a similar project in the UK.

The objectives of the project were threefold:

1. To assess the attitudes of councillors and senior council staff in Britain regarding the visual impacts of wind farms and their acceptability;

2. To determine whether a threshold of acceptability can be derived from the survey;
3. To derive a predictive model of the visual impact of wind farms in Britain.

DIMENSIONS OF WIND FARMS IN BRITAIN

Global wind power has grown from 24 GW in 2001 to 591 GW in 2018. In Britain, there were 29 onshore wind farms in 2000, by 2019 there were 753. In 2018 wind energy provided 18% of UK electricity.

The size of wind turbine has grown from 50 m in total height in the 1980s to over 160 m now with older smaller structures being replaced by larger ones. Their generating capacity has grown accordingly, from 0.4 MW in the early 1990s to 3 MW+ in 2019.

In contrast to Australia where wind farms are large with dozens of turbines, wind farms in Britain tend to be small – 10 turbines or less is common, with only a few very large wind farms.

Since 2016, UK local government authorities have the power to consider and approve wind farms providing the site has been identified as suitable and the community impacts have been addressed.

The UK targets are 15% of energy from renewables by 2020, and 30% of electricity from renewables by 2020. It failed to achieve the first target but has achieved the second, with 39% electricity coming from renewables, including wind.

VISUAL IMPACTS OF WIND FARMS

A comprehensive country by country review of studies of the visual impacts of wind farms is provided.

Key findings were the following:

1. Of all the perceived impacts of wind farms, their visual impact dominates.
2. Following construction and operation, opposition tends to dwindle as the impacts are found to be not as severe as feared and residents become more positive about them.
3. The presence of existing wind farms can facilitate the acceptance of additional proposals.
4. Opposition declines with distance from turbines.
5. Wind farms should not be located in highly valued landscapes.
6. Early open involvement of the community with proposals and transparency and provision of information by the developer are pre-requisites for a successful outcome.
7. There is some evidence for nearby wind farms affecting property values.
8. Tourism appear to be largely unaffected by the presence of wind farms and indeed they can become an attraction in their own right.
9. Support outweighs the opposition by a large margin. Community support for renewable energy in general and wind farms in particular is very high, around 80%, with opposition very low.
10. Attitudes towards renewable energy and wind farms shape an individual's attitude towards particular wind farms.
11. Offshore locations are favoured over onshore sites.
12. People with a strong environmental ethic favour wind farms no matter what.
13. The community needs to have regard to the bigger picture of climate change and the need to reduce greenhouse emissions.

The author's 2003 and 2018 studies of the visual impacts of wind farms in the Australian landscape are summarised.

The concept of thresholds of visual impact is examined using the standardized mean difference formula.

ACQUIRING THE DATA

The location of wind farms in Britain was ascertained. With time for photography limited to two weeks, travel to photograph wind farms commenced on 31 March, and concluded on 12 April, 2019. The area covered was all of England, southern Scotland and Wales. Rain prevented most photography in Wales.

Photographs were spliced together to cover the extent of wind farms. Haze and distracting elements were removed from the scenes.

Survey scenes

The survey comprised 23 scenes with turbines and the same 23 scenes with the turbines removed, a total of 46 scenes. Of these, 2 were nearby, 10 middle distance and 11 farther distance. Around 65% of the wind farms contained 1 – 15 turbines, and there were four wind farms with more than 20 turbines. Nine each were on flat or undulating terrain, and 5 were on hills. Eleven of the scenes had thin or scattered cloud, and 6 had full sun and 6 had thick cloud. There were 18 scenes with turbines in full sun, and 5 where they were in shadow. The smaller wind farms tended to be nearby while the larger wind farms were at greater distances.

Participation in survey

Councillors in district and county councils, along with senior staff were selected as survey participants given Councils' authority to approve wind farms, their interest in public issues, their links with the community, and their willingness to give of their own time to the community.

England has 326 district councils; Scotland 32 and Wales 22. In England, 317 councils were surveyed, Scotland 27 and Wales 21. In addition, England has 26 county councils which were surveyed. Large cities including London were excluded from the survey. A total of 15.897 councillors were surveyed plus 539 senior staff; total 16,436. The survey commenced on 30 September and ended 58 days later on 26 November, 2019.

DATA ANALYSIS

Data management

The survey attracted 806 respondents which is 4.74% of the invitations sent out. The responses comprised 53% local councils, 22% county councils and 25% senior staff. Response from country councils were three times that of local councils and the highest response was from staff with 37% of all responses.

A total of 526 completed all 46 scenes and 23 failed to rate any. This left a net of 783 respondents which provided a confidence interval of 0.035, much better than the benchmark 0.05 level.

Strategic bias where the respondent attempts to use the survey for their own ends was assessed. Although 31 respondents rated all scenes without wind farms as 10 and 32 respondents rated all scenes with wind farms as 1, the effect on the overall mean, though statistically significant, was minimal, 0.14 – 0.17, and was ignored.

Histograms and QQ plots showed that the distributions exhibited normality. Sixteen of the scenes comprised 2 photos stitched together and 7 scenes comprised 4 – 5 photos, however the difference in rating these was not significant. The average time to complete the survey was 21.6 minutes (SD 9.6 min).

Demographic characteristics

A total of 59% of respondents were male and 41% female. Only 12% were younger than 45 years. Staff had a slightly younger profile than councillors. Both councillors and staff were well qualified, with 52% of county councillors, 59% of local councillors and 66% of senior staff holding bachelor or higher degrees. Less than 10% of respondents had no qualifications.

Some 755 respondents were UK-born (94%) with a further 20 from Europe and 30 from elsewhere.

Familiarity with wind farms

Two-thirds of respondents had seen many wind farms while one third had seen only a few. Staff and county councillors have seen many wind farms with local councillors a few less. Three respondents said they had never seen one! Sixty per cent did not live near a wind farm and a high 40% did live near one. Those living near a wind farm had seen many. For 52% of respondents, the wind farms were over 5 km distant and 19% were less than 2 km.

The majority of comments received concerned their visual impact and location of wind farms and support or opposition to renewable energy. Offshore locations were favoured over onshore.

Ratings

Ratings of scenes without wind farms averaged 7.08 and for scenes with them, 5.24, the difference being significant. Arranging the ratings in ascending order indicated that they converged at a rating of 3.43 which was considerably lower than the finding from the author's 2003 study of 5.10 or the 2018 study of 4.92. Below this rating of the scenes without wind farms, the presence of a wind farm actually enhances the scenic rating. The low rating of 3.43 suggests that the British find that wind farms in landscapes of quite low scenic quality reduce their quality yet further.

Compared with the English and Welsh, Scottish respondents gave the highest ratings of scenes without wind farms and the lowest ratings of scenes with wind farms (see Table).

Respondents	Without wf	With wf	Difference
England	7.07	5.61	1.45
Scotland	7.10	3.54	3.56
Wales	6.96	4.56	2.40

Attitudes towards wind farms

Less than 14% of respondents were opposed to wind farms, while 61% were in favour and a further 24% were equivocal – it depends. However, while 12% of local councillors and 7% of country councillors opposed wind farms, 31% of staff opposed them. Local councillors strongly supported wind farms with 70% in favour and 61% of country councillors were similarly supportive. However, only 41% of staff were in favour.

The strongest support was from respondents who had seen a few wind farms and the strongest opposition came from those who had seen many wind farms. The more educated the respondents were, the more likely they were to be in favour of wind farms and the less likely they were to be against them. The highest support for wind farms corresponded with the largest distance from the respondent's home.

Acceptability of wind farms

The number of acceptability ratings was nearly twice as many as unacceptability (see Table).

Acceptability	Mean	%
Very Acceptable	152.87	25.59
Acceptable	193.96	32.47
Neutral	74.91	12.54
Unacceptable	86.26	14.44
Very Unacceptable	89.30	14.95

While respondents from England were fairly relaxed about wind farms, with 63% finding them acceptable compared with 49% from Wales and 34% in Scotland, (Table). This suggests that the threshold of acceptability has been passed in Scotland and is approaching it for Wales.

%	England	Scotland	Wales
Very Acceptable	29	14	11
Acceptable	35	20	38
Neutral	13	11	16
Unacceptable	14	18	13
Very Unacceptable	10	37	22
Total	100	100	100

The acceptability ratings were analysed by 12 regions across Britain. The strongest support was in the South East region which has few wind farms, followed by the Yorkshire/Humber region, the South West region and the East of England region, all three of which have many wind farms. The highest proportion opposed to wind farms was north and south Scotland, both 55%, followed by south Wales, 50% and north Wales, 43%. Figures were presented in an Appendix for each postcode area.

While both local and county councillors generally found wind farms acceptable, the opposite applied to senior staff, many of whom rated the wind farms as very unacceptable (Table).

%	Staff	County Council	Local council
Very Acceptable	19.17	22.02	29.64
Acceptable	21.93	37.31	35.68
Neutral	11.82	15.43	11.91
Unacceptable	14.11	14.69	14.06
Very Unacceptable	32.96	10.55	8.72
Total	100	100	100

Generally, there were significant differences between the staff and councillors, particularly over the very unacceptable ratings. Respondents who were in favour of wind farms voted strongly for their acceptability whereas those against them voted them unacceptable.

Those who were against wind farms voted more strongly regarding their acceptability than those whose were in favour of them. Of respondents in England, Scotland and Wales who were in favour of wind farms, between 66% and 72% found them acceptable or very acceptable. However, respondents in the same countries who were against wind farms voted 91% to 96% unacceptable or very unacceptable, a far stronger condemnation of wind farms.

Attitudes toward wind farms also shaped their acceptability by respondents, with those in favour finding most wind farms acceptable while those against them finding virtually all wind farms unacceptable.

Factors affecting ratings

Factors which influence ratings comprised four environmental factors (weather, land form, land use, vegetation) and four wind farm related factors (turbine height, turbine numbers, distance, and sunlight or shade).

<u>Environmental factors</u>
WEATHER Scenes with scattered cloud achieved higher ratings than sunny scenes. Thick cloud did not have as large a depressing effect on ratings as expected. The presence of snow in the scene lifted ratings slightly.
LAND FORM All ratings increased with the hilliness of the terrain, the lowest ratings were for flat land.
LAND USE The highest ratings were for natural scenes followed by mixed cropping and grazing.
VEGETATION The vegetation generally comprised low trees or was quite barren. The absence of any trees lowered ratings the most.

<u>Wind farm factors</u>
NUMBER OF TURBINES Increasing the number of turbines slightly decreased ratings.
HEIGHT OF TURBINES Ratings increased slightly with greater actual height of turbines and the height as viewed in the field.
DISTANCE TO TURBINES Distance had virtually no influence on ratings.
SUNLIGHT OR SHADE Shaded turbines rated slightly lower than those in sunlight.

Regression analysis

Ratings of scenes without wind farms were influenced mainly by the land form, vegetation and land use. The presence of snow and the weather had only a minor influence. Ratings of scenes with wind farms were strongly influenced by environmental factors – land form, vegetation and weather with distance being the main wind farm factor. The number of turbines, their height and whether in sun or shade played very minor

roles. Excluding environmental factors, ratings of wind farm scenes were mainly determined by the distance to the wind farm and their visual height as seen in the field.

Threshold of visual impact

The Standardised Mean Difference was applied and found the majority of scenes created a large and adverse visual impact.

Visual impact predictive model

Applying the algorithms from the analysis of all scenes, a predictive model was derived to show the likely ratings of wind farms given knowledge of the existing scenic quality rating of the locality.

Project objectives

The objectives of the project were threefold:

1. To assess the attitudes of councillors and senior council staff in Britain regarding the visual impacts of wind farms and their acceptability;
2. To determine whether a threshold of acceptability can be derived from the survey;
3. To derive a predictive model of the visual impact of wind farms in Britain.

The first objective was fulfilled with nearly 800 councillors and staff from England, Scotland and Wales participating in the survey and providing information on their attitudes regarding the visual impact of wind farms and their acceptability.

The second objective was examined and data derived but more research is needed on the threshold of acceptability of wind farms.

The third objective, a predictive model, was achieved.

Strengths and weaknesses of the survey were identified.

Participant comments

Twenty-five per cent of respondents provided comments at the end of the survey (Table), the largest number being negative comments about wind farms.

Theme	N	%
Survey - positive	11	5.37
Survey - negative	24	11.71
Wind farms - positive	40	19.51
Wind farms - negative	76	37.07
General comments	54	26.34
Total	205	100

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DETAILED CONTENTS

CHAPTER 1 INTRODUCTION

Wind farms have become a key renewable energy source of electricity in Britain with a large number of wind farms onshore and offshore. In 2018, wind power contributed 18% of the total electricity generation in United Kingdom compared with 14% for Europe.

A significant issue associated with proposals is their likely impact on the landscape – their visual impact. This has been the basis of many of the objections to wind farm proposals.

Predicting the likely visual impact of wind farm projects has been based largely on simulations by landscape architects of the proposed placement and distribution of the turbines within a landscape and their professional judgement of the significance of their visual impact. Usually no effort is made to test their judgements against the community although some provide displays of the simulations and ask people to comment.

The author conducted research in South Australia of the likely visual impact of wind farms in 2003 at a time when there were very few in operation. The survey used hypothetical sites around the coast of South Australia and also inland sites. This survey found that the community opposed wind farms along the coast and also in high quality landscapes away from the coast. However, for lesser quality inland landscapes, generally flat and treeless, the wind farm added interest and diversity into an otherwise mediocre landscape. In these situations, the presence of the wind farm actually enhanced the perceived scenic quality of the landscape.

In 2018, the author carried out a further survey in Australia to ascertain contemporary opinions of wind farms. Whereas the previous study was confined to South Australia, this survey covered wind farms in New South Wales and Victoria as well as South Australia. And whereas the previous study used hypothetical sites, the 2018 study mainly used photos of actual wind farms. And finally, whereas the previous study used participants only from South Australia, this study was extended Australia-wide, with participants from all States and Territories.

In 2019, the opportunity arose to visit the UK and to carry out a similar project there of the acceptability of wind farms.

The objectives of the project were threefold:

4. To assess the attitudes of councillors and senior council staff in Britain regarding the visual impacts of wind farms and their acceptability;
5. To derive a predictive model of the visual impact of wind farms in Britain;
6. To determine whether a threshold of acceptability can be derived from the survey.

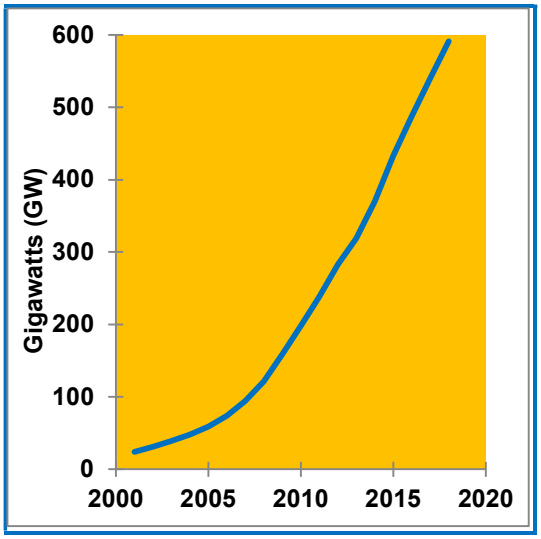
This report of the project commences by examining the growth of wind farms in the UK and their visual impact. It then describes how the project was undertaken and data acquired. The analysis of the data follows, followed by a short conclusions chapter. Appendices show the scenes and their ratings, the Internet survey, the acceptability of wind farms by postcode area, and the comments received on various questions posed by the survey.

Wind farm near Ashington, NE England

CHAPTER 2 DIMENSIONS OF WIND FARMS IN BRITAIN

2.1 GLOBAL GROWTH IN WIND FARMS

In 2018 new global wind turbines totaling 51 GW (gigawatts) were installed, bringing total global installed capacity to nearly 591 GW (Global Wind Energy Council, 2019). Wind energy has grown enormously since 2001 at which time only 24 GW had been installed (Figure 2.1).

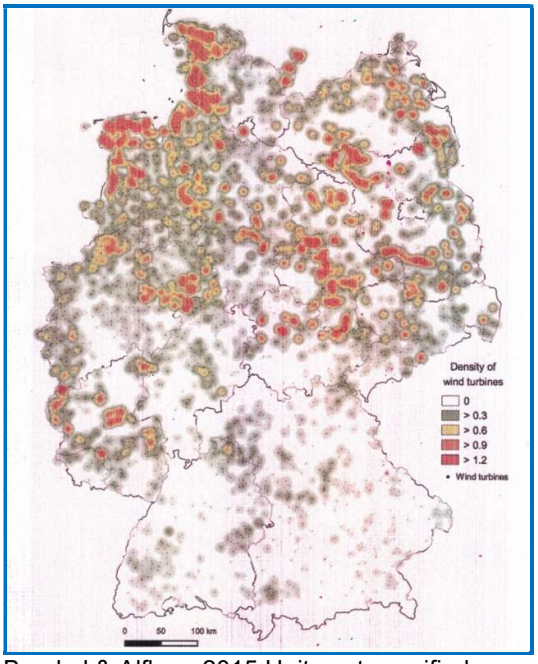


Dimensions Global Wind Energy Council, 2019

Figure 2.1 Global wind energy growth

The greatest growth in wind farms is in China with 21 GW installed in 2018. Since 2006, China's Renewable Energy Law has required power grid operators to purchase a full amount of wind power generated by registered producers (Saidur *et al*, 2010).

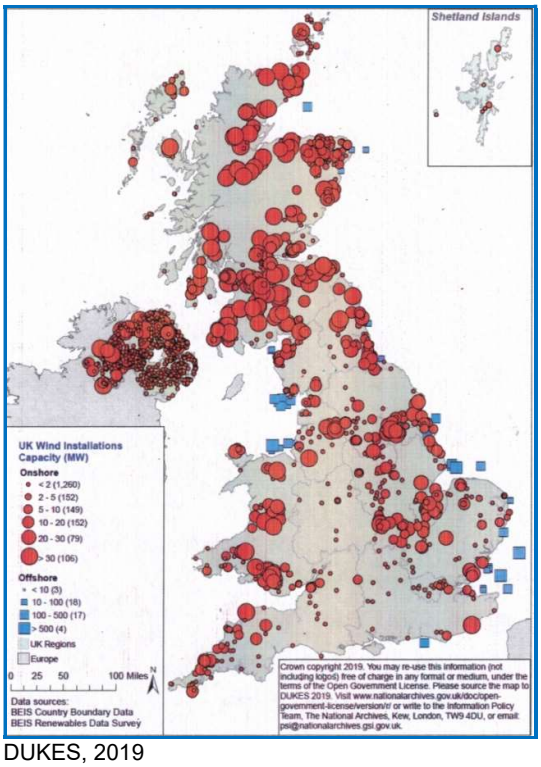
Figure 2.2 shows the dense distribution of wind farms in Germany where wind energy provides a quarter of the country's total electricity compared with 9.3% in 2010. In 2016, there were 27,270 wind turbines onshore. Many thousands of Germans have invested in citizen wind farms and hundreds of companies operate in the sector.



Broekel & Alfken, 2015 Units not specified.

Figure 2.2 Density of wind farms in Germany, 2012

2.2 BRITISH WIND FARMS

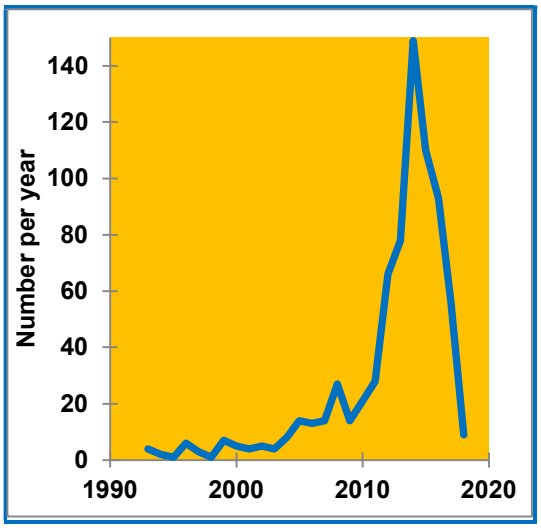


DUKES, 2019

Figure 2.3 UK onshore & offshore wind locations, 2019

In Britain[1] in 2000 there were 29 onshore wind farms, by 2019 there were 743 wind farms (RenewableUK, Figures 2.3, 2.4 & 2.5). Onshore wind farms peaked in 2014 with 149 installed and has dropped significantly the following years. According to WindEurope (2019):

> "The UK experienced a significant decrease in onshore wind installations. The end of the Renewable Obligation Certificate (ROC) caused a peak in 2017 and onshore wind installations will now have to rely on Power Purchase Agreements (PPAs) and other merchant options, as the UK government has given clear signals that there will be no auctions for onshore wind."



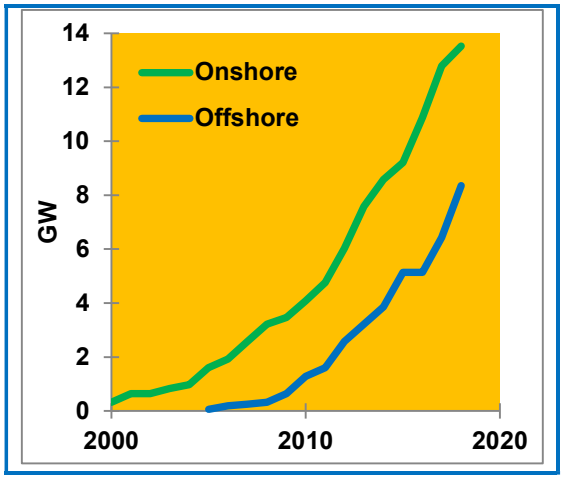
Dimensions RenewableUK

Figure 2.4 Growth of onshore wind farms in Britain

By 2020, there were 10,374 turbines, 8,358 onshore and 2016 offshore (RenewableUK). These generate 22 GW, comprising 13.5 GW onshore and 8.48 GW offshore.

The 2009 Renewable Energy Directive (RED) has a target for the UK to obtain 15 per cent of its energy from renewable sources by 2020 (DUKES, 2019). In 2018, wind energy provided 18% of the UK's electricity, compared with 14% for the EU (Wind Europe, 2019).

It is the rapidity of the change over a single decade or so by such a significant visual element in the landscape that is a major reason for the antagonism they have generated in some areas.



Dimensions DUKES 2019.Statistica.com.

Figure 2.5 Growth of UK wind energy, 2000 - 2018

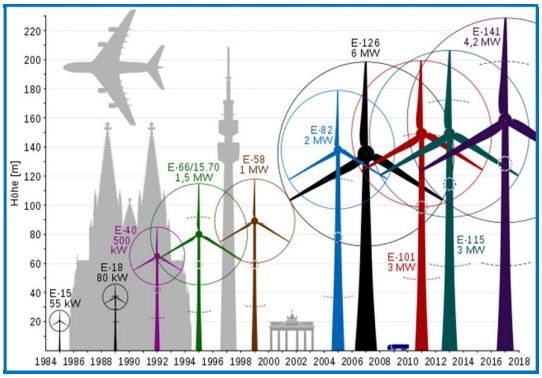
Offshore wind farms have expanded greatly, driven in part by the opposition to onshore wind farms. Currently, they are mainly located in the seas off Europe – North Sea, Baltic Sea, Irish Sea and the English Channel, but offshore developments have also commenced off China, Japan, South Korea, Taiwan and the US. In Europe, the strategy is to "*site the turbines out to sea, out of sight and out of mind*" (Babbage 2010). The largest onshore turbines now generate 3.6 MW while offshore turbines are much larger, 7.7 MW (Wind Europe, 2019). The largest turbine in the world is 8.8 MW with a rotor diameter of 164 m.

2.3 SIZE OF WIND TURBINES

An additional factor in the visual impact of wind turbines is the growth in their size (Figure 2.6). During the 1980's, wind turbines were less than 50 m in height to the top of the hub with 10 – 15 m blades. By 2018, turbine hubs had grown to 160 m with 70 m blades. These are very sizeable structures in the landscape, far larger than electricity transmission towers. Old 60 m turbines are being replaced by 150 m high

1. Britain refers to England, Wales & Scotland. The United Kingdom adds Northern Ireland.

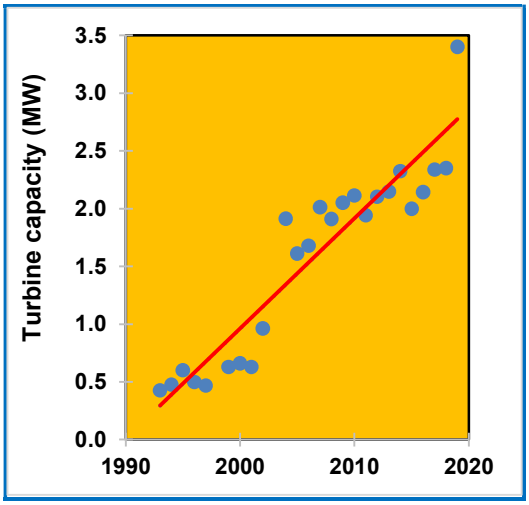
turbines in a process called repowering which has also drawn flack.



Enercon

Figure 2.6 Growth of wind turbine size

Figure 2.7 illustrates the increasing generating capacity of turbines over the past three decades, from 0.4 MW in the early 1990s to over 3 MW in 2019. The trend line indicates that the generating capacity is increasing by nearly 0.1 MW per year and 1 MW in a decade. The latest turbines are 4 MW in size. A 1.5 MW turbine has fifty times the output of a 1980 turbine.

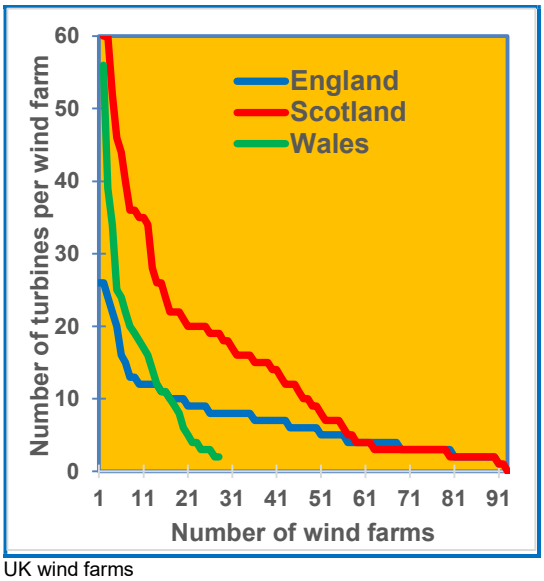


Renewables UK list.

Trend line: y = 0.095x- 189.75, R^2 = 0.88

Figure 2.7 Increasing generating capacity of wind turbines, 1993 - 2019

Figure 2.8 shows the number of turbines per wind farm for England, Scotland and Wales. In contrast to Australia where wind farms are large with dozens of turbines, most of the wind farms in England are relatively small with 71 of the 92 wind farms (77%) having less than 10 turbines. In Wales, 11 of its 31 wind farms (35%) have less than 10 turbines. In Scotland, 44 of its 92 wind farms (47%) have less than 10 turbines. There are only a few very large wind farms: Whitelee wind farm in Scotland with 215 turbines and Llandinam in Wales with 103 turbines.



UK wind farms

Note: Plus Whitelee wind farm, Scotland 215 turbines & Llandinam, Wales 103 turbines.

Figure 2.8 Size of wind farms, England, Scotland & Wales

2.4 ROLE OF UK LOCAL GOVERNMENT IN ASSESSING WIND ENERGY APPLICATIONS

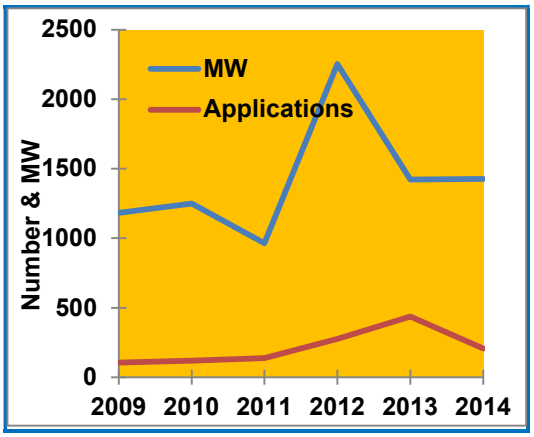
Up to 2016, local authorities in the UK handled wind farm applications under 50 MW and the Secretary of State dealt with larger proposals in which instance, Councils provided a recommendation. With the Energy Act, 2016, all decisions were given to local authorities. However, they should only grant planning permission if:

- The development site is in an area identified as suitable for wind energy development in a local or neighbour-hood plan; and
- Following consultation, it can be demonstrated that the planning

impacts identified by affected local communities have been fully addressed and the proposal has their backing.

The judgement of whether the local community backs the proposal is a planning judgement by the planning authority. The measures do not provide a veto of proposals; all have to be considered on their merits. However, Cowell & Devine-Wright (2018) consider that it provides local communities with a veto to stop wind farms. The industry body, RenewableUK, was unaware of any council who had identified suitable areas for wind farms. The Planning Officers Society suggested that it would be politically contentious to identify sites for wind energy in the local plan.

Planning practice guidance was provided in 2014 which made clear that proposals cannot override the environmental concerns of communities, particularly landscape and visual impact issues. The National Planning Policy Framework (NPPF) directs local authorities to prepare local plans containing policies relating to renewable energy.

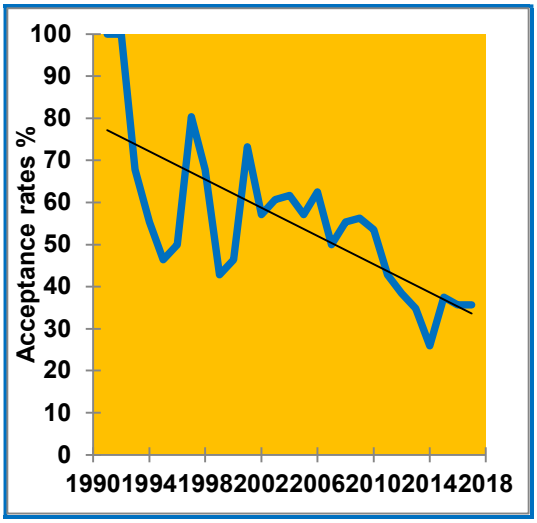


Dimensions
2014 extrapolated from Jan – May figures.

Figure 2.9 Approved wind farm applications, 2009 – 14

In response a question in the House of Lords, figures were provided on 22 July, 2014 on the number of wind farm applications that had been approved or refused over the previous five years. Figure 2.9 summarises the number of applications.

According to DECC, 52% of onshore wind farm applications have been refused permission or have been abandoned by the developer, compared with 25% refusal of solar photovoltaic systems and 11% for offshore wind. This figure is the highest for any form of renewable energy in the UK. Figure 2.10 shows the steady decrease in the acceptance rate of onshore wind farms in Britain. Over the period 1991 to 2017 approvals of onshore wind farms averaged only 44%, the lowest of any renewable energy technology (Harper *et al*, 2019). The size of the project, local demographics and proximity to existing wind farms were key factors influencing approval of new projects (ibid).



Dimensions Harper *et al*, 2019
Trend line: y = -1.67x + 3409, R^2 = 0.54

Figure 2.10 Wind farm acceptance rate, 1991 - 2017

Roddis *et al* (2018) reported that between 1990 and 2017, 27 years, 756 wind farms were approved in Britain and 586 refused and provided maps of their locations.

2.5 RENEWABLE ENERGY TARGETS

The UK adopted the EU target of 15% of energy consumed should come from renewables by 2020. However, it appears that it will fall short of this target. It also has a target of generating 30% of its

electricity from renewable energy sources by 2020, a target which has been achieved (www.technology.org). By October, 2019, 39% of UK's electricity was from renewable sources including 20% from wind, 12% bioenergy and 6% solar (Guardian).

In mid-2019, the UK set the target of achieving zero greenhouse gas emissions by 2050 and has already achieved a 42% reduction (www.gov.uk).

The European Union (EU) has a renewable energy target of 20% renewables target by 2020. This is followed by a more ambitious target of 32% renewable energy by 2030 (Wikipedia). Germany is aiming for 40-45% from renewables by 2025 but has already achieved 47%.

CHAPTER 3 VISUAL IMPACTS OF WIND FARMS

3.1 NATIONAL PERSPECTIVES OF VISUAL IMPACT

United Kingdom

Perhaps no development has raised more concerns regarding their visual impact as wind farms. The construction of their massive scale across the countryside has galvanised criticism and opposition, particularly in the United Kingdom, Europe, United States and Australia. The English experience is particularly interesting given the English love of their countryside:

> *More than their poets, their art, or their architecture, the English love their landscape and woe betide any who would threaten it. This protectionist attitude has brought wind development in England nearly to a standstill* (Short, 2002).

The Economist (1994) described wind farms as a "*new way to rape the countryside"* and Sir Bernard Ingham described a wind farm in Yorkshire as "*lavatory brushes in the air"* (Pasqualetti, 2002). Ann West, vice Chair of Country Guardian, described them as "*industrial-size blots on the landscape"* (West, 2004). At the same time, there are many in the community who appreciate the significant contribution wind farms make to renewable energy.

Wind farm on England's south downs

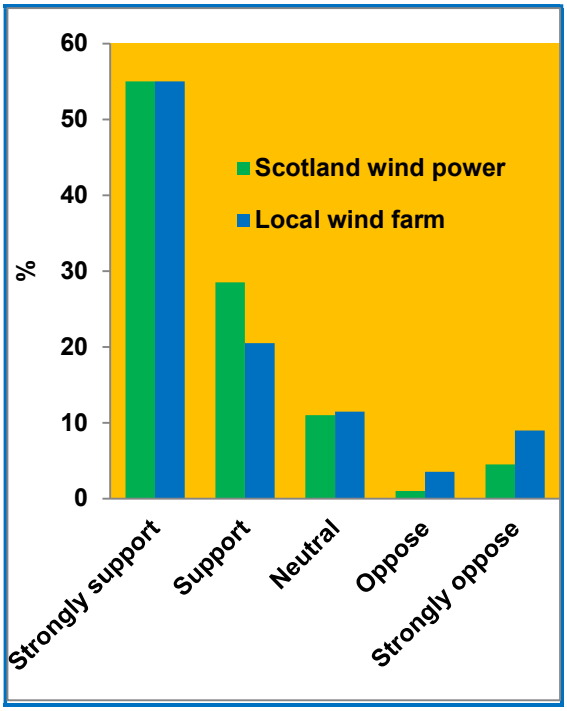
Warren *et al* (2005) contends that the visual impact of wind farms on valued landscapes is the key motivation of opposition which is exacerbated by many wind farms being in scenically attractive upland areas where the wind is strongest. Warren synthesised the primary arguments used by opponents of wind farms:

- Landscape impacts from construction, turbines, access roads and new power transmission lines; possible planning blight;
- Adverse effects on tourism through loss of scenic value;
- Impacts on fauna and flora, especially through bird strikes on turbines;
- Noise pollution and vibration during construction and operation, including infrasound;
- Intermittent electricity generation (weather-dependent): results in low output, requiring extra capacity, plus back up from conventional power stations (fossil fuel, nuclear);
- Insignificant power contribution: could only generate a small percentage of society's needs;
- Few local socio-economic benefits: limited job-creation, and few local benefits;
- Military objections: windfarms opposed by Ministry of Defense in low-fly training zones (collision potential) and close to air-defense radar facilities due to interference problems;
- Inappropriate policy for emissions reduction: better to focus on reducing energy use, e.g. energy efficiency measures; reducing road and air traffic;
- Better to promote other, less visually intrusive renewable technologies, e.g. underwater tidal turbines;
- Indirect emissions: once operational, windfarms produce clean energy, but the production, transport and installation of turbines produce emissions.

The most influential objectors to wind power developments in the UK according

to Warren are local authority planning departments, conservationists and the Ministry of Defense.

Warren surveyed residents near two wind farms (one operating, one proposed) in the Scottish Borders and compared their attitude towards wind energy in principle with their attitude to the local wind farms (Figure 3.1).



Dimensions Warren *et al*, 2005

Figure 3.1 Attitudes to wind power and local wind farms

Residents were overwhelmingly positive about wind energy in principle. With one of the wind farms operating and the other proposed, the survey found that for 65% of respondents their attitudes were unchanged pre and post construction. Of the 24% who changed their attitude, all but one became more positive. Residents found the wind "not unattractive" and noise was non-existent. Warren found: "the actual impacts had been far less than expected. People's fears had not been realized, especially concerning noise." They also found the results indicate that aesthetic perceptions, both positive and negative, are "the strongest single influence on public attitudes".

Warren concluded that although the vast majority of people, including those who live near wind farms are positive about them, that this:

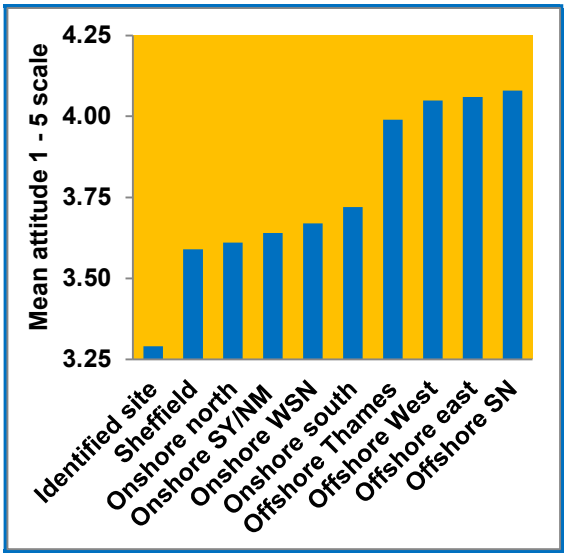
> "stands in marked contrast with the impression conveyed in much media coverage, which typically portrays massive grassroots opposition to windfarms. The press, it seems, gives disproportionate emphasis to the vocal minority that opposes wind power while ignoring the silent, contented (and less newsworthy) majority."

Wind turbines along Liverpool docks. Wind farms can be located in industrial areas.

In a study near Sheffield, Jones & Eiser (2010) examined respondent's attitudes to wind farm development at a number of sites around England, Wales, Scotland and Northern Ireland, including offshore sites. The survey assessed how the attitudes changed with the perceived distance from the proposed developments – i.e. the size of the backyard. All onshore locations away from Sheffield were preferred over the local sites, and offshore localities were preferred over onshore sites. Figure 3.2 shows the mean attitudes at each location. Support grows strongest with distance from Sheffield and for offshore locations. Interestingly, the most favoured onshore location was the south of England where the highest population density is found.

Jones & Eiser found concern that the development would spoil the landscape was *"a particularly strong predictor of attitudes*" followed by lowering of house prices and construction impacts. A development that is 'out of sight' will

generally be acceptable. The author's concluded that the extent of a person's backyard was defined by the extent that the development was likely to be seen.



Dimensions Jones & Eiser, 2010,
Scale: 1 Oppose 5 Support
SY/NM = South Yorkshire / North Midlands
WSN = Wales, Scotland, Nth Ireland
SN = coast of Scotland & Nth Ireland

Figure 3.2 Attitudes to wind developments

From case studies in England, Wales and Denmark, Loring (2007) found that high levels of participatory planning were fundamental to the societal acceptance of wind farm proposals. In addition, stable networks of individuals and organisations were more likely to form and assist project acceptance.

In a survey in the Scottish Highlands and Islands, Survation (2014) found strong support for special protection of the wildlands from large scale wind farms – 49% support and 22% opposition (plus 22% neutral & 8% don't know).

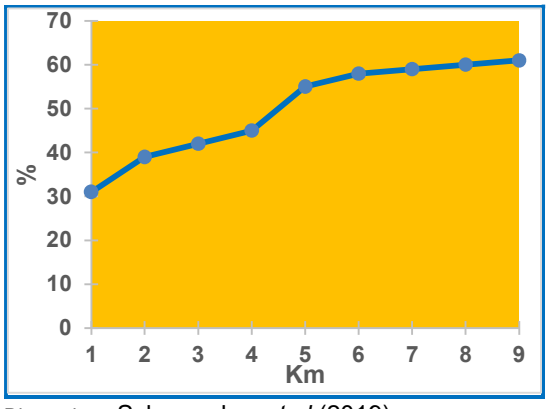
Germany

Landscape publications in Germany have described the destruction of scenic beauty as a "*catastrophe*" and "*the beauty of our landscape is in danger*" (Hoppe-Kilpper & Steinhäuser, 2002). Even tourist areas have been targeted for wind farms including the Moselle Valley, the Allgäu, Lake Constance and the foothills of the Alps. The German Association for Landscape Protection generally opposes wind farms. Over 700 citizens' initiatives have been founded in Germany to campaign against what they describe as "*forests of masts*", "*visual emissions*" and the "*widespread devastation of our highland summits*" (Schulz, 2013).

German wind farm near Wurzburg

Meyerhoff *et al* (2010) used choice modelling to assess the social acceptability of various wind farm options with local communities in Germany and found negative landscape externalities would result.

In a survey of residents in the Upper Rhine Region of France, Germany and Switzerland, Schumacher *et al* (2019) found that public acceptance of renewable technologies, including wind farms, is very dependent on the technology in question, the dimensions of social acceptance, and previous experience with such technologies.



Dimensions Schumacher *et al* (2019)

Figure 3.3 Desired minimum distance to wind farms

Respondents were asked whether wind farms along with other renewable technologies should keep a minimal distance from their homes and Figure 3.3 shows the cumulative frequencies, indicating that 50% wanted them 4 to 5 km away. They also found that the distances are significantly smaller if respondents already had a plant in their vicinity.

France

A French survey (Enevoldsen & Sovacool, 2016) surveyed "elite stakeholders" (e.g. mayors) and site factors and project management factors as contributing to social acceptance of wind farms. There are more than 1,500 wind farms in France. Site factors are their visual impact, pre-use of place, ownership and contribution to the local economy. Project management factors were ownership of wind project, information level, local supportive network and involvement of local contractors.

In five case studies in France and Germany, Jobert *et al* (2007) analysed their site and project management factors and found that the local integration of the developer, creation of a network of support, and access to ownership of the wind park were important for acceptance.

Nadaï & Labussière (2015) explored the complexities involved in planning for wind farms in the region around Chartres Cathedral.

Holland

As part of their investigation of the visual impact of developments on the Dutch landscape, De Vries *et al*, (2012) included wind farms. They examined the mitigating influence of distance to the turbines, their height and their configuration (Table 3.1).

Turbines at 500 m distance reduced ratings from 5.91 to 3.77 (7 - point scale), a reduction of 36%. When the turbines were viewed at 2000 m distance, this fell to 4.42, a 25% reduction. Distance thus had a slight influence. Increasing the height of turbines increased their visual impact, but whether the turbines were in a cluster or in linear configuration did not make much difference.

Table 3.1 Percentage reduction in ratings due to mitigating components for wind farms

Distance to turbines	500 m	1500 m	2000 m
% reduction in ratings	36.29%	28.12%	25.21%
Height of turbines	80 m	120 m	
% reduction in ratings	25.15%	33.16%	
Configuration	Cluster	Linear	
% reduction in ratings	30.89%	32.85%	

De Vries *et al*, 2012.
Ratings without these components: distance 5.91, height 5.80, configuration 6.15.

Greece

A study in Greece (Kaldellis, 2005) found that while there was strong support for wind farms on the islands, the opposite applied on the mainland. On the islands, 80 – 90% supported existing wind farms, while on the mainland there was only 15 – 40% support. The study pointed to a minority of around 15% who were strongly opposed to new wind farms regardless of their benefits.

On the Aegean island of Skyros, Skanavis & Kounani (2018) examined how community opposition to, and postponement of a giant wind farm proposal (111 turbines of 3 MW each) could be changed through local ownership. Asked if they were positive about the installation of wind turbines in their region, 55% disagree but 85% agreed with the idea to change from large wind farms to small scale wind farms. A further 95% agreed with such a proposal owned by Islanders instead of large companies. How realistic this option is was not examined by the paper – it is worth noting however, that in an earlier question to respondents of the most serious problems facing the world, by far the most dominant response was poverty which could reflect the Islander's own circumstances.

Poland

In a country-wide survey in Poland, Bożena & Kurpas (2014) found 85.5% of the respondents favoured wind energy as a form of renewable energy with 83% agreeing that it had favourable health benefits through reducing air pollution from alternative energy sources.

Czech Republic

In the Czech Republic, Molnarova *et al* (2012) reported from a survey that for the most attractive landscapes, only 1% regarded the addition of a wind turbine as a positive improvement whereas 35% regarded it negatively. In the least attractive landscapes, 8% regarded a wind turbine as a significant improvement.

They also found that the only characteristic of respondents which influenced their responses was their attitude to wind power – those who regarded it negatively considered landscapes with wind farms significantly less attractive, mean 1.69. By comparison, the mean for those who accepted wind power conditionally was 2.33, while the mean for supporters of wind power was 2.8. Their attitude influenced their assessment of the visual impact of wind turbines. The authors concluded that the quality of the landscape is an important factor in the public acceptance of wind farms.

Norway

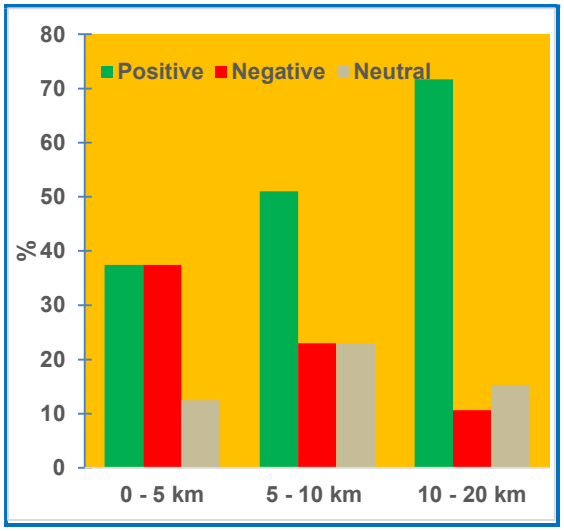
In Norway, Rygg (2012) interviewed stakeholders in 13 wind power parks. Landscape impacts and noise were the most common arguments against them while the opportunity for employment, new industry and economic benefits were the most common arguments in favour. Modernization was also seen as a benefit. In contrast to many studies where the benefits are seen as global in terms of climate change, in this study the benefits were essentially local.

Sweden

In a study in Sweden, Ek (2005) found support for wind power decreased with age and income of respondents. Environmentalists were the most positive. A survey of over 500 respondents in 2002 found 64% were positive, 10% negative and a surprisingly large 23% who were neither positive nor negative.

United States

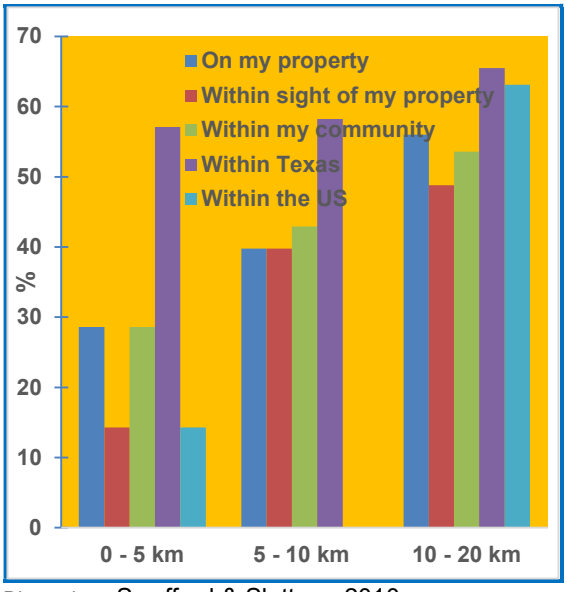
In Texas which has the most wind farms of any US State, Swofford & Slattery (2010) found 57% were supportive of wind energy and 21% were negative. 47% said that wind farms were an unattractive feature in the landscape. When driving, 90% saw wind farms. Figure 3.4 shows their attitudes to wind farms based on their distance from home - support increases dramatically with greater distance.



Dimensions Swofford & Slattery, 2010

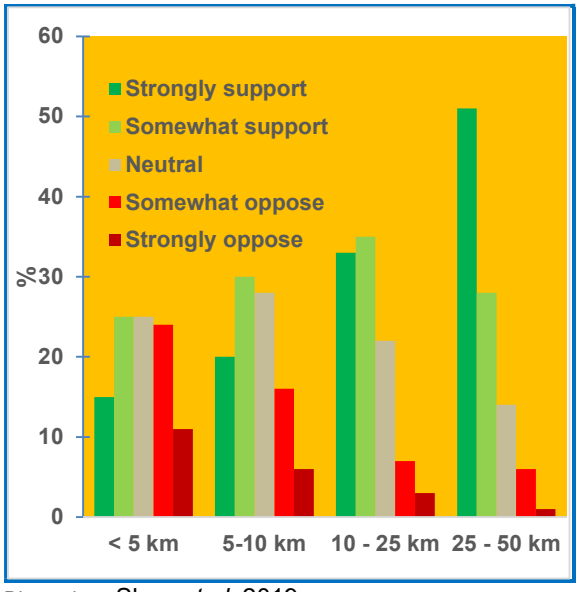
Figure 3.4 Attitudes to wind farms in Texas

A follow-up question by Swofford & Slattery asked where would respondents support a wind farm and a surprisingly high percentage, 29%, said within their property (Figure 3.5). The highest percentages were for Texas and the US.



Dimensions Swofford & Slattery, 2010

Figure 3.5 Where Texans would support wind farms



Dimensions Shen *et al,* 2019

Figure 3.6 Respondent reaction to the distance of wind turbines from home

South Africa

Lombard & Ferreira (2014) found that while there was high support for wind farms in South Africa, that this support decreased as the projects moved closer to their homes. Nevertheless, there was 60% support for wind farms in or close to their towns.

Japan

From a survey of residents in Japan near an existing wind farm, Motosu & Maruyama (2016) found a high level of acceptance of it but 54% disapproved of a new wind farm. They found that residents preferred to be silent regarding their opinions and that participation efforts needed to be intensified to gain them.

China

In China, Shen *et al* (2019) assessed the reaction of householders to wind turbines at varying distances from their home (Figure 3.6). Support for turbines increased with their distance from home, and conversely, opposition fell with greater distance.

3.2 PERCEPTIONS OF WIND FARMS

Attitudes

The Netherlands researcher, Maarten Wolsink, has extensively researched attitudes to wind energy. Wolsink (1989) found that perceptions about wind farms comprised four distinct attitudes:

- A general attitude expressing support or opposition to wind energy;
- An attitude towards energy policy stimulating wind energy development and regulation of turbine siting;
- An attitude to wind energy specifically concerned with its proximity to the built environment;
- An attitude towards the size of turbine development, contrasting scattered single turbines versus concentrated wind farms.

He argued for the "*multidimensionality of wind farm perception".* Attitudes towards wind farms are clearly a significant factor. In 2007, Wolsink wrote:

> *Regarding community acceptance of wind power schemes, the visual evaluation of the impact of wind power on the values of the landscape is by far the most dominant factor in explaining*

opposition or support. Type of landscape fully overshadows other attitudinal attributes, as well as other visual and scenic factors such as the design of wind turbines and wind farms, and the number and size of turbines.

Mimicking President Clinton's motto, "*It's the economy, stupid!,"* Wolsink coined: "*It's the landscape, stupid!"*

Breukers & Wolsink (2007) found the impact on the local landscape was central to local opposition. In contrast, from a survey of residents in coastal Michigan, Bidwell (2013) found that support depended on a belief that the wind farm would provide economic benefits to the community.

NIMBY

Devine-Wright (2005) examined NIMBYism (not in my back yard) opposition to wind farms and based on an extensive review of the literature identified six strands:

1. Public support for switching from conventional energy sources to wind energy;
2. Aspects of turbines associated with negative perceptions;
3. Impact of physical proximity to turbines;
4. Acceptance over time of wind farms;
5. NIMBYism as an explanation for negative perceptions;
6. Impact of local involvement on perceptions.

He found the research was fragmented and "*failed to adequately explain, rather than merely describe, perceptual processes."*

Graham *et al* (2009) added further factors which stemmed from their research in New Zealand. Table 3.2 summarises *the "physical, contextual, political, socio-economic, social, local and personal aspects and reflect the complex, multi-dimensional nature of forces shaping public perception"* of wind farms.

Table 3.2 Summary of factors affecting public perceptions of wind farms

Category	Aspect
Physical	Turbine size, colour, acoustics
	Wind farm size & shape
	Cumulative effects of neighbouring projects
Contextual	Proximity to turbines
	Landscape context
	Proximity to important features
Political & Institutional	Energy policy support
	Political self-efficacy
	Institutional capacity
	Public participation & consultation
	Attitude toward wind power in general
	National good / security of supply
Socio-economic	Shareholding
	Economic effect – property values
	Social impact
Social & communicative	Social influence process (media, social networks, trust)
Symbolic & ideological	Representations of wind turbines
Local	Place & identity processes
	Local & community benefit & control
	NIMBYism
	Local construction impacts
Personal	Previous experience & knowledge
Environmental	Local environment

Devine-Wright, 2005; Graham *et al*, 2009

Early wind turbines at Tehachapi Pass near Los Angeles, California

Graham found that the most important negative factor was landscape. They noted that this was consistent with Wolsink (2007) and Ellis *et al* (2007) who:

> "separately concluded that the impact of wind farms on landscape values is the main determining factor in explaining opposition or support."

Opposition to outsiders

In Australia, Hindmarsh (2010) surveyed eleven "landscape guardian" groups and their primary concerns, in order (by the number of groups) were: noise, spoilt sense of place, property values, and visual amenity. Spoiling the sense of place referred *to "outsiders", "environmental identity"* and "*destruction of our way of life."* "*Outsiders"* were regarded as profit driven and therefore they failed *to "objectively assess wind farm impacts on the landscape and community."* They objected to sacrificing their local landscape for external electricity users. Hindmarsh found the extent of community engagement in wind farm planning to be inadequate in Australia. He suggested:

> *A more promising approach is the collaborative approach, which can also facilitate social mapping of local community qualifications and boundaries about wind farm location alongside technical mapping of wind resources. This is needed to identify the most socially, economically and technically viable locations to locate wind farms to ensure effective renewable energy transitions.*

A similar finding by Warren & Birnie (2009) was that landscapes have symbolic value, particularly related to place attachment and that opposition to wind farms is an "effort to protect place-based identities and fend off disruption of place attachment. A proposal to construct a wind farm is seen as a threat to the part of one's identity that is tied to a personally valued landscape."

From a survey of stakeholders in Australia, Hall *et al* (2013) identified four common themes which influenced the social acceptance of wind farms: trust (of wind farm developers), distributional justice (equal sharing of costs and benefits), procedural justice (open participatory decision making), and place attachment (personal identity and meaning of the local environment). Three principles underwrite procedural justice: honesty and transparency, full and unbiased information, and ensuring that donations of funds to the community were not seen as tacit support.

Aesthetic response

In 2011, Ian Bishop of the University of Melbourne presented to the World Renewable Energy Congress in Sweden an analysis of 31 studies of the public response to wind farms across the world. He found:

> … *a large gap between the knowledge required for effective planning and the agreed understanding of visual and other impact levels, and the influence of planning and communication processes. There is only limited agreement on some basic impact variables: numbers of turbines, amelioration with distance, role of design and so forth. There is no consensus on what methods should be used to assess acceptability or to design for acceptable outcomes. This means that, in many countries, there is no societal consensus about the acceptability of widespread deployment of wind energy systems.*

Table 3.3 summarises Bishop's key findings relating to the aesthetic aspects of on-shore wind farms.

There are considerable uncertainties regarding the planning of wind farms but Bishop concluded the following:

- Aesthetic impacts are less the further the viewer is from the turbines (although we have no clear idea of the shape of the distance - impact curve);
- Contrast with the surroundings and background should be low;
- Wind farms should not be located in highly valued landscapes;

- The distribution and design of the turbines should have regard for aesthetic factors such as complexity and continuity;
- Protected sites should be avoided;
- Less dissent arises through involvement of the local population in the siting procedure, transparent planning processes, and a high information level.
- Familiarity with existing small-scale projects is likely to increase later acceptance of further projects.

Table 3.3 Key findings of aesthetic response to on-shore wind farms

Variable increasing	On-shore impact
Distance	Linear decline to 7.5 miles (12 km)
Number of turbines	Increase with number, size & proximity until they occupy 15% of view, then constant.
Colour/ contrast	Increase with contrast.
Turbine size	One 5 MW turbine has more impact than many smaller units totalling 5 MW
Movement	No known studies
Visual complexity	Fractality (i.e. fractals) introduced, simpler structures preferred.
Host landscape	Effect is negative on high scenic quality but positive in low scenic quality.

Bishop, 2011

In a survey in England, Maehr *et al*, (2015) found that people's psychophysiological response to the appearance of wind farms was stronger than that of churches but similar to powerlines and powerplants. However, they were rated less aversive and more calming compared with powerlines and powerplants and equivalent to churches. In Australia, D'Souza & Yiridoe (2014) found the visual intrusion of wind farms and turbines to be the top factor in the opposition to wind farms.

Pricing the visual impact

As a surrogate of visual impact, several authors have examined the impact of wind farms on property values as this is often a concern regarding proposed wind farms. Gibbons (2014) measured the visual impact of wind farms by examining their effects on house prices in England and Wales. Using a GIS digital elevation model, he defined viewsheds of houses with a view of a wind farm and those without. A total of 148 wind farms were involved and he took land cover into account. He used housing transaction data for the period 2000 – 12 and examined sales of houses with a view and compared these with sales of houses without a view. Wind farm visibility reduces local house prices, and the implied visual environmental costs are substantial. He found the following:

- The price reduction was around 5-6% within 2 km, falling to less than 2% between 2 and 4 km, and less than 1% by 14 km which is at the limit of likely visibility;
- Small wind farms had no impact beyond 4 km, whereas the largest wind farms (20+ turbines) reduced prices by 12% within 2 km, and reduced prices by around 1.5% right out to 14 k.
- A household would be willing to pay around £600 per year to avoid having a wind farm of small-average size visible within 2 km, around £1000 to avoid a large wind farm visible at that distance and around £125 per year to avoid having a large wind farm visible in the 8-14 km range.
- The implied amounts required per wind farm to compensate households for their loss of visual amenities was therefore fairly large: about £14 million on average to compensate households within 4 km. The corresponding values for large wind farms would be much higher than this, as their impact is larger and spreads out over much greater distances.

In contrast, Hoen *et al* (2010), who examined the sales of 7,500 homes within ten miles of 24 existing wind farms in the United States, found that "*neither the view of the wind facilities nor the distance of the home to those facilities was found to have a statistically significant effect on home sales prices."* They did concede, however, that houses within 1000 feet of turbines may be negatively impacted.

A German study (Sunak & Madlener, 2012) found some evidence for negative local pricing effects of proximity to the site and shadowing caused by wind turbines, but the results were not sufficiently determinant.

A choice experiment of a hypothetical wind farm in Norway (Garcia *et al*, 2016) found households favoured public compensation over private compensation and that 35% of the welfare losses were of non-use values.

A study in China (Shen *et al,* 2019) asked householders their willingness to pay for increased electricity price from wind farms and in the words of the authors their "enthusiasm faded as their monthly electricity bill increased."

Impact on tourism

A number of studies have examined the impact of wind farms on tourism. A study in Wales and Scotland found that while some tourists were repelled by wind farms, others were attracted (NFO System 3, 2002). An early comprehensive survey of attitudes to wind farms in Scotland found they had no adverse effects (MORI, 2002). Dinnie (2012) found wind farms to have no impact on Scottish tourism.

In a poll of Highlanders and Islanders in Scotland, Survation (2014) found that faced with the prospect of more wind farms in the uplands, 49% said the impact would be negative, 6% that it would be positive, and 45% that it would have no effect on tourism.

In a survey of tourists in the Czech Republic, Frantál & Kunc (2011) found that attractive landscape and surrounding scenery was the #1 attraction of an area. Asked about their attitude to anthropogenic objects, wind power turbines were well down on the list, 22% negative compared with industrial buildings 66%, mines & mining 59%, mobile phone masts 40%, and electricity poles & wires 30%. Ninety per cent said that the presence of the wind would have no influence on their future visits to the area.

In Iceland, 50% of visitors said the wind farm was incompatible with the landscape while 33% said that it was compatible (17% neutral) (Frantál, *et al*, 2017).

In Portugal, Silva & Delicado (2017) found that local stakeholder involvement in all stages of the wind farm development were critical to resident's attitudes as well as tourism impact. No visitor to the region said that the presence of the wind farm affected their decision to come to the area, even in proximity to medieval architecture.

In an exhaustive study in Germany where the number of turbines has increased from 1,652 in 1993 to a huge 24,458 in 2014, Broekel & Alfken (2015) analysed tourism data from the period, 2008 – 12 for over 11,000 municipalities, comparing tourism demand with the number of turbines in the municipality. Their survey found that both the size and number of turbines were important and that turbines had a weak negative effect on tourism. In coastal areas, there was a positive relationship between tourism and wind farms.

3.3 POSITIVE ATTITUDES ABOUT WIND ENERGY

"Compared with other kinds of electricity production, a vast majority favour wind energy. It seems, therefore, quite puzzling why it is so hard to succeed in building new wind turbines. (Wolsink, 2000).

In this context, the conclusion of Schumacher *et al* (2019) is pertinent:

> *"*We hence conclude that former experiences are favourable for public acceptance as these experiences provide a more realistic picture of the actual impacts of local RE plants, which otherwise tend to be overestimated."

A meta-analysis of projects summarised opinion surveys from across Europe (Heiskanen *et al*, 2007):

- Austria: 50% support promotion of wind energy;

- Belgium: 78% positive or neutral toward offshore wind farms;
- Denmark: 68% support continued construction of wind turbines;
- France: 92% in favour of further developing wind energy.
- Germany: 66% in favour of construction of more wind farms;
- Greece: 68% supported existing wind energy turbines;
- Poland: 41% reported willingness to pay more for electricity from renewable sources such as wind turbines;
- Sweden: 64% would increase wind energy;
- Spain: about 80% of residents in different regions support wind energy;
- UK: 77% in favour of wind energy.

In a poll of all Scots, Suvation (2018) found 66% supported wind energy while 9.5% opposed it. A Swedish survey (Ek, 2005) found 64% were positive about wind energy and only 10% were negative. In the Czech Republic, Molnarova *et al* (2012) found 35% were positive about wind energy, 51% were tolerant, and 8% were negative.

In Texas in the United States, Swofford & Slattery (2010) found 70% agreed that the US should use more wind power and only 10% disagreed. In a later US survey, Hoen *et al* (2019) found 57% positive about the local wind farm, 8% negative, and a high 34% neutral. In South Africa, Lombard & Ferreira (2014) reported 85% support for wind energy. In Australia support for wind farms has consistently been above 80% over the past decade (Lothian, 2018).

United Kingdom

The before and after attitude to three wind farms in Wales was surveyed by Bishop and Procter (?) and they found support was 41% prior and 66% after construction. In Scotland, 40% expected a negative impact but this reduced to 9% who experienced problems after construction (Dudleston, 2000).

Over time, residents near wind farms become adjusted to them and become increasingly positive about them. Braunholtz (2003) found in a survey of 10 wind farms in Scotland 48% negative prior and 18% after construction. He found from the survey of over 1800 people who lived within 20 km of wind farms in Scotland that three times as many people regard the wind farm as a positive feature compared with those with a negative attitude.

A survey of 1200 people in Ireland found only 1% were opposed whereas 84% regarded them positively without any adverse effect on landscape or on wildlife, tourism or property values (SEI, 2003a).

Jones & Eiser (2009) distributed 1200 questionnaires to towns and villages near Sheffield, England, half the questionnaires going to four locations that the council had targeted as suitable for wind farms and the other half to non-affected locations to provide a control group without wind farm proposals. Respondents were asked about their general attitude to wind development and their attitude to the specific proposals. Respondents near the targeted sites were significantly less in favour than those in the control group. The difference between the general and specific attitudes was greatest for those near the targeted sites.

A key finding of the study was that the general attitude was a key predictor of specific attitudes for both groups, control and targeted. The study also found that perceived community opinion, both positive and negative, was an important predictor of specific attitudes. Both control and target groups were more likely to have negative attitudes towards the wind farm development if they felt it would despoil the landscape and affect property prices.

Eltham *et al* (2008) surveyed residents of their opinion of the Carland Cross wind farm in Cornwall which comprised, by today's standards, small turbines only 30 m high. The residents had been canvassed prior to the wind farm's construction in 1991, and then in 2006. The survey found that prior to its construction, 74% supported it and 14% opposed it while 15 years later, support had risen to 82% and opposition had slipped to only 6%.

In 2012, the UK Department of Energy and Climate Change initiated national quarterly surveys of areas covered by the Department including renewable energy. The question asked was: *Generally speaking, do you support or oppose the use of the following renewable energy developments: Onshore Wind*. While the Department has changed over the years since (it is now the Dept for Business, Energy & Industrial Strategy - DBEIS), the surveys have continued and provide a unique monitor of UK public opinion on wind energy (Figure 3.7).

The surveys are conducted face-to-face and cover 4,000 households across the UK. Over this period, support was nearly seven times the opposition.

Based on surveys taken by various bodies over the period, 1994 – 2019, the author has compiled the graph shown by Figure 3.8. The sources include data collected by the British Wind Energy Association to 2005 augmented by IpsosMORI surveys covering 2004 – 12, the DBEIS quarterly surveys, surveys commissioned by *The Times* and *The Guardian* newspapers, and by the McGowan and Sauter (2005) study.

The surveys have in common, questions on the support or opposition to wind farms.

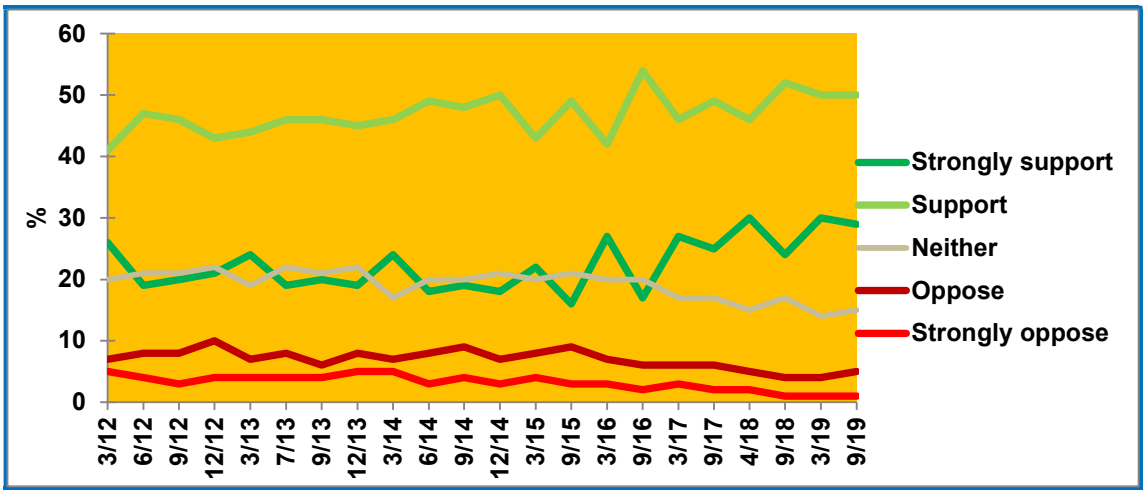


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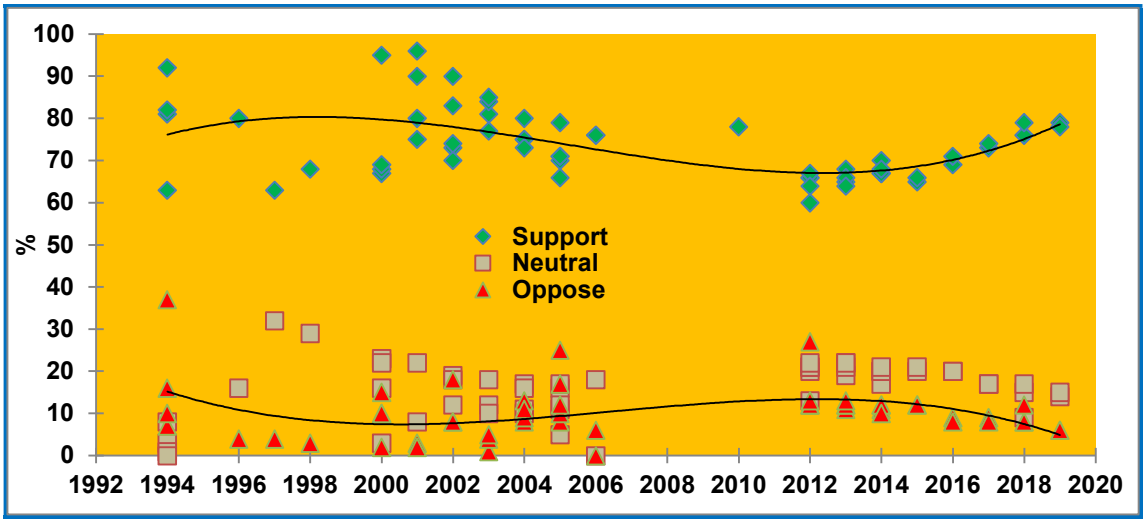
Figure 3.7 DBEIS quarterly surveys of UK public opinion about onshore wind



Dimensions Trend lines: Support $y = 0.0094x^3 – 56.39x^2 + 113073x-8E+07$, $R^2 = 0.31$
Oppose $y = 0.0076x^3 + 45.49x^2 - 91263x-6E+07$, $R^2 = 0.19$

Figure 3.8 UK public opinion regarding wind farms, 1994 - 2019

In the 1990s through to the mid-2000s, opinion fluctuated fairly widely, however from around 2012 onwards it stabilized although this could be due to the lack of multiple surveys. Overall, according to the trend lines, support peaked in the late 1990s, then waned through the 2000s to pick up again in the years since 2012. Opposition has fallen over these recent years. To some extent the trend lines in the early years reflect the years when new wind farms were being installed and the latter years when few are being installed onshore.

3.4 BALANCING ENVIRONMENT AND CLIMATE CHANGE

Recognizing that renewable energy technologies reduce our reliance on fossil fuels with their substantial adverse environmental and health effects, Bisbee (2004) argued in the context of National Environment Protection Act (NEPA) in the US that these benefits are more important than their visual impact: "*local aesthetic preferences must not be permitted to overshadow broad regional benefits."* She concluded the essentially legal review:

> *Offshore wind power can reduce emissions of air pollutants that are contributing to global warming and causing premature deaths. This is the most important impact of offshore wind, and it deserves immediate, in-depth attention. Used appropriately, NEPA can show decision makers that when they choose to save the view, they also choose to perpetuate the adverse effects of fossil-fuel use on human health and the environment.*

Interestingly the same argument was presented by Wikipedia (25/11/17):

> …*when appropriate planning procedures are followed, the heritage and landscape risks should be minimal. Some people may still object to wind farms, perhaps on the grounds of aesthetics, but their concerns should be weighed against the need to address the threats posed by climate change and the opinions of the broader community.*

3.5 SUMMARY

Key findings include the following:

1. Of all the perceived impacts of wind farms, their visual impact dominates.

2. Following construction and operation, opposition tends to dwindle as the impacts are found to be not as severe as feared and residents become more positive about them.

3. The presence of existing wind farms can facilitate the acceptance of additional proposals.

4. Opposition declines with distance from turbines.

5. Offshore locations are favoured over onshore sites.

6. People with a strong environmental ethic favour wind farms no matter what.

7. Wind farms should not be located in highly valued landscapes.

8. Early open involvement of the community with proposals and transparency and provision of information by the developer are pre-requisites for a successful outcome.

9. Attitudes towards renewable energy and wind farms shape an individual's attitude towards particular wind farms.

10. There is some evidence for nearby wind farms affecting property values.

11. Tourism appear to be largely unaffected by the presence of wind farms and indeed they can become an attraction in their own right.

12. Support outweigh by a large margin the opposition. Community support for renewable energy in general and wind farms in particular is very high, ~80%, with opposition very low.

13. The community needs to have regard to the bigger picture of climate change

and the need to reduce greenhouse emissions.

3.6 AUTHOR'S STUDIES OF VISUAL IMPACTS OF WIND FARMS

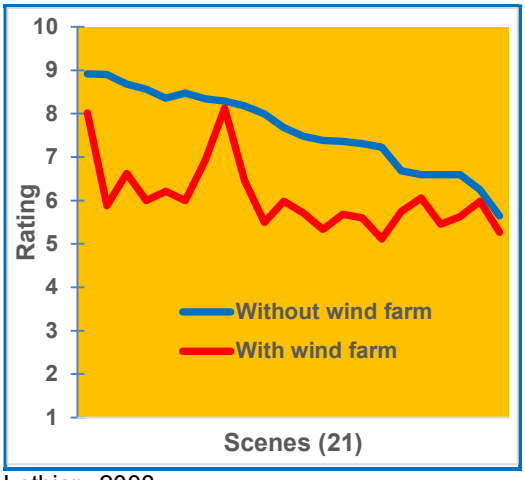
2003 Study

In 2003, the author carried out a study of the likely visual impact from wind farms in South Australia (Lothian, 2008). Scenes were selected to represent both proposed and potential wind farm sites on the coast (21 scenes) and on inland agricultural land (47 sites). The sites were photographed and the images scanned and standardized digitally to show blue skies so that the presence of clouds would not influence ratings. Photomontages were prepared, inserting standard wind turbines into the original photographs.

Figure 3.9 Example of a coastal scene with and without a wind farm

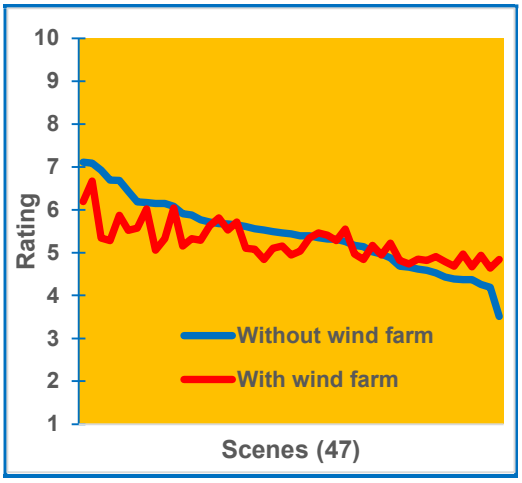
The survey comprised the scenes with and without the wind farm (Figure 3.9), arranged in random order. Participants viewed the survey and rated the images on a 1 – 10 scale. The ratings of 311 participants who completed 150 scenes were selected for analysis.

The results were analysed separately for the coastal and inland scenes. Figure 3.10 shows for coastal scenes the differences in descending order of rating without the wind farm. This indicates the rating of each scene with and without the wind farm. With few exceptions, the difference was largest where the scenic quality was high and narrowed as the rating decreased. In all coastal locations, however, the presence of the wind farm diminished scenic quality.



Lothian, 2008

Figure 3.10 Coastal scenes – visual impact of wind farms on scenic quality



Lothian, 2008

Figure 3.11 Agricultural scenes – visual impact of wind farms on scenic quality

In agricultural landscapes, the presence of wind farms affected areas of high scenic quality but in areas of lower scenic quality

the presence of the wind farm actually enhanced scenic quality (Figures 3.11 & 3.12). This implied that in landscapes of low quality, below 5.1 rating, the presence of the wind farm added interest to an otherwise mediocre landscape and thus enhanced its perceived scenic quality.

Rating with wf 4.84, without wf 3.51

Figure 3.12 Example of a wind farm enhancing landscape quality

2018 Study

In 2018 the author carried out a second study of the visual impacts using scenes of wind farms in 3 States, New South Wales, Victoria and South Australia. The survey comprised scenes from 17 wind farms plus 10 hypothetical sites on the coast. Survey participants were asked to rate the scene with and without the wind farm. The scenes were randomised. For scenes with wind farms, respondents were also asked to indicate the acceptability or otherwise of the wind farm in the landscape.

The survey comprised 49 scenes with wind farms and 49 without, and was launched on the Internet in March, 2018 for 31 days. During this time, nearly 4000 invitations to participate in the survey were emailed to councils and councillors in SA, Victoria and NSW as well as to 1700 clubs across Australia including outdoor, car, caravanning, gem & mineral clubs.

The data set used for analysis was 779 respondents which provided a confidence interval of 0.035 at the 95% confidence level. The survey participants were principally males aged 45 and older and many participants had degrees and higher degrees. Nine times as many said they were in favour of wind farms as those who were against them.

Compared with the Australian population, participants' age, gender, birthplace and education were all statistically significantly different – overall, they were better educated, more middle aged and elderly, more males and more Australian-born than the Australian community. Despite these differences, their mean ratings were fairly similar across all demographic characteristics surveyed indicating that these differences did not affect the outcomes.

The average for scenes without the wind farms was 6.82 and the scenes with the wind farms was 5.61, a reduction of 1.21 (1 – 10 scale). Extrapolating the ratings found they converged at a rating of 4.92. Below this rating, the presence of wind farms would enhance scenic quality.

For scenes with wind farms, the following effects were found:

- Ratings decreased slightly with an increasing number of turbines; increasing the number from 20 to 50 reduced ratings by 0.63.
- Placing turbines linearly along ridges increased ratings by 0.4 compared with random layouts.
- The height of turbines had virtually no influence on ratings; increasing the height from 100 m to 150 m reduced ratings by 0.18.
- With greater distance to the turbines, ratings increased by 0.4 at mid-distance compared with those close by, and increased by 0.65 for the distant turbines.
- The generating capacity of the turbines (MW) decreased ratings slightly; increasing them from 2 MW to 3 MW reduced ratings by 0.054.

Key factors for developers to take into account are the number of turbines and their distribution layout with alignments along ridges preferred over random layouts.

The acceptability of wind farms was rated o a 5-point scale Table 3.4).

Table 3.4 Acceptability of wind farms

Acceptability	Number of participants	%
Very Acceptable	152	29
Acceptable	199	38
Neutral	59	11
Unacceptable	63	12
Very Unacceptable	52	10

Acceptable scores were three times as prevalent as the unacceptable. In only one scene was the unacceptable score higher than the acceptable. This is the principal finding of the survey, that the community found wind farms acceptable in virtually all landscapes, including most coastal scenes. What is particularly surprising is that wind farms were considered acceptable in high quality landscapes, even those rated 8 and above.

3.5 THRESHOLDS OF VISUAL IMPACT

The crucial issue for wind farm location is their acceptability to the community. What is the threshold level when a wind farm shifts from being acceptable to unacceptable? In a hand book on visual impacts, Buchan (2002) noted:

> *Ultimately, significant is whatever individuals, people, organisations, institutions, society and/or policy say is significant – it is a human evaluative and subjective judgement on which there may or may not be consensus. It is therefore important that two separate but critical characteristics of all effects – **magnitude and significance** – are clearly distinguished.*

Buchan proposed the use of matrices to determine significance, these were however, "indicative suggestions only" and "a case by-case approach is required in assessing significance for individual windfarm proposals…"

Palmer (2015) reviewed statistical methods of determining significance of the scenic impact, referred to a study by Stamps (1997) who reviewed "*thousands of ratings for paired landscape scenes"* and adopted Cohen's (1988) effect size thresholds.

Cohen used the standardized mean difference – i.e. the difference between population means (μx) that is divided by the population standard deviation (σ) (i.e. $(\mu x_1 - \mu x_2)/\sigma$). Stamps proposed:

> Difference = 0.2 is trivial or too small to be noticed.
> Difference = 0.5 is a medium size effect, large enough to be visible to the naked eye.
> Difference = 0.8 is grossly perceptible, sufficient to draw one's gaze.

Stamps further suggested a threshold of difference = 1.1 of a very large impact that authorities should anticipate public opposition. Palmer, however, suggested:

> 0 – 0.2 Possibly go unnoticed
> 0.2 – 0.5 Noticeable but not adverse
> 0.5 – 1.1 Adverse
> > 1.1 Unreasonably adverse

Applying these figures to the 2003 South Australian study yielded the following number of scenes (Table 3.5).

Table 3.5 Application of Palmer (2015) thresholds to South Australian scenes

Inland scenes $\sigma = 1.85$

Difference	Significance	Scenes
0 – 0.2	Possibly go unnoticed	33
0.2 -0.5	Noticeable but not adverse	22
0.5 – 1.1	Adverse	5
>1.1	Unreasonably adverse	0
	Total	60

Coastal scenes $\sigma = 1.90$

Difference	Significance	Scenes
0 – 0.2	Possibly go unnoticed	3
0.2 -0.5	Noticeable but not adverse	3
0.5 – 1.1	Adverse	10
>1.1	Unreasonably adverse	6
	Total	22

Six coastal scenes exceeded 1.1 from the author's 2003 study. However, two further significant sites were below the 1.1

threshold. Both of these scenes were from South Australia's premier coastal resort area of Victor Harbor. Wind farms in these locations are likely to be strongly opposed by the community.

Based on these examples, the top threshold may need to be below 1.0, possibly 0.9 or even 0.8. It is quite arbitrary where to set the threshold. Stamps suggested 0.8 is grossly perceptible, sufficient to draw one's gaze.

An alternative approach is to calculate the difference in ratings with and without the wind farm. Only the negative differences need to be used – the positive differences indicate that the wind farm enhances the landscape quality. Using the South Australian study again, Table 3.6 shows the results.

Table 3.6 Difference in ratings, with and without wind farm, SA study

Range	Frequency
0 to - 0.49	19
0.50 - 0.99	13
1 - 1.49	3
1.5 - 1.99	6
2 - 2.49	6
2.5 - 2.99	1
3 +	1
Total	49

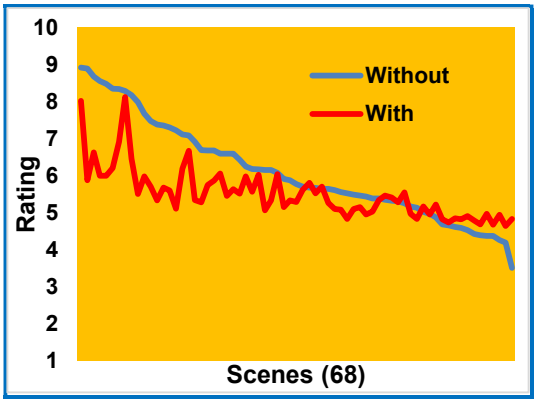
On the basis of this, it suggested that a difference of 0 - 1 is acceptable, a difference of 1 – 1.5 is marginal, a difference of 1.5 - 2 is unacceptable, and a difference of 2+ is very unacceptable.

The foregoing analysis, however, considers only the reduction in landscape quality caused by the development, it does not consider the level of landscape quality prior to the development. The visual impact of a development in a landscape of 4 or 5 rating will be far less objectionable than a development in a landscape of 6, 7 or especially 8 rating. This corresponds with the finding from the author's 2003 study that while ratings increased where the wind farm was located in low quality landscapes, they decreased for higher value landscapes. For coastal wind farms, all sites reduced the landscape quality.

The thresholds in landscapes of high quality will be considerably less than the thresholds for landscapes of low quality. A reduction from 8 to 7 will be far more objectionable than a reduction from 5 to 4. Two factors need to be considered in establishing visual thresholds, firstly the rating of the subject landscape, and secondly, the reduction in landscape quality that results from the development.

This is similar to Buchan's suggestion that **magnitude** and **significance** are the important issues. It is then necessary to determine at what point the reduction in scenic quality becomes unacceptable.

A possible clue to how these thresholds may change with the landscape quality may be derived from the results of the 2003 study. Figure 3.13 combines the data from the coastal and inland sites. Figure 3.15 shows the trend lines for the two lines, with and without the wind farms.



SA Study

Figure 3.13 Coastal and inland wind farm sites combined

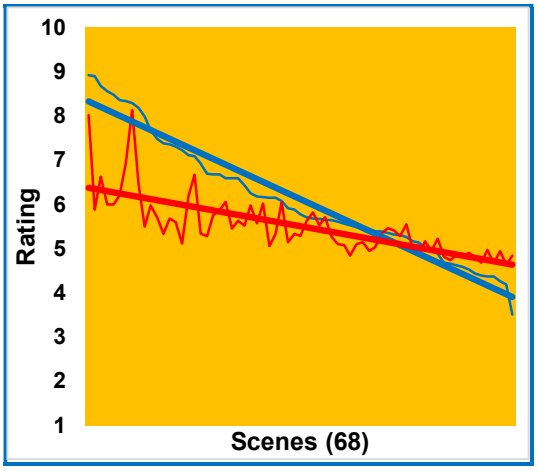


Figure 3.15 Trend lines for wind farm sites

Table 3.7 indicates the average gap for each level of landscape quality.

Table 3.7 Influence of landscape quality on the visual impact of wind farms

Landscape quality	Wind farm present	Gap
9	6.64	-2.36
8	6.25	-1.75
7	5.86	-1.14
6	5.46	-0.54
5	5.00	0.00
4	4.60	+0.60

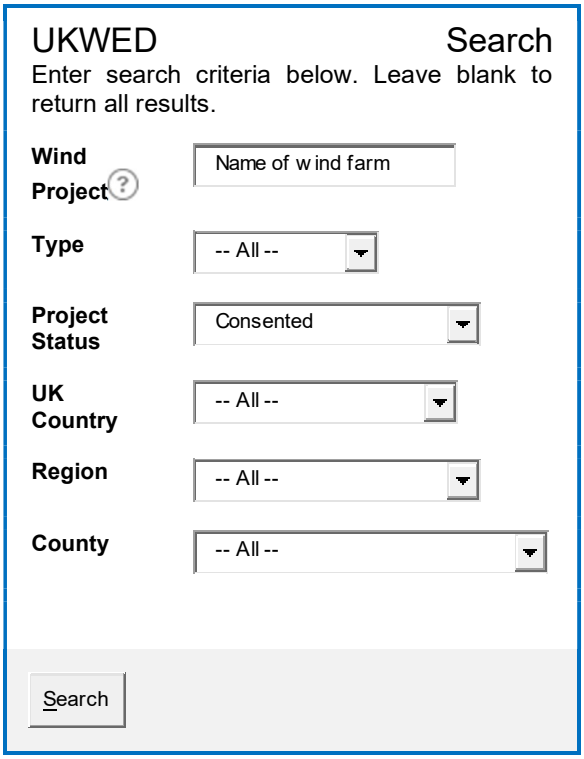
The question arises from Table 2.8 of whether these gaps represent the threshold for a given level of landscape quality at which the wind farm becomes unacceptable. Thus, for a landscape quality 8, a reduction of 1.75 to 6.25 represents a significant diminution in landscape quality which would be considered unacceptable.

The thresholds for visual impact is clearly an area for further research.

CHAPTER 4 ACQUIRING THE DATA

4.1 BRITISH WIND FARMS

The RenewableUK website provided an up to date list of wind farms in Britain (www.renewableuk.com). A further website: www.thewindpower.net included details of each wind farm. The RenewableUK website included a search option of wind farms across the UK.



Type: Offshore or Onshore;
Project status: Consented, operational, under construction;
UK Country: England, Northern Ireland, Scotland, Wales;
Regions: Geographic regions, e.g. East Midlands;
County: List of all counties in the 4 countries of the UK – England, Scotland, Wales & Northern Ireland.

From this database an Excel spreadsheet was prepared which listed all the wind farms and showed their name, the number of turbines, the total generating capacity (MW), the generating capacity of each turbine (MW), the year of operation, and the region in which it was located.

Entering the name of the wind farm from the RenewableUK database and clicking on Onshore and Operational yielded details of the wind farm including its location. The following is an example.

Project Name	Kirkby Moor		
Location	Kirkby Moor and Lowick High Common, Grizebeck, Broughton-in-Furness, LA17 7UN		
County	Cumbria	**Region**	North West
Turbine Capacity	0.4		
Number of Turbines	12		
Project Capacity (MW)	4.8		
Developer	Innogy Renewables UK Ltd		
Owner	Ventient Energy Ltd		
Local Planning Authority	South Lakeland District Council		
Latitude (decimal)	54.2461	**Longitude (decimal)**	-3.15222
Type	onshore	**Project Status**	Operational

Note that the latitude and longitude are in decimal form. However, Google Earth uses degrees/minutes/seconds. To convert them to this, the following website was used:
www.fcc.gov/media/radio/dms-decimal

Decimal Latitude: 54.2461

Decimal Longitude: -3.15222

Convert to degrees, minutes and seconds

Result: Latitude 54° 14' 45.9594"

Longitude -

3°9'7.9914"

Clear Values

These results were then entered into the spreadsheet as a record and into Google Earth, including the N for latitude and W (or E) for longitude. The result is shown in Figure 1.

Figure 4.1 Kirkby Moor Wind farm location

4.2 FIELD ASSESSMENT OF WIND FARMS

Having located the wind farms, their locations were transferred to an AZ Great Britain Road Atlas with the name of the wind farm and the number of turbines. This greatly assisted in locating the wind farm when in the field.

As a special trip to the UK was to be made for the purpose of photographing wind farms, only a period of two weeks was available to carry this out. It was therefore important to maximise the number of wind farms that could be photographed in that time.

Eighty-five wind farms with 10 or more turbines were identified by the method described above (Table 1). The majority of wind farms in the UK, 58%, are located in Scotland. Of the Scottish wind farms 56% are located in southern Scotland, south of the latitude of Edinburgh (Table 2). The survey therefore aimed to cover most of the wind farms in England, Wales and southern Scotland. Given that it would take an extra week if northern Scotland was included, this was excluded.

Table 4.1 Onshore wind farms in the UK (≥10 turbines)

Location	Wind farms	Turbines	Capacity MW
England	20	297	399.80
Scotland	48	1326	2421.30
Wales	17	451	321.75
Total	85	2074	3142.85

Table 4.2 Scottish wind farms (≥10 turbines)

Location	Wind farms	Turbines	Capacity MW
Scotland	48	1326	2421.3
Sth Scot.	27	866	1674.75
% sth Scotland	56%	65%	69%

Travel to photograph wind farms commenced on 31 March, 2019 and concluded on 12 April. Table 4.3 shows the locations covered and the number of wind farms photographed on each day. Rain and fog limited photography in some locations and in Wales prevented it almost entirely. In all, the trip covered 3,975 km over 13 days travel.

Figure 4.2 outlines the route taken to photograph the wind farms, starting and finishing at Horley, south of London.

Table 4.3 Schedule of UK trip to photograph wind farms

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
31 March Collected car at Horley, Gatwick M25 and M1 to Rugby. Kettering. Peterborough Boston O/n Lincoln 6 wfs 460 km	**1 April** Lincoln Scunthorpe Bickerfen Goole Beverley Bridlington Middlebrough O/n Hartlepool 9 wfs 375 km	**2 April** Hartlepool Newcastle Ashington Alnwick **Scotland** Preston O/n Edinburgh 11 wfs 375 km	**3 April** Edinburgh (rain)	**4 April** Southern Scotland Oxton Galashiels Peebles Strathaven O/n Lanark 9 wfs 291 km	**5 April** Lanark Broughton Moffat Crawford Strathaven Kilmarnock New Crumnock O/n Ayr 17 wfs 344 km	**6 April** Ayr Girvan Stranraer New Luce Dumfries **England** O/n Carlisle 5 wf 312 km
7 April Carlisle Kendal Ambleside Ulverston M6 & M56 Ellesmere Port **Wales** O/n Bangor 2 wfs 423 km	**8 April** Bangor Anglesea Dongellau (Rain & fog) O/n Aberystwth 3 wfs 256 km	**9 April** Aberystwth Newtown (rain & fog) Abergavenny Newport **England** Taunton Barntaple O/n Ilfracombe 1 wf 449 km	**10 April** Ilfracombe Torrington Launceston Wadebridge Redruth O/n Plymouth 10 wfs 309 km	**11 April** Plymouth O/n Christchurch 219 km	**12 April** Christchurch Returned car at Horley O/n Horley 161 km	**13 April** Departed England

Note: The number of wind farms shown here totals 73 which includes a number of sites with less than 10 turbines.

Figure 4.2 Route of wind farm photo project

4.3 RESULTS OF FIELD WORK

In photographing the wind farms, care was taken to avoid back-lit scenes looking into the sun which renders the turbines black against the sky. This necessitated driving to positions on the sunny side of the wind farm; in the morning, approaching from the east and in the afternoon, from the west.

A Nikon D60 SLR camera with a focal length of 50 mm and F1.8 lens was used throughout for all photographs. The focal length of 50 mm approximates that of the human eye so that the photographs would be similar to that seen by the eye.

Table 4.4 summarises the number of wind farms and photographs taken in England, Wales and Scotland. A total of 44 wind farms were covered, this being 52% of the number of wind farms in England, Wales and southern Scotland.

Table 4.4 Wind farms photographed

Location	Wind farms	Wind farms photographed	Photos
England	20	22	211
Scotland	48	19	307
Wales	17	3	12
Total	85	44	530

Note: The discrepancy in the England figures suggests more wind farms were photographed than exist. The list of wind farms from the RenewableUK website includes sites of < 10 MW a few of which were photographed. In the field it is often difficult to ascertain the name of the wind farm which may account for some of these differences.

In all, 530 photographs were taken of the wind farms including 28 scenes of signs about the wind farms. The small number in Wales was due to the inclement weather which made seeing the wind farms, let alone photographing them, virtually impossible. Tables 5 and 6 summarise the results.

Weather

Only 38% of scenes enjoyed full sun while a similar percentage had part sun. Nearly a quarter of scenes had overcast sky (Table 4.5).

Table 4.5 Number of scenes – weather

Location	Overcast	Part sun	Full sun
England	71	45	87
Scotland	43	137	107
Wales	1	11	0
Total	115	193	194
%	22.64%	37.99%	38.19%

Sun on wind turbines

Table 4.6 Sun on wind turbines – number of photos

Location	Shaded	Part sunlit	Sunlit
England	54	65	84
Scotland	48	77	162
Wales	1	0	11
Total	103	142	257
%	21.06%	29.04%	52.56%

Table 4.6 indicates how much sun was on the wind farm as although the sky may be partly sunny, or even overcast, often the wind farm was sunlit. The table indicates that over half of the scenes were in full sun despite Table 4.5 showing that only 38% of scenes enjoyed full sun. The turbines were shaded in only 21% of the scenes although some of these were due to the photograph being taken into the sun, a situation avoided as much as possible.

Distance

Table 4.7 classifies the scenes by the distance to the wind farm, being distant, medium or nearby. Figure 4.3 shows examples of each of these.

Table 4.7 Distance to the wind farm – photos

Location	Distant	Medium	Nearby
England	19	142	42
Scotland	61	188	38
Wales	6	6	0
Total	86	336	80
%	17.13%	66.93%	15.94%

Distant wind farm

Medium distance wind farm

Nearby wind farm

Figure 4.3 Penmanshiel and Crystal Rig wind farms, Scottish Borders

Use of scenes

While classifying the photographs an assessment was made of their suitability for use in the survey. Table 4.8 shows that nearly two-thirds were considered suitable for the survey, a relatively low figure due to inclement weather in some of the scenes. Unsuitable scenes amounted to nearly a quarter of the scenes and a further 13% were "maybe's".

Table 4.8 Suitability of scenes for the survey

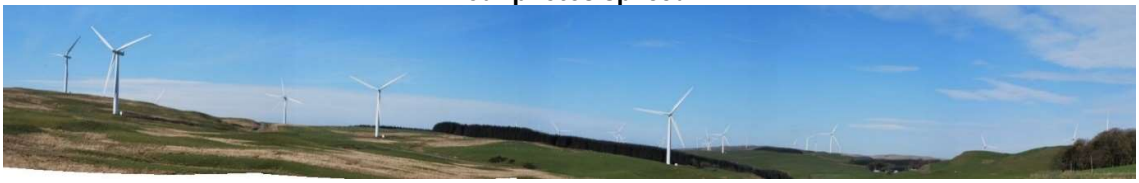
Location	Yes	No	Maybe
England	20	11	6
Scotland	27	6	4
Wales	2	1	0
Total	49	18	10
%	63.64%	23.38%	12.99%

Panorama scenes

Hadyard Hill Wind Farm, South Ayrshire, Scotland Two photos spliced

Three photos spliced

Four photos spliced



Five photos spliced

Figure 4.4 Spliced scenes

As most wind farms are spread over a wide area, panoramas of successive photos were taken which could be spliced together for the survey. A total of 107 panoramas of multiple scenes were identified. Splicing more than three photos together renders the image very wide but the height decreases and the wind farm becomes less dominant in the scene (Figure 4.4). A photostich program (Canon Utilities PhotoStich, Version 3.1.1) was used to combine scenes.

Over the 107 spliced scenes, 38 were of two photos, 29 of three photos, 19 of four photos, and 9 of five photos. There are 12 remaining splices with up to 10 photos. Two or three scenes out of multiple splices may be extracted for a desired image.

Treatment of photographs

As haze was a constant issue in England and Scotland at the time, Photoshop Elements was used to remove haze and to adjust the lighting as required. Most scenes required some adjustment. In addition, Photoshop was used for the removal of distracting elements such as strongly contrasting irrelevant objects in the foreground, removal of half-hidden turbines sited behind another turbine and also deletion of additional distant wind farms on the horizon of the scene where these occurred. While the latter distant wind farms were barely visible, their removal simplifies the scene in terms of rating the wind farms present.

4.4 SELECTION OF SCENES

The survey comprised 23 scenes with turbines and the same 23 scenes with the turbines removed, a total of 46 scenes. Participants rated the scenic attractiveness of each scene on a 1 (low) to 10 (high) scale. The difference in ratings indicated the visual impact of the wind farm on the landscape. This method has been used in the author's two previous surveys of wind farms (Lothian, 2008, 2018).

To ensure the wind farm was sufficiently large in the image to enable an assessment of its visual impact, only panoramas with two or three images stitched together were used. This did not exclude taking a selection of scenes from four or greater number of images that had been stitched together. A careful selection of the scenes was made which reduced the number of scenes from 106 to 64. A further selection reduced this to 46 scenes and then to 23.

Characteristics of selected scenes

Scenes were classified by the following characteristics:

- Distance to turbines: nearby, middle, distant, very distant;
- Number of turbines in the scene: 1-5, 6-10, 11-15, 16-20, 21-25, 26-30;
- Terrain: flat, undulating, hilly;
- Weather conditions: sunny, thin/ scattered cloud, thick cloud;
- Turbines in sun: sunlit, in shadow.

Table 4.9 and Figure 4.5 summarise their characteristics.

Table 4.9 shows that 43% of the wind farms are in the middle distance and most of the remainder are distant. Distance allows for the scenes to contain a larger number of turbines.

Table 4.9 Distance to turbines

Distance	Frequency	%
Near	2	8.70
Middle	10	43.48
Distant	11	47.83
Total	23	100.00

Around 65% of the wind farms were in groups of 1 – 15 turbines, and there are four wind farms with more than 20 turbines (Table 4.10).

Table 4.10 Number of turbines in scene

Number of turbines	Frequency	%
1 - 5	2	8.70
6 - 10	7	30.43
11 - 15	6	26.09
16 - 20	4	17.39
21 - 25	1	4.35
26 - 30	3	13.04
Total	23	100.00

While five of the wind farms are on hilly terrain, the remaining 18 are split equally between flat and undulating terrain (Table 4.11).

Table 4.11 Wind farm terrain

Terrain	Frequency	%
Flat	9	39.13
Undulating	9	39.13
Hilly	5	21.74

Nearly three-quarters of the wind farms were photographed in sunny conditions or with thin or scattered cloud cover (Table 4.12).

Table 4.12 Weather prevailing at time of photo

Weather	Frequency	%
Sunny	6	26.09
Thin/scattered cloud	11	47.83
Thick cloud	6	26.09

Over three-quarters of the turbines were in sun, despite the cloud cover (Table 4.13).

Table 4.13 Turbines in sun or shade

Turbines in sun or shade	Frequency	%
Sunlit	18	78.26
In shade	5	21.74

Table 4.14 shows the number of turbines in wind farms compared with their distance from the viewer in the scenes. It indicates that the smaller wind farms tend to be nearby while the larger wind farms are at greater distances (Figure 4.5). Many of these larger wind farms were shown on spliced photos.

Table 4.14 Distance vs number of turbines

Turbine	Near	Middle	Distant	Total	%
1 - 5	1	1		2	8.7
6 - 10		6	1	7	30.4
11 - 15	1	1	4	6	26.1
16 - 20		2	2	4	17.4
21 - 25			1	1	4.3
26 - 30			3	3	13.0
Total	2	10	11	23	100
%	8.70	43.48	47.8	100	

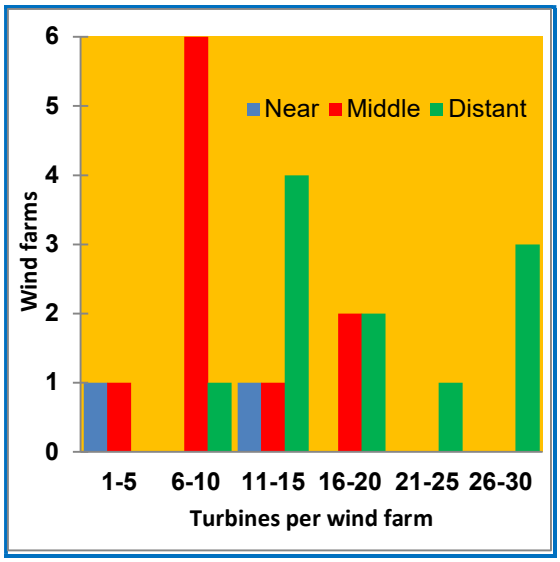


Figure 4.5 Distance vs number of turbines

Table 4.15 and Figure 4.6 compares the number of turbines with the terrain and shows that many of the smaller wind farms, up to 15 turbines, are on flat or undulating land, while the larger wind farms are located on flat, undulating and hilly terrain.

Table 4.15 Terrain vs number of turbines

Turbine	Flat	Undulating	Hilly	Total	%
1 - 5		1	1	2	8.7
6 - 10	5	1	1	7	30.4
11 - 15	1	4	1	6	26.1
16 - 20	1	2	1	4	17.4
21 - 25	1			1	4.3
26 - 30	1	1	1	3	13.0
Total	9	9	5	23	100
%	39	39	22	100	

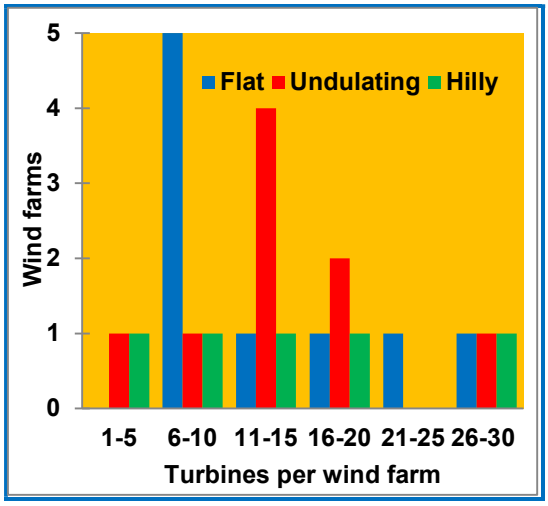


Figure 4.6 Terrain vs number of turbines

Table 4.16 and Figure 4.7 compare the terrain on which the wind farms are located with their distance from the viewer. The bulk of the wind farms in the middle and distant distances are located on flat or undulating terrain.

Table 4.16 Distance vs terrain

	Near	Middle	Distant	Total	%
Flat		5	4	9	39.13
Undul.	1	3	5	9	39.13
Hilly	1	2	2	5	21.74
Total	2	10	11	23	100
%	8.7	43.5	47.8	100	

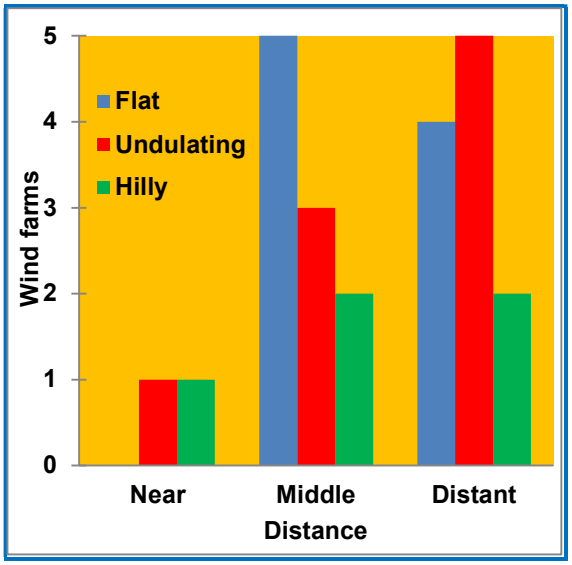


Figure 4.7 Distance vs terrain

Table 4.17 and Figure 4.8 compare the weather conditions with whether the turbines were in the sun or in shadow. Regardless of the weather conditions, 18 of the 23 scenes are sunlite.

Table 4.17 Weather vs shade or sun

	Sunny	Thin or scattered cloud	Thick cloud	Total	%
Shade	2	3	5	4	21.7
Sunlite	6	9	3	18	78.3
Total	6	11	6	23	100
%	26.1	47.8	26.1	100	

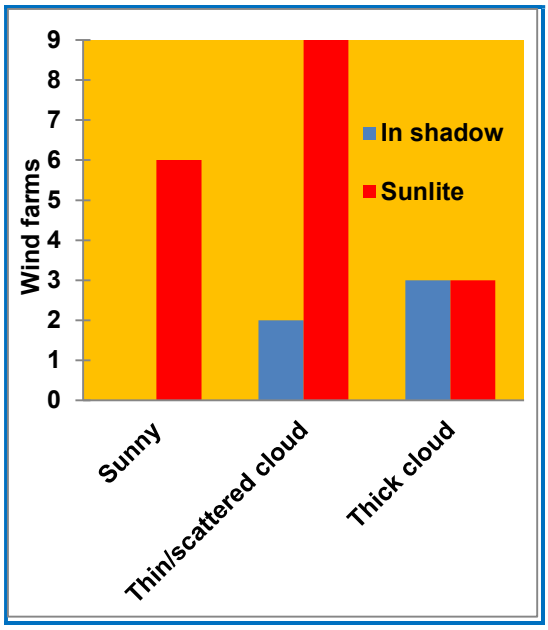


Figure 4.8 Weather vs sunlit or shadow

Appendix 1 shows the scenes selected for the survey.

4.5 PARTICIPATION IN THE SURVEY

The survey covered wind farms in England and southern Scotland, and to a limited extent, Wales. It was considered essential that participants in the survey be drawn from these areas.

Councillors in local government are particularly appropriate as survey participants given Council's authority to approve wind farms, the interest of councillors in public issues such as wind farms, their links with the community, and their willingness to give of their own time to the community.

England has 326 council districts; Scotland has 32 and Wales 22. In England, 317 councils were surveyed and the emails of 12,100 councillors were extracted. Councils excluded were 34 London boroughs and eight major cities (Birmingham, Manchester, Blackpool, Bradford, Coventry, Milton Keynes, Newcastle and Sheffield). Three council websites failed to open: Bolsover, Redditch and Walshall. In seven councils (East Cambridgeshire, Mendip, Mid Devon, North

Warwickshire, Nuneaton & Bedworth, South Cambridgeshire and Wychavon) the emails for councillors were not shown and could only be accessed by sending a message to them via the website, These seven councils were not included.

Council elections in England were held on 2 May, 2019 and some of the councillors which had been listed prior to that date were no longer on council and additional councillors were elected.

Scotland has 32 councils and 27 were covered excluding four cities – Dundee, Aberdeen, Edinburgh and Glasgow, and one council (Fife) for which emails could only go through the website. The total number of councillors listed was 925.

Wales has 22 councils and 21 were covered including two cities – Cardiff and Swansea but excluding one council, Neath Port Talbot, for which emails could only go through the website. The total number of councillors listed was 1166.

In addition to the local councils, England has 26 County Councils with a further 1708 councillors. Neither Scotland nor Wales have county councils.

The total number of councillors therefore was nearly 16,000. Table 4.18 summarises the councils and councillors for whom email addresses were obtained.

Table 4.18 Councils and Councillors

Country	Councils	Councillors	%
England	317	12100	76.11
Scotland	27	925	5.82
Wales	21	1166	7.33
Total	365	14191	89.26
County Councils	26	1708	10.74
Total	391	15899	100.00

In addition to Councillors, some websites identified the Chief Executive and senior officers in the Council. In all, 111 Councils provided email addresses of their CEOs and senior staff (England 96, Scotland 10, Wales 5). A total of 474 were thus provided plus 66 from county councils, making a total of 540 (Table 4.19).

Table 4.19 Council staff

Country	Councils	Staff	%
England	96	414	76.67
County councils	26	66	12.22
Scotland	10	31	5.74
Wales	5	29	5.37
Total	137	540	100.00

4.6 SURVEY OPTIONS

In presenting the images for rating, consideration was given to the following two options.

Option 1
Randomise all photos. This is how the previous survey was done.
Advantages
Provides immediate contrast between the scenes with wind farms and those without.
May be somewhat confusing for participants, having to swap from scenes with and without wind farms constantly.

Option 2
Firstly present all the scenes without wind farms followed by the scenes with wind farms. Randomise the photo within each category.
Advantages
Enables ratings of scenes without wind farms to be carried out separate from any viewing of wind farms and hence may provide a more accurate assessment of scenic quality.
Enables ratings of scenes with wind farms to be carried out in a block, which may provide a better assessment of their relative visual impact on the landscape.
May be less confusing for participants

While the preference was for Option 2, the Survey Monkey instrument did not allow for separate blocks of photos and randomisation within each block unless a far more expensive survey option was taken. Therefore, the entire set of photos, with and without the wind farms were randomised as a set.

4.8 INTERNET SURVEY

The internet survey is at Appendix 2.

4.9 SURVEY IMPLEMENTATION

Using Gmail, invitations were forwarded to councilors in bulk, council by council. The number of councillors varied, from the low 30s to above 90. As Gmail limits daily emails to 500, each day saw around 480 sent, leaving the balance to include the return email to myself as well as other emails sent during the day.

For the first 13 days, the emails were sent to be received first thing in the morning in England. However, it was considered that the low response may be due to the overwhelming number of emails one receives in the morning and so on day 14, emails were scheduled, using the Gmail facility, to arrive in England late morning or lunchtime. Whereas previously a response of 12 a day was average, the change of timing doubled this to over 20 per day on average.

Emails were sent to district councils in England, Scotland and Wales, followed by county councils in England and then to senior council staff for those councils which supplied addresses. Table 4.20 summarises the total number of councillors and staff to whom emails were sent.

Table 4.20 Emails sent to councillors and staff by country

Council	England	Scotland	Wales	Total
District councils	12071	929	1178	14178
County councils	1719			1719
Senior staff - District councils	409	33	31	473
Senior staff – County councils	66			66
Total	14265	962	1209	16436
%	86.79	5.85	7.36	100.00

Note: There are no county councils in Scotland or Wales.

CHAPTER FIVE ANALYSIS OF DATA

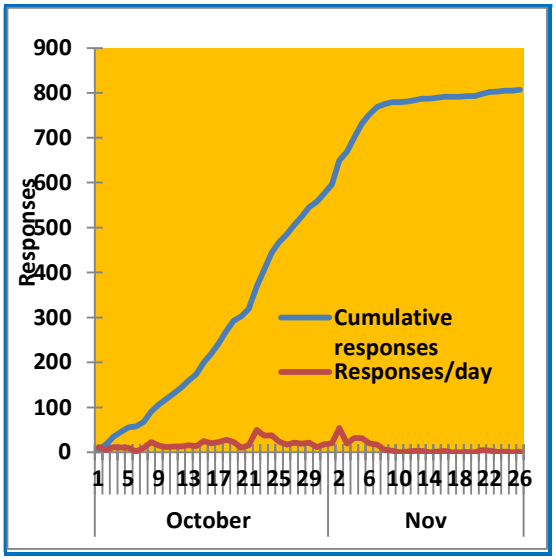
5.1 INTRODUCTION

The analysis of the data covers the derivation of the data set, the analysis of respondents and their influence on ratings, analysis of the ratings themselves and the respondents' attitudes towards and acceptability of wind farms. Finally, thresholds of visual impact are analysed, and a predictive model is derived.

5.2 DATA MANAGEMENT

Survey responses

The survey was launched on 30 September, 2019 and terminated 58 days later on 26 November. Over this period, 806 persons participated in the survey with 526 or 65% completing all 46 scenes. The total of 806 is 4.74% of the emails invitations sent out. Figure 5.1 indicates the daily and cumulative response to the survey.

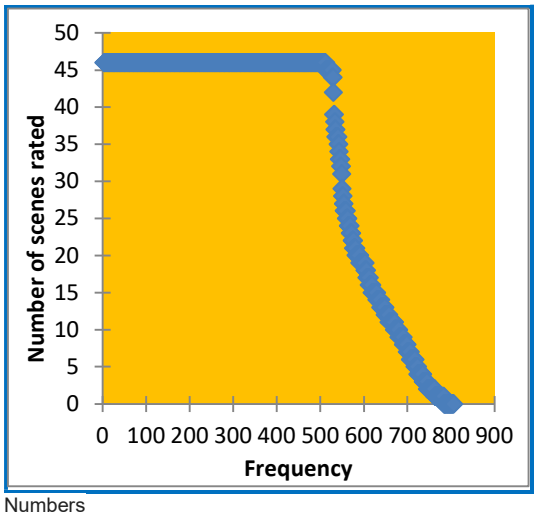


Survey numbers

Figure 5.1 Daily and cumulative responses

Figure 5.2 and Table 5.1 show the number of scenes rated with the flat line being the 526 who completed all scenes, then dropping away to zero.

Only 23 respondents failed to rate any scenes, the probable reason being, according to Survey Monkey, that their Internet browser was out of date. A caution was included at the beginning of the survey warning of this possibility and advising to update the browser.



Numbers

Figure 5.2 Number of scenes rated by respondents

Table 5.1 Number of scenes completed by respondents

Scenes rated	Frequency
40 - 46	529
30 - 39	19
20 - 29	41
10 - 19	90
1 - 9	104
0	23
Total	806

Total analysis

The total data set comprised 806 respondents. Omitting the 23 zero responses leaves a total of 783 responses.

Confidence interval

The confidence interval for the 529 who completed most of the survey is 0.043 at the 95% confidence level, well below the 0.05 benchmark expected for social science surveys (www.surveysystem.com). Including all ratings but omitting the zero

responses leaves 783 which has a confidence interval of 0.035.

Strategic bias

Strategic bias describes respondents who attempt to use the survey for their own objectives, for example to advance the recognition of an area they might rate all scenes 10. And the converse occurs as well. Table 5.2 indicates the number of multiple ratings of 10 for scenes without wind farms, and multiple ratings of 1 for scenes with wind farms.

Table 5.2 Multiple ratings of 10 and 1 by respondents

Scenes	Rated 10 Without wf	Rated 1 With wf
23	2	32
22	11	5
21	9	7
20	9	2
Total	31	46

Numbers

While there were only two respondents who rated all 23 scenes without wind farms as 10, another 11 rated 22 scenes as 10. There were 32 respondents who rated all 23 scenes with wind farms as 1 and a further 14 respondents who rated between 20 and 22 scenes as 1.

Table 5.3 indicates the effect that removing these ratings has on the overall mean. For scenes without wind farms the mean increases by 0.14 and for the scenes with wind farms, the mean decreases by 0.17.

Table 5.3 Effect of removing multiple ratings on means

	Without wf	With wf
All respondents	7.08	5.24
Exclude 20 - 23 scenes	6.94	5.58
Difference	0.14	-0.17

Though small, the differences were significant for both the scenes without wind farm and the scenes with wind farms.

Without wind farm: $t = 14.94$, $df = 22$,
$p < 0.000$
With wind farm: $t = -32.94$, $df = 22$,
$p < 0.000$

While recognizing that the differences were statistically significant, their effect on the overall result was minor. The ratings which reflect strategic bias have therefore been included in the analysis.

A combination which was unexpected was eight respondents who rated all scenes with and without wind farms as 10 or nearly so. This means they saw no difference in the quality of the scene whether they had a wind farm or not.

Normality

Histograms and QQ plots provide a visual means of assessing the normality of the distribution. A normal bell-shaped distribution indicates normality in a histogram while for QQ plots, ratings close to the diagonal line indicates a normal distribution. Figures 5.3 to 5.10 show the histograms and QQ plots for, firstly, the scene means and, secondly, for respondent means. These all display reasonable normality.

The histograms are shown on the left and the QQ plots on the right for the ratings of scenes and by respondents.

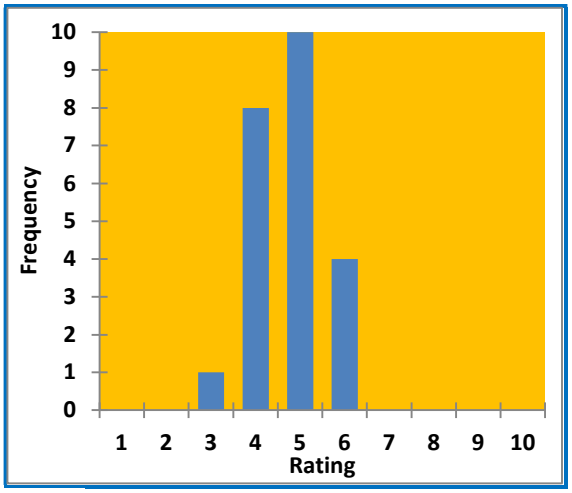


Figure 5.3 Scene ratings with wind farm

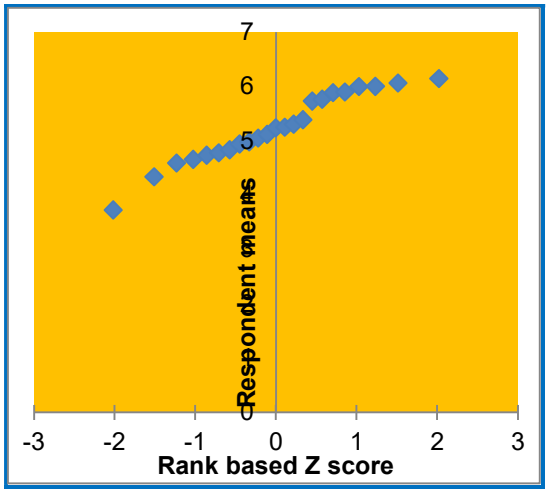


Figure 5.4 Scene ratings with wind farm

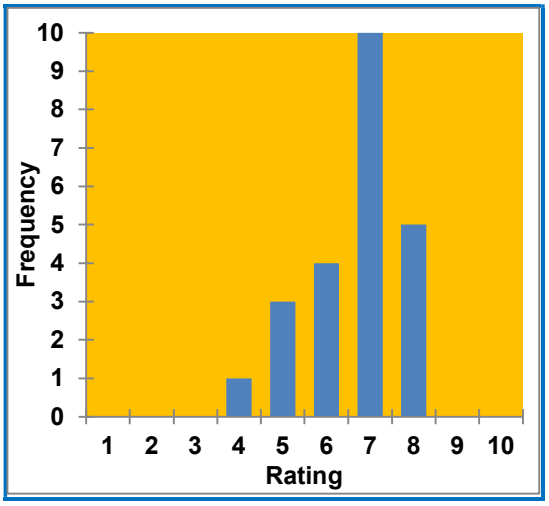


Figure 5.5 Scene ratings without wind farm

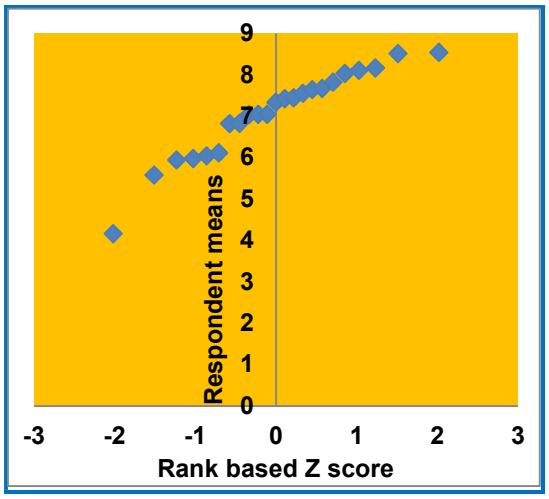


Figure 5.6 Scene ratings without wind farms

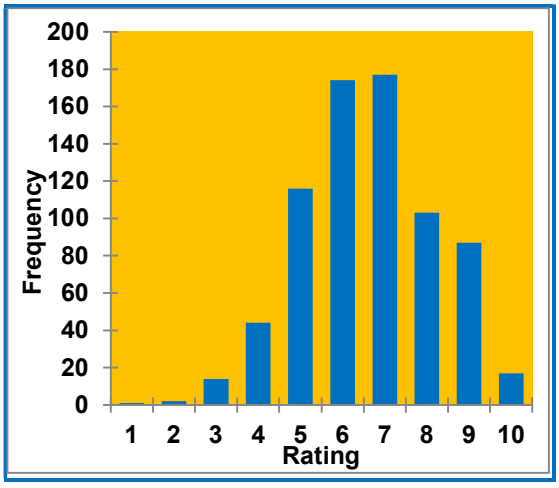


Figure 5.7 Respondent ratings without wind farm

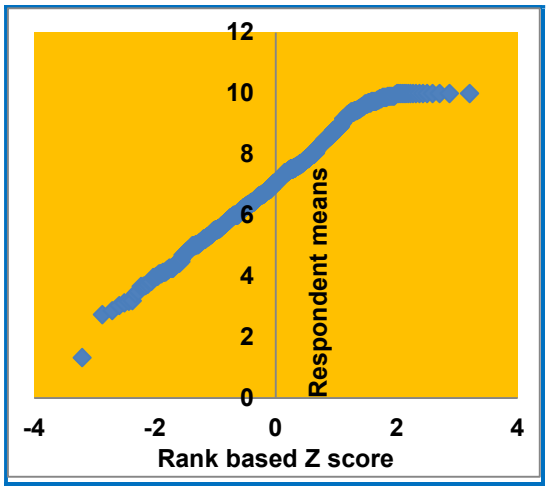


Figure 5.8 Respondent ratings without wind farms

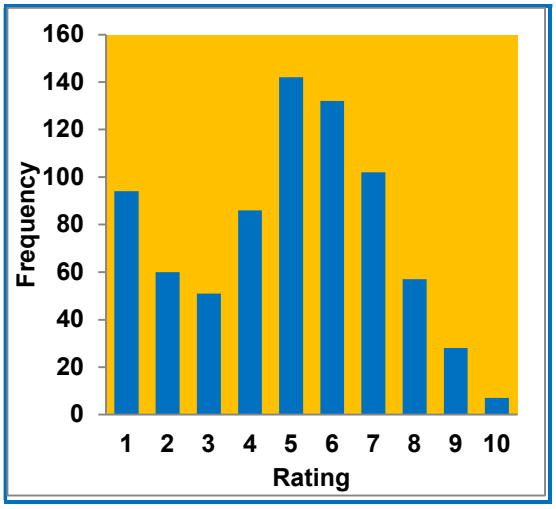


Figure 5.9 Respondent ratings with wind farm

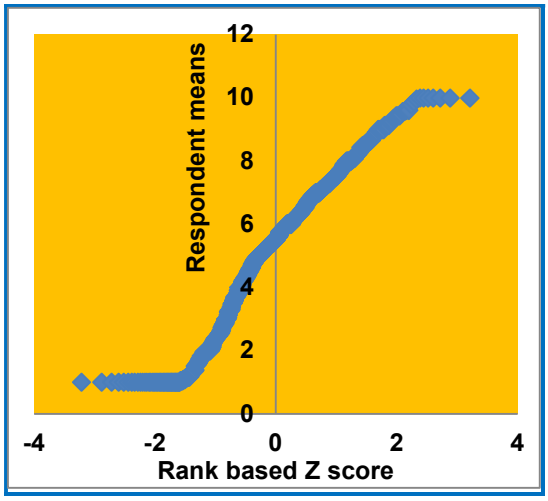
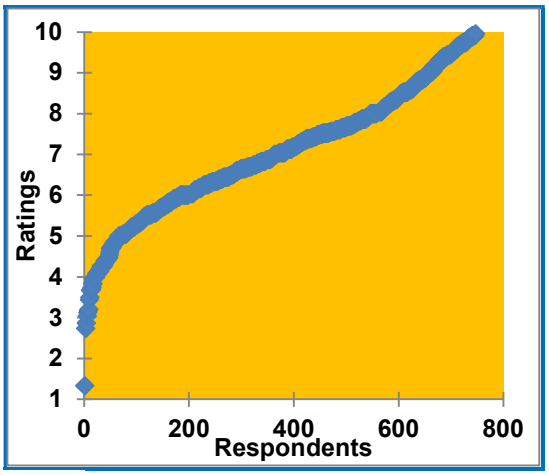


Figure 5.10 Respondent ratings with wind farms



Numbers

Figure 5.11 Distribution of respondent ratings

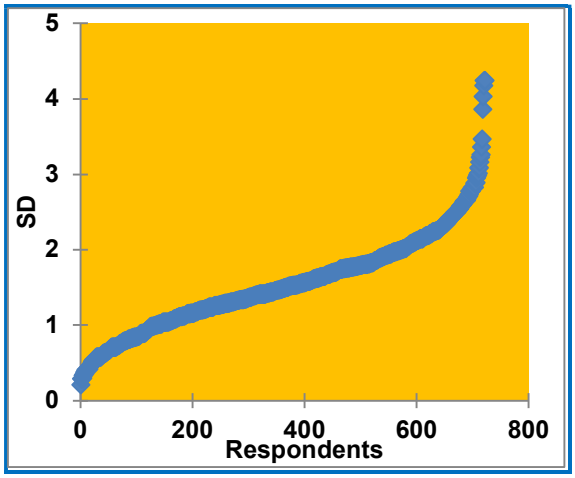


Figure 5.12 Distribution of respondent standard deviations

Figures 5.11 and 5.12 show the distribution of the mean ratings and standard deviations of the ratings by respondents arranged in ascending order. These are scenes of the landscape without the wind farms. The distribution displays an 'S' curve which curves down at the lower range and arches upwards at the top of the range. This suggests a tendency to place slightly more extreme values on scenes of very low or very high scenic quality, a phenomenon which is common in surveys of this nature[2].

Scene format

The scenes used in the survey were in two formats, 16 comprised two photos stitched together and seven scenes comprised four photos (one of these had 5 photos) stitched together. The means for the sets of scenes are summarised in Table 4.

Table 5.4 Mean ratings of stitched photos

	Without wind farm	With wind farm
Mean 2 scenes	7.21	5.36
Mean 4/5 scenes	6.79	4.98

23 scenes

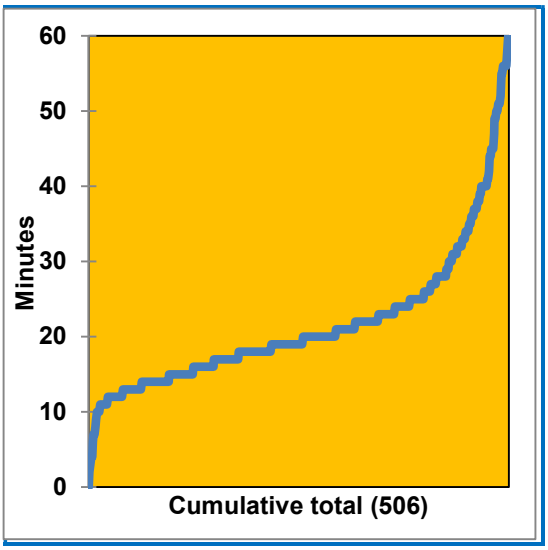
2. Pers. comm. Prof Terry Daniel, Dept of Psychology, University of Arizona.

The number of photos stitched together had no influence on the ratings – i.e. they were not statistically significant:

ANOVA Without wind farm
F = 0.76, df = 1, 21, p = 0.39
With wind farm
F = 1.88, df = 1, 21, p = 0.18

5.3 TIME TAKEN FOR SURVEY

The spreadsheet that recorded the ratings of respondents also included the time they commenced and completed the survey. From this the time taken for the survey was extracted. Figure 5.13 summarises the periods taken. The mean time was 21.6 minutes with a standard deviation of 9.6 minutes. Nine completed the survey in less than 10 minutes and a further 116 completed it in between 10 and 15 minutes.



Timing.
Covers ratings of >40 scenes. Omits eight >60 minutes.

Figure 5.13 Elapsed time for rating scenes

5.4 SOURCE OF RESPONSES

Table 5.5 indicates the source of respondents and Table 5.6 indicates the percentage responses per source. Local councils accounted for nearly 87% of invitations but only 3% of responses which was disappointing. One council respondent wrote that councillors receive many surveys every day which may explain the low response. The response of county councillors, over 10%, was more than three times the percentage of local councils. The highest response rate was from staff with 37% and a quarter of all responses. This suggests that while councillors are fully engaged and have little time for such surveys, the staff are less busy or perhaps more interested in such surveys.

Table 5.5 Invitations and responses

	Invitations sent	
Location	**N**	**%**
Local councils	14716	86.70
County councils	1719	10.13
Staff	539	3.18
Total	16974	100
	Respondents	
Local councils	428	53.17
County councils	178	22.11
Staff	199	24.72
Total	805	100

Emails sent

Table 5.6 Response per source

Location	% response
Local councils	2.91
County councils	10.35
Staff	36.92
Total	4.74

5.5 DEMOGRAPHIC CHARACTERISTICS

This section examines the characteristics of the respondents to the survey. Using Excel's Pivot Table facility, cross tabulations of the data were derived.

Table 5.7 indicates that the age profile was in the older brackets, with 88% being 45 or older. The age profile of councillors and staff is unknown but for the UK population, the 45+ age group comprises 54% of the population. Assuming the respondents are a fair reflection of the councillors and staff, it indicates that they are generally of the older segment of the population. The difference in the age profile between the survey and the UK population was significant (χ^2 = 4.46E-237, df = 3, p < 0.000).

Table 5.7 Age and gender of respondents

	Female	Male	Total	%
18-24	9	4	13	1.61
25-44	38	44	82	10.19
45-64	162	204	366	45.47
65+	122	222	344	42.73
Total	331	474	805	100
%	41.12	58.88	100	

Demography

Table 5.8 indicates the age profile of staff and councillors. It shows that the staff has a slightly younger age profile than the councillors. Local councillors are slightly younger than county councillors. Table 5.9 indicates that while males dominate as councillors, there are slightly more females than males working as senior staff in councils.

Table 5.8 Age and location of respondents

Age	Staff	County council	Local council	Total
18-24	11		2	13
25-44	33	12	37	82
45-64	87	80	199	366
65+	68	86	190	344
Total	199	178	428	805

Table 5.9 Staff and Councillors gender

Gender	Staff	County council	Local council	Total
Female	106	46	179	331
Male	93	132	249	474
Total	199	178	428	805

The proportion of females among the respondents, including both councillors and staff, was 41%, somewhat higher than the proportion of females who had been emailed invitations which was 32% (Table 5.10).

Table 5.10 Females in councils and staff surveyed

Country	Total	Females	% female
England	14327	4772	33.31
Scotland	919	245	26.24
Wales	1189	322	25.94
Staff	539	145	26.90
Total	16974	5484	32.31

The difference was significant (χ^2= 26.70, df = 1, p < 0.000). It was also somewhat lower than the proportion of females in the UK's population which is 50.2%.

Table 5.11 summarises the highest qualification of respondents as detailed below:

- Certificate, Diploma, Foundation Degree (Levels 4 & 5)
- Bachelor Degree, graduate diploma (Level 6)
- Higher Degree – post-grad diploma, Masters, PhD (Levels 7 & 8)

Table 5.11 Highest qualifications by gender

Qualification	Female	Male	Total	%
No qual.	22	53	75	9.32
Cert; Diploma	81	124	205	25.47
Bachelor	114	140	254	31.55
Masters, PhD	98	126	224	27.83
Other	16	31	47	5.84
Total	331	474	805	100

Councillors and staff were very well qualified, with nearly 60% having either a bachelor's degree or higher degree. Females had slightly fewer of these qualifications than males, 26% compared with 33%. A relatively small number of respondents, less than 10%, had no qualification. The staff were the best qualified with 66% holding bachelor or higher degrees compared with 52% for county councillors and 59% for local councillors (Table 5.12).

Table 5.12 Councillors and staff qualifications

Qualification	Staff	County council	Local council	Total
No qual.	15	27	33	75
Cert; Diploma	44	53	108	205
Bachelor	69	49	136	254
Masters, PhD	64	44	116	224
Other	7	5	35	47
Total	199	178	428	805

Most of the respondents, 94%, were born in the UK, with a further 20 born in a European country and 30 born in other countries – USA 6, Australia and South Africa 5 each, New Zealand and China/ Hong Kong 3 each, Canada and Kenya 2

each, and one each in Sudan, Kenya, Zimbabwe, Brazil and Malaysia (Table 5.13). Table 5.14 indicates that respondents in the UK, Europe and elsewhere are all well qualified. None from Europe were without qualifications.

Table 5.13 Birthplace of respondents

Birthplace	Female	Male	Total
Within UK	301	454	755
Europe	12	8	20
Other	18	12	30
Total	331	474	805

Table 5.14 Qualifications & birthplace of respondents

Qualification	UK	Europe	Other	Total
No qual.	73		2	75
Cert; Diploma	197	5	3	205
Bachelor	241	4	9	254
Masters, PhD	201	11	12	224
Other	43		4	47
Total	**755**	**20**	**30**	**805**

5.6 EXPERIENCE WITH WIND FARMS

The survey asked councillors and staff the following questions:

- How familiar are you with wind farms? - Never seen one, Seen a few, Seen many.
- Do you live near a wind farm? No, Yes. If yes, how far away is it? 0 - 2 km, 2 – 5 km, 5 – 10 km. Comment.
- Attitude to wind farms: Against, In favour, It depends, Don't know.

Familiarity

Table 5.15 – 5.18 summarise the familiarity of respondents with wind farms. Overall, two thirds of respondents had seen many wind farms while one third had seen only a few. Figure 5.14 illustrates the familiarity of councillors and staff and indicates that the senior staff and county councillors have both seen many wind farms with local councillors a little less. More males than females had seen many wind farms (Table 5.17). Three claimed to have never seen a wind farm, two were council staff and all three were well qualified.

Table 5.15 Respondents' familiarity with wind farms – Councillors & staff

Respondents	Seen a few	Seen many	Total	%
Staff	54	142	198	25
Local council	163	263	427	22
County council	46	130	176	53.
Total	263	535	801	100.
%	32.8	66.79	100	

Attitude Never seen one: 2 staff, 1 local council

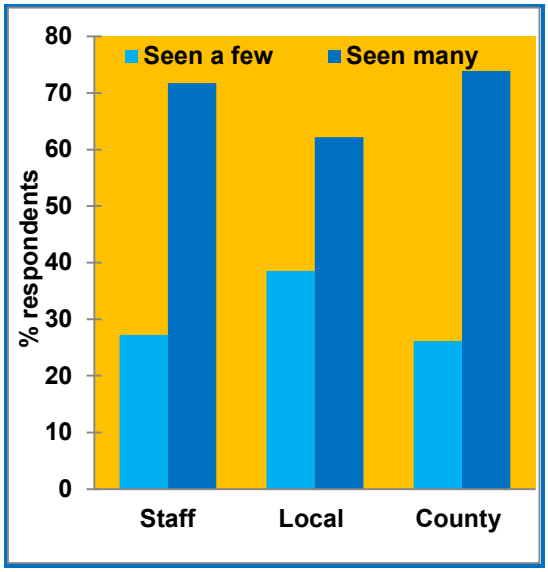


Figure 5.14 Respondents' familiarity

Table 5.16 Respondents' familiarity with wind farms – Gender

Respondent	Never seen one	Seen a few	Seen many	Total
Female	2	143	184	329
Male	1	120	351	472
Total	3	263	535	801

Table 5.17 Respondents' familiarity with wind farms – Age

Respondent	Never seen one	Seen a few	Seen many	Total
18-24		3	10	13
25-44		31	51	82
45-64	1	131	233	365
65+	2	98	241	341
Total	3	263	535	801

Table 5.18 and Figure 5.15 illustrate the influence of qualifications on familiarity and indicates similar proportions across all

qualifications, but those without qualifications had seen fewer.

Table 5.18 Respondents' familiarity with wind farms – Qualifications

Respondent	Never seen one	Seen a few	Seen many	Total
No qual		32	42	74
Cert, Dip.	1	54	149	204
Bachelor	1	90	161	252
Higher degree	1	70	153	224
Other		17	30	47
Total	3	263	535	801

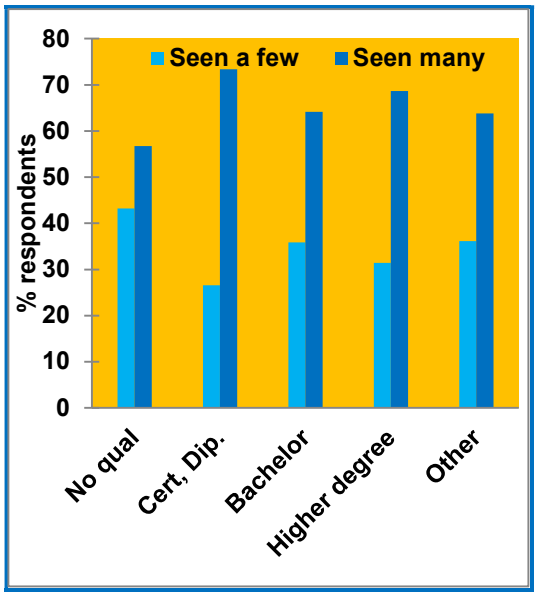


Figure 5.15 Influence of education on familiarity

Respondents were asked whether they live near a wind farm. A total of 479 said "no" and 314 said "yes" they do live near one. Combining their proximity to a wind farm with their familiarity found, as one would expect, that those living near a wind farm had seen many, while those not living near one were equivocal – similar proportions saw a few or many (Table 5.19, Figure 5.16).

Table 5.19 Proximity vs familiarity

Familiarity	Yes	No
Seen a few	57	204
Seen many	257	275
Total	314	479

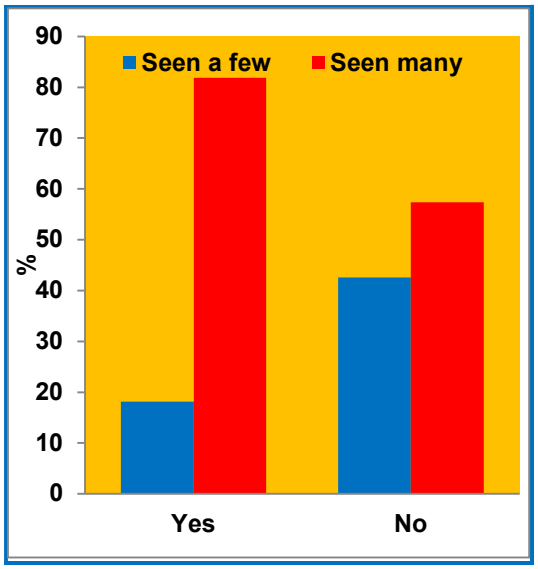


Figure 5.16 Proximity vs familiarity

Only 208 respondents indicated the distance to the wind farm from their home and the majority of these were at considerable distance: 5 – 10 km (Table 5.20)

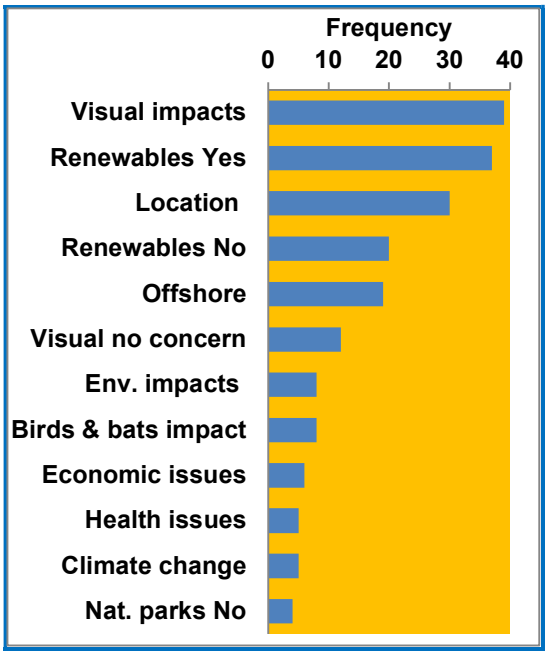
Table 5.20 Distance to nearest wind farm

Familiarity	0-2 km	2 - 5 km	5 - 10 km
Seen a few	5	9	25
Seen many	34	52	83
Total	39	61	108

Comments

After indicating whether they lived near a wind farm or not, and its distance if they did, respondents were given an opportunity of providing comment on the wind farms. A total of 166 respondents provided comments.

The major issues were, in order: visual impacts of wind farms, favour renewable energy, location of wind farms, oppose renewables, favour offshore over onshore location, visual impacts are of no concern, and their environmental impacts (Figure 5.17). Minor issues included noise, decommissioning, solar and tidal preferred, nuclear option, health issues, and proximity to housing.



Demography

Figure 5.17 Comments on wind farms

5.7 ANALYSIS OF RATINGS

Overall ratings

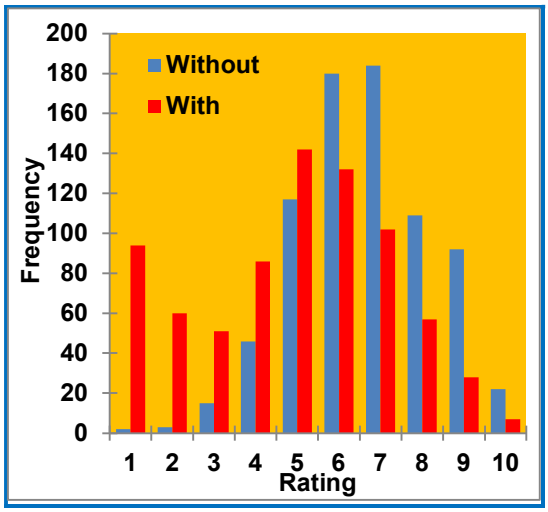
The means for all scenes and respondents are summarised in Table 5.21. This indicates that the overall difference in mean ratings for scenes with wind farms is 1.82 to 1.84 lower than for scenes without the wind farms. The paired T test indicates that the differences were significant.

Table 5.21 Means of scenes and respondents

	Without wind farm	With wind farm	Diff.	p
Scenes	7.08	5.24	1.84	<0.000
Respondents	7.09	5.27	1.82	<0.000

Numbers

Figure 5.18 compares the mean ratings by respondents for scenes with and without the wind farms. It is evident that there are many lower ratings for scenes with wind farms while higher ratings occur for the scenes without wind farms.



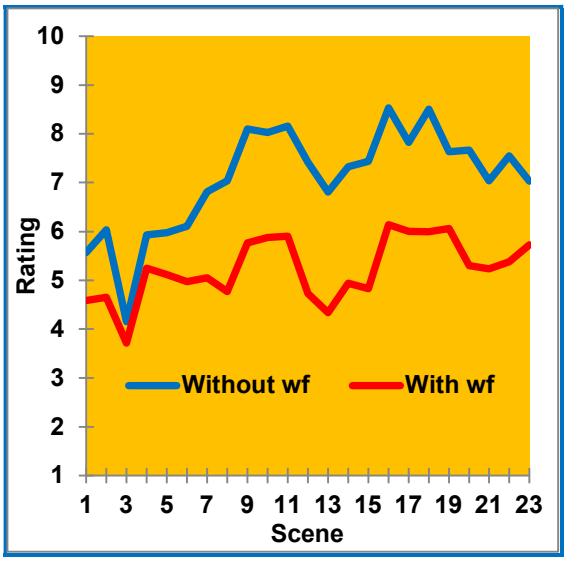
Numbers

Figure 5.18 Respondent ratings of scenes with and without wind farms

The ratings of the 23 scenes, without and with the wind farms, were assessed separately (Table 5.22, Figure 5.19). ANOVA tests of each of the pairs of scenes with and without the wind farms indicated that the differences for each were significant.

Table 5.22 Ratings of scenes

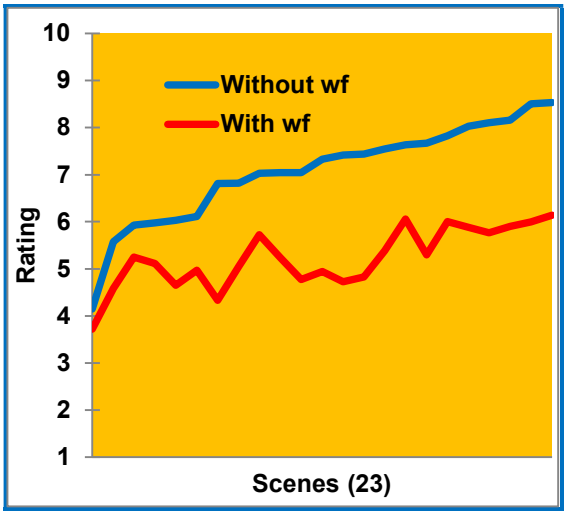
Scenes	Without	With	Diff.	p
1	5.57	4.58	0.99	2.50E-11
2	6.03	4.65	1.38	1.40E-20
3	4.15	3.72	0.43	0.0009
4	5.93	5.24	0.68	3.30E-06
5	5.98	5.11	0.86	3.20E-09
6	6.11	4.97	1.14	4.70E-15
7	6.82	5.05	1.77	1.50E-37
8	7.04	4.77	2.27	1.20E-60
9	8.10	5.76	2.34	3.50E-67
10	8.03	5.88	2.15	9.40E-57
11	8.16	5.90	2.26	1.60E-63
12	7.42	4.73	2.69	1.40E-78
13	6.81	4.33	2.48	1.60E-66
14	7.33	4.94	2.39	3.60E-67
15	7.44	4.83	2.61	1.60E-77
16	8.53	6.14	2.39	3.20E-66
17	7.82	6.00	1.82	1.50E-39
18	8.51	5.99	2.51	2.00E-68
19	7.64	6.06	1.58	9.40E-33
20	7.67	5.30	2.37	5.70E-67
21	7.04	5.23	1.81	2.30E-37
22	7.55	5.38	2.17	2.80E-55
23	7.03	5.73	1.30	4.80E-24
Mean	**7.07**	**5.23**	**1.84**	**6.81E-12**



Ratings

Figure 5.19 Rating of scenes

Convergence of ratings

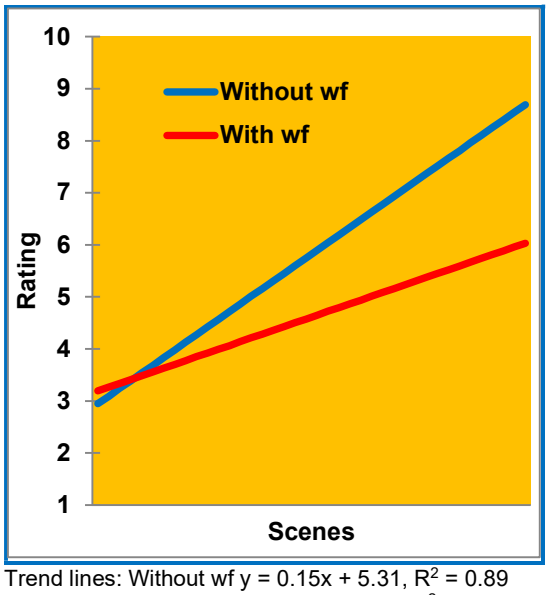


Ratings

Figure 5.20 Scenes without wind farms arranged in ascending order

Arranging the ratings of scenes without wind farms in ascending order yields the graph shown by Figure 5.20. The gap between the ratings widens as the ratings of scenes without wind farms increases. Based on the trend lines for the two data, they converge at a rating of 3.43 (Figure 5.21).

In the author's 2003 study of hypothetical South Australian wind farms the convergence occurred at 5.10. In the 2018 survey of actual wind farms in New South Wales, Victoria and South Australia it was 4.92. Below this rating of the scenes without wind farms, the presence of a wind farm actually enhances the scenic rating. Above the convergence point, the presence of the wind farm lowers landscape quality.



Trend lines: Without wf $y = 0.15x + 5.31$, $R^2 = 0.89$
With wf $y = 0.07x + 4.36$, $R^2 = 0.61$

Figure 5.21 Trend lines for rating of scenes without and with wind farms

It is of interest that the convergent point of 3.43 is considerably lower than in the Australian surveys. This suggests that the point at which wind farms actually enhance the landscape comprises landscapes of much lower quality in Britain than in Australia.

5.8 ATTITUDES TOWARDS WIND FARMS

Respondents were asked about their attitude towards wind farms – whether they were in favour, against them, it depends, or don't know. The null hypothesis is that their attitude does not affect their ratings, e.g. if against them then they would not rate low the scenes with wind farms. Those in favour would not rate them higher.

The highest ratings for the scenes without wind farms were from respondents who were against them while those in favour of wind farms had the lowest ratings for these scenes. However, the ratings of scenes with wind farms were lowest for those against wind farms and highest for those in

favour. This demonstrates conclusively that attitudes affect ratings which is counter to the null hypothesis. Moreover, the difference in ratings for those in favour was only 0.54 but the difference for those against was a massive 5.75.

Table 5.23 Ratings vs attitude

	In favour	Against	It depends	Don't know
Without wf	6.89	7.85	7.15	7.29
With wf	6.35	2.11	4.34	3.42
Difference	0.54	5.75	2.81	3.87
Scenes	480	107	187	8
%	61.38	13.68	23.91	1.02

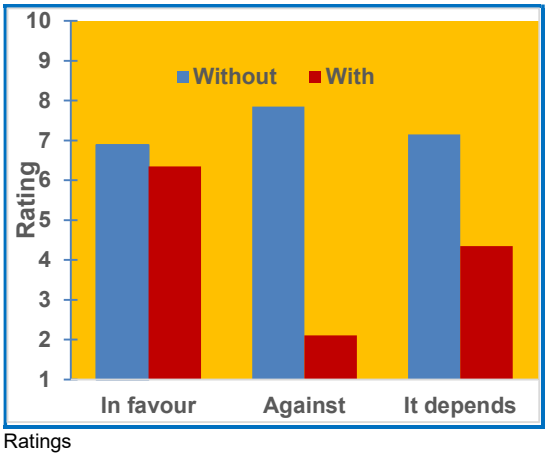


Figure 5.22 Ratings v attitude to wind farms

Applying the paired sample T test indicated that the differences in ratings between scenes without wind farm and scenes with wind farm were, not surprisingly, significant:

In favour: t = 8.47, df 465, p < 0.000
Against: t = 22.56, df 101, p < 0.000
It depends: t = 16.24, df 168, p < 0.000
Don't know t = 4.82, df 7, p = 0.001

Ratings by country

The ratings were analysed separately by country for respondents from England, Scotland and Wales. Table 5.24 and Figure 5.23 summarises their mean ratings. These indicate that while the difference in English ratings between scenes without and with wind farms was only 1.45, it was 2.40 for the Welsh and more than twice the English difference for the Scots.

The ratings of scenes without wind farms were similar across the three countries, varying by only 0.14. However, the ratings of scenes with wind farms varied widely across countries, by 2.07 between England and Scotland and by 1.05 between England and Wales. The mean rating of Scottish respondents is 63% of those in England, and for Welsh respondents it is 81%.

Table 5.24 Mean ratings of respondents by country

Respondents	Without wf	With wf	Difference
England	7.07	5.61	1.45
Scotland	7.10	3.54	3.56
Wales	6.96	4.56	2.40

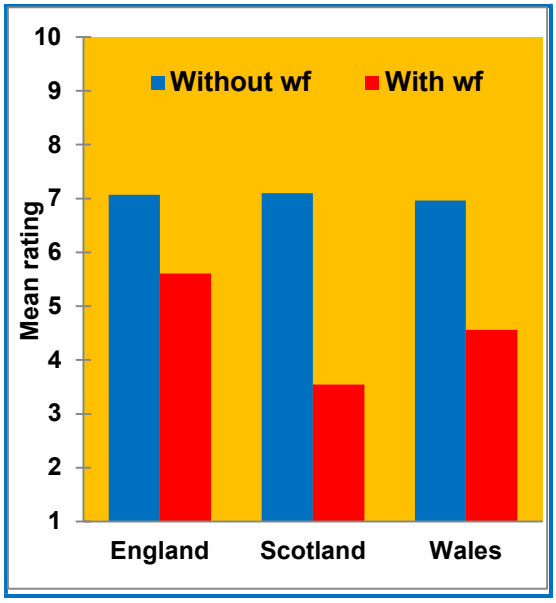


Figure 5.23 Mean ratings of respondents by country

The difference in ratings of scenes without and with wind farms was significant for all countries:

England t = 10.32, df = 22, p < 0.000
Scotland t = 22.63, df = 22, p < 0.000
Wales t = 15.08, df = 22, p < 0.000

Table 5.25 and Figure 5.24 summarise the mean ratings of scenes in England and Scotland by all respondents (There was only one scene in Wales). This indicates that the mean rating of scenes in England

were lower (5.95) than in Scotland (7.68). The difference between scenes without and with wind farms for Scottish scenes (2.26) was twice that of the English scenes (1.07).

Table 5.25 Mean ratings of scenes by country

	Without wf	With wf	Difference
England	5.95	4.88	1.07
Scotland	7.68	5.42	2.26

Ratings Wales with one scene omitted from Table.

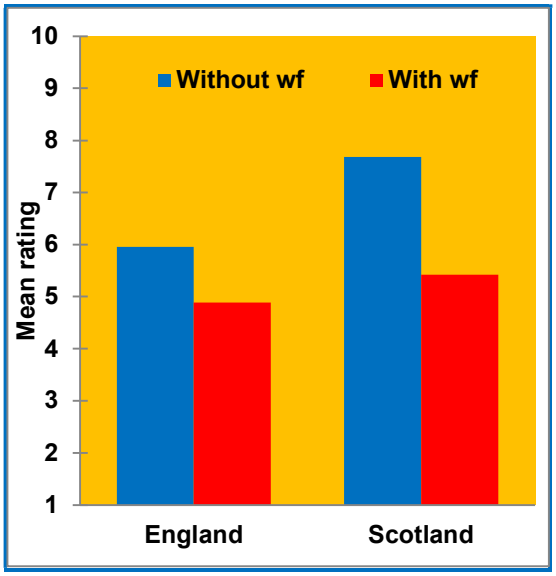


Figure 5.24 Mean ratings of scenes by country

Council attitudes

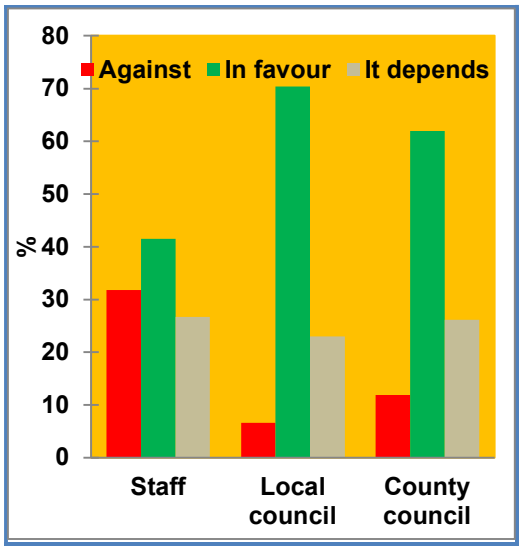
While 12% of local councillors and 7% of country councillors opposed wind farms, 31% of staff opposed them (Table 5.26, Figure 5.25). This difference in attitude is a significant finding of the survey.

Table 5.26 Respondent's attitude to wind farms – Councillors & staff

Respondents	Against	In favour	It depends	Total
Staff	62	81	52	198
Local council	28	297	195	427
County council	21	109	46	176
Total	111	487	195	801
%	13.86	60.80	24.36	100

Attitude Plus 8 don't know (1%)

Local councillors strongly supported wind farms with 70% in favour and 61% of country councillors were similarly supportive. However, only 41% of staff was in favour.



Attitude

Figure 5.25 Attitude of staff and councillors

Attitude and familiarity

Table 5.27 and Figure 5.26 examine the relationship between attitude and familiarity with wind farms and indicate that the strongest support was from respondents who had seen a few wind farms. Figure 5.20 shows that 65% of those who had seen a few wind farms favoured them, compared with 59% of those who had seen many wind farms. The strongest opposition came from those who had seen many wind farms – 18% were against them compared with 6% for those who had seen a few.

Table 5.27 Respondent's attitude to wind farms – Familiarity

Respondent	Against	In favour	It depends	Total
Never seen one		2	1	3
Seen a few	15	172	73	263
Seen many	96	313	121	535
Total	111	487	195	801

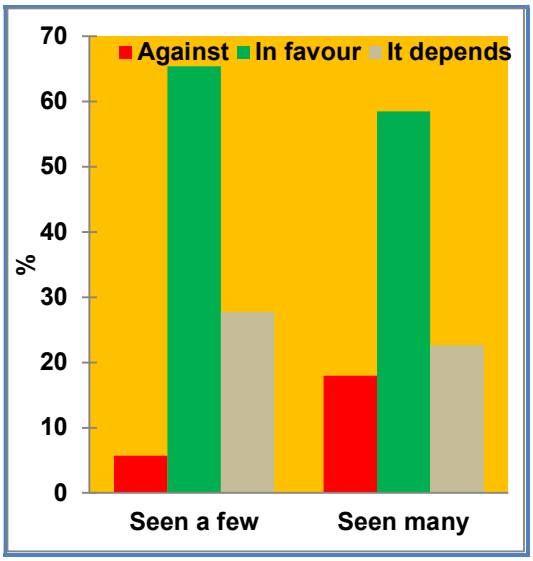


Figure 5.26 Attitude vs familiarity re wind farms - percentages

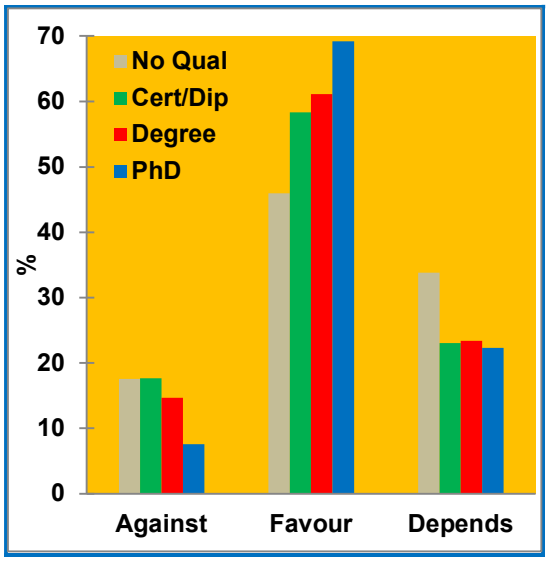


Figure 5.27 Respondent's attitude to wind farms – Qualifications

Table 5.28 and Figure 5.27 show that the more educated the respondents were, the more likely they were to be in favour of wind farms and the less likely they were to be against them. This finding was consistent across the four education levels. The category, "It depends", was highest among those without qualifications and similar for all education levels.

Table 5.28 Respondent's attitude to wind farms – Qualifications

Respondent	Against	In favour	It depends	Total
No qual.	13	34	25	74
Cert, Dip.	36	119	47	204
Bachelor	37	154	59	252
Higher degree	17	155	50	224
Other	8	25	14	47
Total	111	487	195	801

Comparing the distance to the nearest wind farm with the attitude of respondents showed that the proportion of respondents opposed to wind farms or in favour of them did not vary consistently with distance (Table 5.29, Figure 5.28). The highest support for wind farms though corresponded with the largest distance from the respondent's home.

Table 5.29 Relationship of distance and attitude to wind farm

	0-2 km	2 - 5 km	5 - 10 km	Total
Against	9	17	18	44
In favour	19	23	62	104
It depends	11	21	27	59
Total	39	61	107	207

Plus 1 don't know

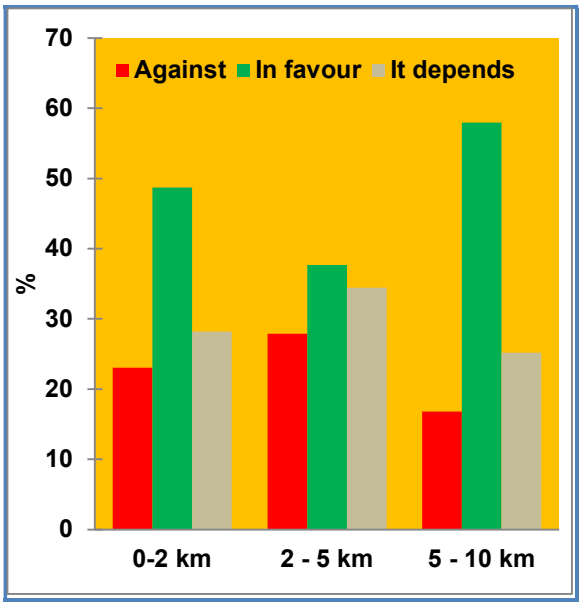


Figure 5.28 Relationship of distance and attitude to wind farm

5.9 ACCEPTABILITY OF WIND FARMS

The overall acceptability of the wind farms shown in the survey is summarised by Table 5.30 and Figure 5.29 which show the average scores. These show that the number of acceptability ratings was nearly twice as many as unacceptability.

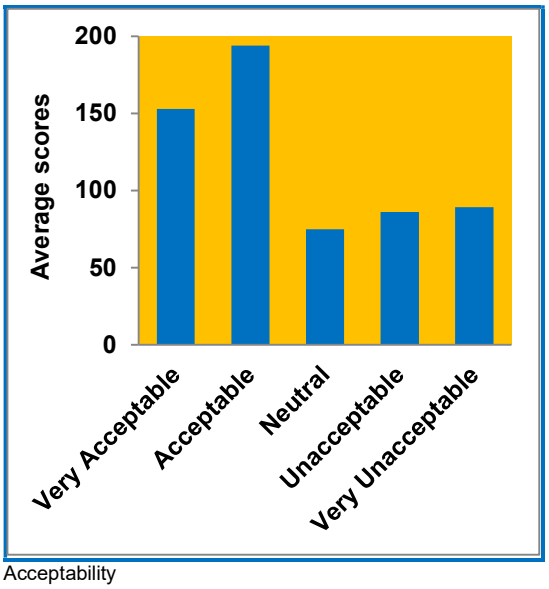


Figure 5.29 Acceptability of wind farms - Britain

Table 5.30 Acceptability of wind farms - Britain

Acceptability	Mean	%	SD
Very Acceptable	152.87	25.59	31.18
Acceptable	193.96	32.47	18.69
Neutral	74.91	12.54	11.94
Unacceptable	86.26	14.44	16.51
Very Unacceptable	89.30	14.95	20.88
Total	597.30	100.00	

Acceptability

The respondents were divided by country: England, Scotland, and Wales. Table 5.31 summarises the number of respondents in each country.

Table 5.31 Respondents by country

Scenes	England	Scotland	Wales	Total
1 - 46	612	106	40	758
zero	16	4	1	21
Total	628	110	41	779
%	80.62	14.12	5.26	100
Britain %	86.61	8.49	4.90	100

Total analysis

An additional ten respondents did not live in the Britain, and a further 17 respondents did not enter their postcode but were assumed to live in Britain. Nearly 81% of the respondents were from England, 14% from Scotland and the remaining 5% from Wales. Compared with the populations of each country, the responses from Wales were nearly the same, around 5%, while responses from Scotland matched its population percentage (14.12%) as did England's percentage (80.61%).

Acceptability of wind farms by country

The acceptability of wind farms was examined for England, Scotland and Wales (Tables 5.32 & 5.33, Figure 5.30). These indicate that while respondents from England were fairly relaxed about wind farms, with 63% finding them acceptable, this was less so in Wales with 49% finding them acceptable and 35% unacceptable. However, in Scotland the majority, 55%, found them unacceptable compared with 34% acceptable. This suggests that the threshold of acceptability has been passed in Scotland and is approaching it for Wales.

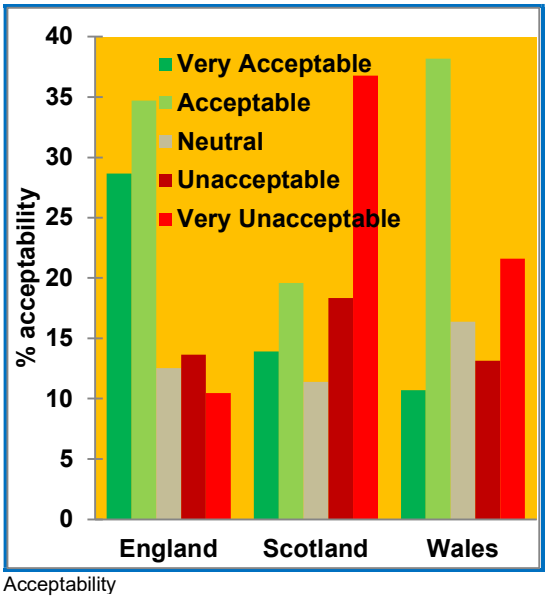
Table 5.32 Acceptability of wind farms by country – Average of ratings

Mean	England	Scotland	Wales	Total
Very Acceptable	134	12	3	134
Acceptable	162	16	12	162
Neutral	58	9	5	58
Unacceptable	64	15	4	64
Very Unacceptable	49	31	7	49
Total	466	83	31	466

Acceptability

Table 5.33 Acceptability of wind farms by country – Average %

Mean %	England	Scotland	Wales	Mean
Very Acceptable	29	14	11	29
Acceptable	35	20	38	35
Neutral	13	11	16	13
Unacceptable	14	18	13	14
Very Unacceptable	10	37	22	10
Total	100	100	100	100



Acceptability

Figure 5.30 Acceptability of wind farms by country – Average %

Comparing the responses for England, Scotland and Wales found that the differences between countries were significant for the very acceptable, acceptable and very unacceptable categories, but were not significant for the neutral and unacceptable categories (Table 5.34).

Table 5.34 Significance of differences in acceptability between countries

Category	ANOVA
Very Acceptable	F = 8.60, df = 2, 755, p = 0.0002
Acceptable	F = 8.02, df = 2, 755, p = 0.0004
Neutral	F = 0.21, df = 2, 755, p = 0.81
Unacceptable	F = 1.76, df = 2, 755, p = 0.17
Very Unacceptable	F = 31.28, df = 2, 755, p < 0.000

Total analysis

Acceptability by region

To ascertain the acceptability of wind farms in different parts of the country, the data was divided by region based on their councils. There are eight official regions in England (Figure 5.31). In Scotland, there are many regions but the sake of simplicity the data was divided between southern Scotland (south of the Firth of Forth) and northern Scotland. Similarly, Wales was divided between north and south Wales, the boundary being level with Aberystwyth. Twelve regions in total were defined.

Figure 5.31 Regions of England

Table 5.35 indicates the number of respondents in each region.

Table 5.35 Respondents per region.

Region	Respondents	%
South West England	89	11.41
South East England	180	23.08
East of England	103	13.21
East Midlands	60	7.69
West Midlands	40	5.13
North West England	92	11.79
Yorkshire & the Humber	45	5.77
North East England	20	2.56
North Scotland	58	7.44
South Scotland	52	6.67
North Wales	13	1.67
South Wales	28	3.59
Total	780	100.00

Note: Excludes respondents who did not indicate their council

Figure 5.32 summarise the acceptability of wind farms by region. Broadly it reinforces the earlier finding of the unpopularity of wind farms in Scotland and Wales, with much higher proportions of the population finding them unacceptable compared with England where their acceptability dominates.

Table 5.36 and 5.37 summarise the results per region. The strongest support for wind farms is in the South East region, where there are very few present, followed by the Yorkshire/Humber region, the South West region and the East of England region, all three of which have many wind farms. The region most sure of its opinion is Yorkshire & Humber with only 8% neutral, while South Wales has the largest proportion, 25%, unsure about wind farms. The highest proportion opposed to wind farms is North Scotland and South Scotland, both 55%, followed by South Wales, 50% and North Wales, 43%.

Table 5.36 Acceptability ratings by region - %

Region	Very acceptable	Acceptable	Neutral	Unacceptable	Very unacceptable
South West England	29.32	31.43	12.29	13.85	13.11
South East England	33.74	34.90	11.11	12.75	7.50
East of England	21.53	38.15	15.56	15.74	9.01
East Midlands	22.75	32.21	13.65	15.47	15.92
West Midlands	28.19	29.73	11.78	12.06	18.23
North West England	23.89	34.85	15.95	14.61	10.70
Yorkshire & the Humber	34.38	31.10	8.49	8.63	17.40
North East England	30.97	20.65	11.29	23.23	13.87
North Scotland	10.92	22.61	11.88	16.95	37.64
South Scotland	18.23	15.68	11.50	18.93	35.66
North Wales	21.61	17.59	17.59	17.09	26.13
South Wales	9.29	15.71	25.32	17.63	32.05

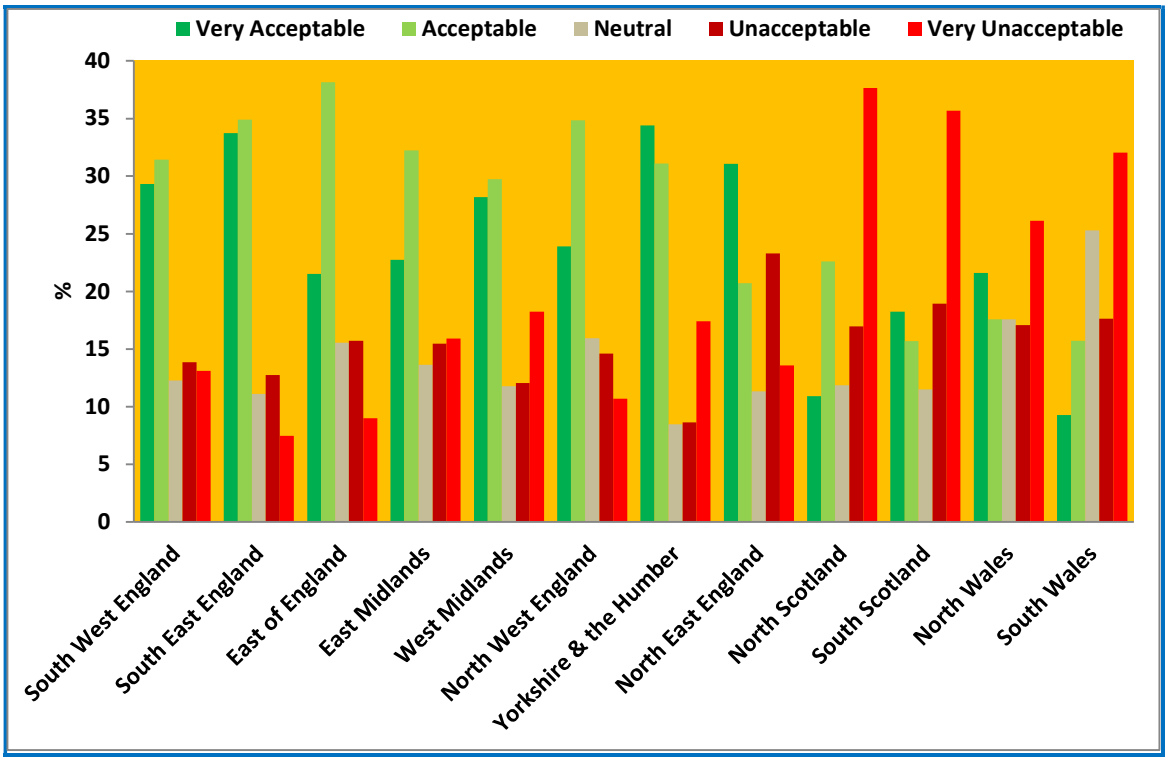


Figure 5.32 Acceptability ratings by region - %

Table 5.37 Summary of results by region

Region	Acceptability
South West England	Acceptable 61% Unacceptable 27% Neutral 12%
South East England	Acceptable 69% Unacceptable 20% Neutral 11%
East of England	Acceptable 60% Unacceptable 25% Neutral 16%
East Midlands	Acceptable 55% Unacceptable 31% Neutral 14%
West Midlands	Acceptable 58% Unacceptable 30% Neutral 12%
North West England	Acceptable 59% Unacceptable 25% Neutral 16%
Yorkshire & Humber	Acceptable 65% Unacceptable 26% Neutral 8%
North East England	Acceptable 52% Unacceptable 37% Neutral 11%
North Scotland	Acceptable 34% Unacceptable 55% Neutral 12%
South Scotland	Acceptable 34% Unacceptable 55% Neutral 11%
North Wales	Acceptable 39% Unacceptable 43% Neutral 18%
South Wales	Acceptable 25% Unacceptable 50% Neutral 25%

Acceptability of wind farms by postcode area

To enable their location across Britain to be determined, respondents were asked to indicate the first two digits of their postcode. The first two digits are the Postcode Areas which indicate the main city, town or region, e.g. Hd = Huddlesfield, La = Lancaster, Ox = Oxford. Within these postcode areas are county councils and local councils.

The number of respondents per postcode area ranged from 1 to 27 (Gloucester). Appendix 3 shows the results by postcode area. The following analysis covers only those with four or more respondents per postcode area.

Taking the very acceptable and acceptable categories together:

- Areas with the strongest support for wind farms were: Torquay 98%, Doncaster 96%, Warrington 96%,

Salisbury 93%, Kingston upon Thames 91%;
- Areas with lowest acceptability for wind farms were: Blackburn 32%, Exeter 33%, Wigan 34%, Cleveland 41%,

Taking the very unacceptable and unacceptable categories together:

- Areas with the least support for wind farms were: Exeter 61%, Wigan 52%, Sheffield 48%, Leeds 45%, Enfield 44%, Worcester 43%,
- Areas with the nil opposition to wind farms were: Torquay, Salisbury, Warrington, and those with little opposition Doncaster 2%, Truro 3%, Bournemouth 4%, Kingston upon Thames and Canterbury 7%.

Councillors and staff

Respondents were asked whether they were on a local (borough) council or county council, or whether they worked for the council. (Table 5.38).

Table 5.38 Number of councillors and staff

Status	Frequency	%
Staff	199	24.72
County Council	178	22.11
Local Council	428	53.17
Total	805	100.00

Demography

Tables 5.39 & 5.40 and Figure 5.33 show the ratings of acceptability by councillors in local and county councils and by senior staff. There is a considerable disparity in the acceptability of wind farms between councillors and senior staff. While both local and county councillors generally found wind farms acceptable, the opposite applied to senior staff, many of whom rated the wind farms as unacceptable.

Whereas councillors, both local and county, rated 23% of wind farms as either unacceptable or very unacceptable, more than double this, 47% were rated either unacceptable or very unacceptable by senior staff.

Table 5.39 Acceptability ratings by councillors & staff - Number of ratings

	Staff	County Council	Local council	Total
Very Acceptable	603	595	2217	3415
Acceptable	690	1008	2669	4367
Neutral	372	417	891	1680
Unacceptable	444	397	1052	1893
Very Unacceptable	1037	285	652	1974
Total	3146	2702	7481	13329

Table 5.40 Acceptability ratings by councillors & staff - %

	Staff	County Council	Local council
Very Acceptable	19.17	22.02	29.64
Acceptable	21.93	37.31	35.68
Neutral	11.82	15.43	11.91
Unacceptable	14.11	14.69	14.06
Very Unacceptable	32.96	10.55	8.72
Total	100	100	100

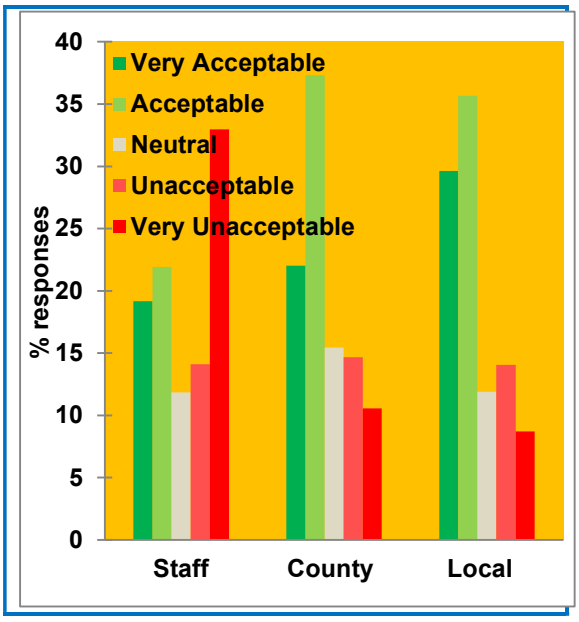


Figure 5.33 Acceptability ratings by staff & councillors

Assessing the significance in differences between the ratings for staff, county and local councils found that only the unacceptable ratings were not significant,

but all the other categories were significant (Table 5.41).

Table 5.41 Significance of differences in acceptability between staff, country councils and local councils

Category	ANOVA
Very Acceptable	F = 7.32, df = 2, 755, p = 0.0007
Acceptable	F = 10.64, df = 2, 755, p < 0.000
Neutral	F = 34.20 df = 2, 755, p < 0.000
Unacceptable	F = 0.105, df = 2, 755, p = 0.90
Very Unacceptable	F = 35.19, df = 2, 755, p < 0.000

Drilling further into the data, acceptability of wind farms was analysed between staff and county councils and staff and local councils separately (Table 5.42).

Table 5.42 Significance of differences in acceptability between 1. staff and county councils, and 2. staff and local councils (ANOVA)

Category	County Councils
Very Acceptable	F = 0.08, df = 1, 344, p = 0.77
Acceptable	F = 11.40, df = 1, 344, p = 0.001
Neutral	F = 50.83, df = 1, 344, p < 0.000
Unacceptable	F = 0.058, df = 1, 344, p = 0.81
Very Unacceptable	F = 27.80, df = 1, 344, p < 0.000
Category	**Local Councils**
Very Acceptable	F = 10.16, df = 1, 589, p = 0.001
Acceptable	F = 20.82, df = 1, 589, p < 0.000
Neutral	F = 67.60, df = 1, 589, p < 0.000
Unacceptable	F = 0.036, df = 1, 589, p = 0.85
Very Unacceptable	F =59.59, df = 1, 589, p < 0.000

Of most significance is the difference in opinion between staff and councillors for the very unacceptable categories. There was a significant difference in the very unacceptable category, in other words, the councillors, at both county and local level, had a different opinion about wind farms than did the staff. A much larger proportion of the staff considered them unacceptable than did the councillors (see Table 5.40) and the difference was significant for both county and local councils.

There was also a significant difference for the acceptable category for both county and local councils compared with staff; a much greater proportion of councillors considered the wind farms acceptable than did the staff. For the very acceptable category, the difference between staff and county councillors was not significant, but it was significant for the local councils.

Acceptability vs attitude

There is a clear link between the attitude of respondents towards wind farms and their scoring of their acceptability.

The acceptability of wind farms was scored on a 5-point scale: very acceptable, acceptable, neutral, unacceptable, and very unacceptable.

For each respondent the frequency of each score was added together. The number of scenes was 23 so for respondents against wind farms, there may be 5 very unacceptable, 12 acceptable, and 6 neutral, total, 23. If all the scores were at the extreme values – very acceptable or very unacceptable, then the quotient would be 46 (i.e. 2 X 23).

Assuming that a very acceptable core is twice that of acceptable, and the same for very unacceptable, then an acceptability quotient can be derived by the following algorithm: (very acceptable X2) + acceptable – (unacceptable + very unacceptable X2). Whether the extreme scores are twice that of the less extreme score is unknown; for some respondents it may be much higher, say three or four times, or for some it may be only marginally greater. In the absence of contrary advice, twice is adopted here.

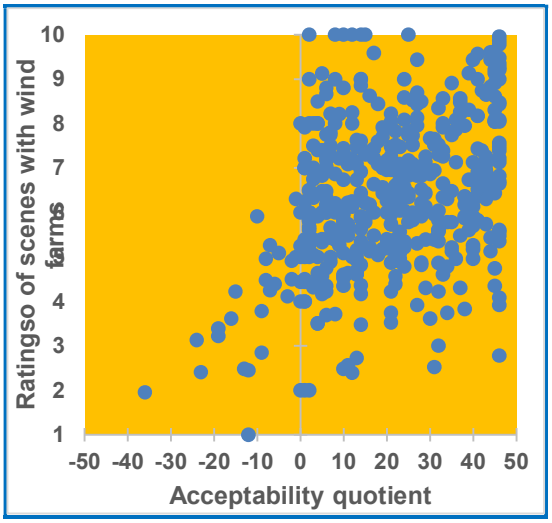
Positive acceptability quotients indicate that the positive scores of acceptability outweigh the negative scores, and, conversely, the negative acceptability quotients indicate that the unacceptable scores outweigh the positive acceptability quotients.

Table 5.43 shows the acceptability quotient means for each attitude category. As expected, the mean for the 'in favour' group is nearly 20 while that for the 'against' category is a much larger negative figure of nearly 28.

Table 5.43 Mean acceptability quotients per attitude category

	In favour	Against	It depends	Don't know
Quotient	19.55	-27.86	-4.94	-7.88

Figures 5.34, 5.35 and 5.36 show the ratings vs acceptability quotients for the 'in favour', 'against', and 'it depends' groups. In Figure 5.34, 'in favour', most of the respondent's ratings were on the positive side while in Figure 5.35, 'against', all but one of the scores are on the negative side. In Figure 5.36, 'it depends', the scores are scattered across both positive and negative scores although the majority are on the negative side.



Rating

Figure 5.34 'In favour' attitude wind farm group

It is interesting that the ratings of the scenes were higher for the 'in favour" group compared with the 'against' group, ranging up to 10 for the former but only to 7 for the latter. Also of interest is the one individual who was against wind farms but who voted 19 of the 23 scenes with wind farms as very acceptable, resulting in an acceptability quotient of 31 as shown in Figure 5.35.

Overall, these figures provide evidence that attitude has a major influence on the scores of acceptability of wind farms.

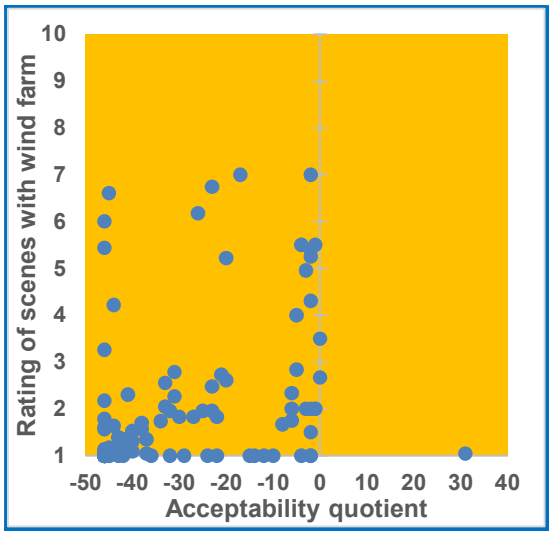


Figure 5.35 'Against' attitude wind farm group

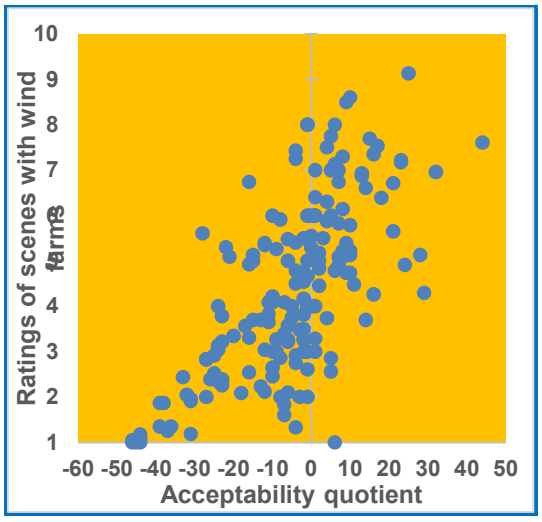


Figure 5. 36 'It depends' attitude wind farm group

Attitudes vs acceptability by country

Table 5.44 and Figure 5.37 show the relationship between attitudes and acceptability for all of Britain – those who were in favour of wind farms voted strongly for their acceptability whereas those against them voted them unacceptable. About 21% voted "It depends" and these derived largely from respondents who were against wind farms.

Table 5.44 Respondent attitudes vs acceptability of wind farms (%) - Britain

%	In favour	Against	It depends	Total
Very Acceptable	94.20	1.16	4.53	**100**
Acceptable	82.05	0.45	16.27	**100**
Neutral	61.23	5.69	32.04	**100**
Unacceptable	27.97	19.51	50.00	**100**
Very Unacceptable	6.82	67.43	23.90	**100**

Plus 1.2% 'Don't know'

%	In favour	Against	It depends
Very Acceptable	38.06	2.12	5.48
Acceptable	41.92	1.04	24.88
Neutral	12.07	5.08	18.89
Unacceptable	6.35	20.04	33.95
Very Unacceptable	1.60	71.72	16.80
Total	**100**	**100**	**100**

Plus 1.2% 'Don't know'

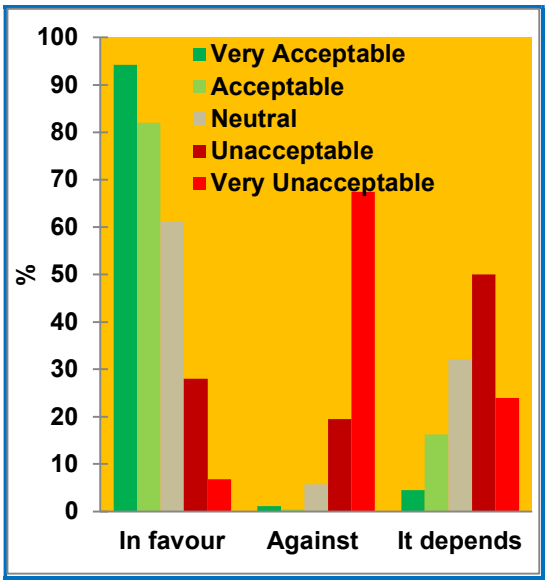


Figure 5.37 Respondent attitudes vs acceptability of wind farms – Britain

The data on acceptability vs attitude was examined for England, Scotland and Wales. Table 5.45 and Figure 5.38 show the results for England.

Table 5.45 Respondent attitudes vs acceptability of wind farms (%) – England

%	In favour	Against	It depends	Total
Very Acceptable	95.83	0.13	3.91	**100**
Acceptable	82.69	0.08	15.75	**100**
Neutral	62.77	3.43	32.46	**100**
Unacceptable	75.70	6.19	15.27	**100**
Very Unacceptable	7.84	57.40	31.37	**100**

Plus 1.5% 'Don't know'

%	In favour	Against	It depends
Very Acceptable	34.13	0.48	6.55
Acceptable	35.66	0.36	31.99
Neutral	9.77	5.52	23.80
Unacceptable	19.43	16.43	18.45
Very Unacceptable	1.02	77.22	19.21
Total	**100**	**100**	**100**

Plus 1.5% 'Don't know'

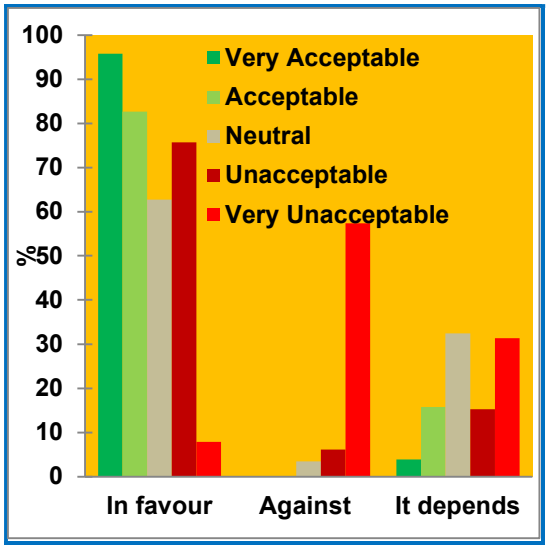


Figure 5.38 Respondent attitudes vs acceptability of wind farms – England

Table 5.46 Respondent attitudes vs acceptability of wind farms (%) - Scotland

%	In favour	Against	It depends	Total
Very Acceptable	86.72	7.38	5.90	**100**
Acceptable	74.12	2.43	23.45	**100**
Neutral	50.22	18.83	30.94	**100**
Unacceptable	22.35	44.12	33.53	**100**
Very Unacceptable	2.14	81.29	16.57	**100**

%	In favour	Against	It depends
Very Acceptable	32.96	2.53	3.98
Acceptable	38.57	1.14	21.64
Neutral	15.71	5.32	17.16
Unacceptable	10.66	18.99	28.36
Very Unacceptable	2.10	72.03	28.86
Total	**100**	**100**	**100**

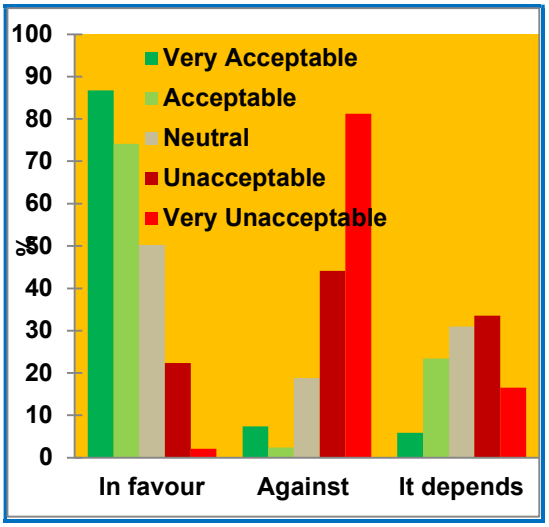


Figure 5.39 Respondent attitudes vs acceptability of wind farms – Scotland

Table 5.47 Respondent attitudes vs acceptability of wind farms (%) - Wales

%	In favour	Against	It depends	Total
Very Acceptable	81.94	0.00	18.06	**100**
Acceptable	82.61	0.36	17.03	**100**
Neutral	73.68	3.51	22.81	**100**
Unacceptable	51.69	4.49	43.82	**100**
Very Unacceptable	12.50	73.68	13.82	**100**

%	In favour	Against	It depends
Very Acceptable	13.53	0.00	8.90
Acceptable	52.29	0.83	32.19
Neutral	19.27	3.31	17.81
Unacceptable	10.55	3.31	26.71
Very Unacceptable	4.36	92.56	14.38
Total	**100**	**100**	**100**

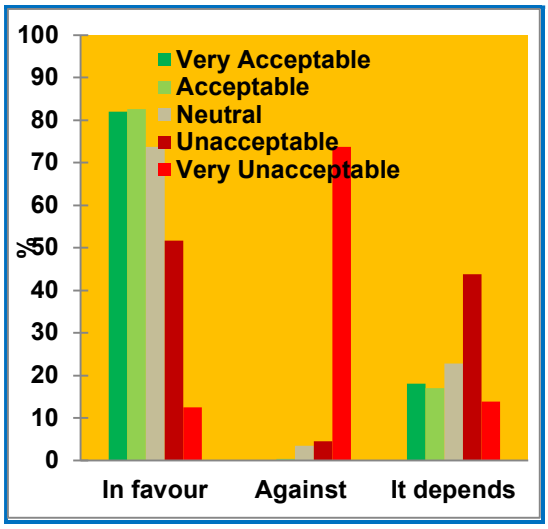


Figure 5.40 Respondent attitudes vs acceptability of wind farms – Wales

Whereas in England the majority of respondents were in favour of wind farms and generally found them quite acceptable, support was less evident in Scotland and Wales (Figures 5.39 & 5.40, Tables 5.46 & 5.47).

Those who were against wind farms voted more strongly regarding their acceptability than those whose were in favour of them. For example, of respondents in England, Scotland and Wales who were in favour of wind farms, between 66% and 72% found them acceptable or very acceptable. However, respondents in the same countries who were against wind farms voted 91% to 96% unacceptable or very unacceptable, a far stronger condemnation of wind farms. Only 1% to 4% of those who were against wind farms found them acceptable in any way whereas 13% - 21% of those in favour found them unacceptable or very unacceptable.

In England and Wales, those respondents who were equivocal, choosing 'It depends', were evenly balanced between finding wind farms acceptable or unacceptable. However, in Scotland, while 26% found them acceptable, more than twice that number, 57%, found them unacceptable in any way.

These figures suggest that while English respondents are generally in favour of wind

farms and find them acceptable, there is less support in Scotland and Wales.

5.10 FACTORS AFFECTING RATINGS

Each of the scenes was assessed for the influence of the following environmental and wind farm factors:

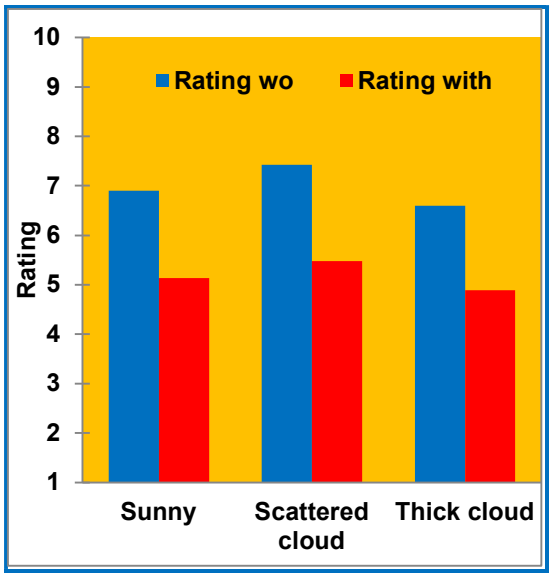
- Weather – sunny, scattered clouds, heavy clouds;
- Terrain – flat, undulating, hilly
- Land use – cropping, grazing, mixed cropping & grazing, pines or natural;
- Vegetation – barren, shrubs, low trees.
- Number of turbines in view
- Actual height of turbines.
- Visual height of turbines
- Distance to the turbines
- Turbines in sun or shade

Weather

Weather is a transient influence, part of the physical environment of the wind farms, but nevertheless, the conditions in which they are viewed affects their perception. Interestingly the survey found the highest ratings were not for sunny scenes but for scenes with scattered cloud (Table 5.48, Figure 5.41) these being 0.53 higher than the sunny scenes. The influence of thick cloud on ratings was not as great as expected, only slightly lower than the sunny scenes. The difference in ratings for the different weather in the scenes without wind farms was significant: ANOVA F = 356.24, df = 1, 44, p <0.000.

Table 5.48 Influence of weather on ratings

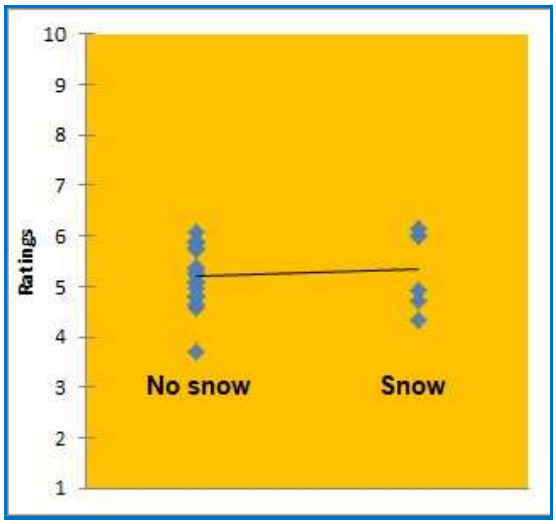
Weather	Without wf	With wf	Scenes
Sunny	6.90	5.13	6
Scattered cloud	7.43	5.47	11
Thick cloud	6.60	4.89	6



23 scenes

Figure 5.41 Influence of weather on ratings

Five scenes included snow on the ground and Figure 5.42 indicates that its presence lifted ratings slightly compared with scenes without snow.



Trend line: Y = 0.17x + 5.02, R^2 = 0.01

Figure 5.42 Influence of snow on ratings

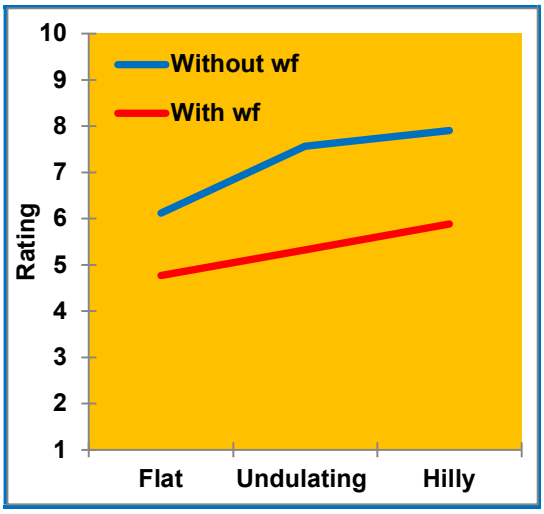
Land form

Table 5.49 and Figure 5.43 show the influence of land form on the ratings. There is a consistent influence as the terrain moves from flat to undulating to hilly, increasing ratings by 1.79 from flat to hilly for scenes without wind farms, and 1.12 for scenes with wind farms. The difference in ratings for the different land forms in the

scenes without wind farms was significant: ANOVA F = 367.96, df = 1, 44, p <0.000.

Table 5.49 Influence of land form on ratings

Land form	Without wf	With wf	Scenes
Flat	6.12	4.77	9
Undulating	7.57	5.33	9
Hilly	7.91	5.89	5



Trend lines:
Without wf: y = 0.89x + 5.41, R^2 = 0.89
With wf: y = 0.56x + 4.21, R^2 = 1

Figure 5.43 Influence of land form on ratings

Land use

Table 5.50 shows the influence of land use on ratings of all scenes and Figure 5.44 shows ratings for scenes without wind farms. The highest ratings for scenes without wind farms were, in order, natural, mixed grazing & pasture, pines, pasture, with cropping last of all. The pines land use comprised mainly scenes in the high Scottish Borders country under snow with extensive barren areas and clumps of pine plantations.

Table 5.50 Influence of land use on ratings

Land use	Without wf	With wf	Scenes
Pasture	7.32	5.17	4
Cropping	5.80	4.76	7
Mixed grazing & cropping	7.83	5.82	4
Pines	7.52	5.00	4
Natural	7.86	5.76	4

The presence of the wind farm in the scenes had its largest impact for the scenes with pines (2.52) followed by pasture (2.15) and natural (2.10). The smallest impact was for cropping land use (1.04).

The difference in ratings for the different land uses in the scenes without wind farms was significant: F = 133.15, df = 1, 44, p <0.000.

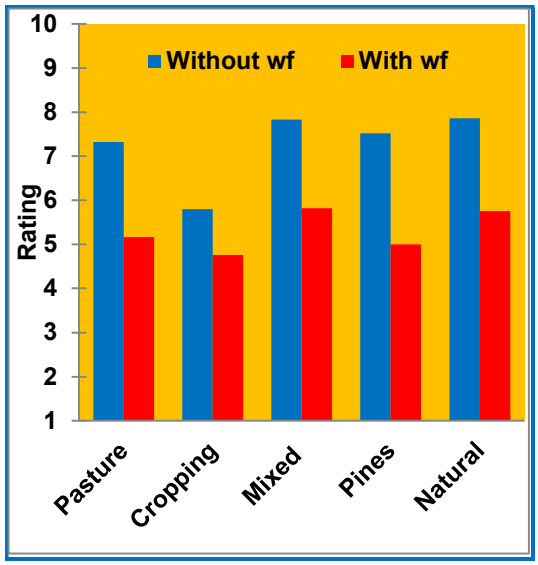


Figure 5.44 Influence of land use on ratings

Vegetation

Table 5.51 shows the influence of vegetation types on ratings. The vegetation generally comprised low trees or shrubs or none at all. The absence of low trees in the scene yielded the largest impact, 2.09 followed by the scenes that were barren of vegetation, 1.61. The difference in ratings for the different vegetation types in the scenes without wind farms was significant: F = 496.54, df = 1, 44, p < 0.000.

Table 5.51 Influence of vegetation type on ratings

Vegetation	Without wf	With wf	Scenes
Barren	7.17	5.56	6
Low shrubs	4.86	4.15	2
Low trees	7.33	5.25	15

Number of turbines

Table 5.52 and Figures 5.45 and 5.46 show the influence that the number of turbines in the scenes had on ratings. In Figure 5.45 the gap between the ratings of scenes without and with wind farms indicates the influence of the groups of turbines. Figure 5.46 shows the individual turbines and their effect on ratings. Although the correlation coefficient is very low (0.06), nevertheless there is a definite downward trend with increasing numbers of turbines. The difference in rating between the number of turbines for scenes with wind farms was significant: ANOVA F = 36.87, df = 1, 44, p < 0.000.

Table 5.52 Influence of the number of turbines on ratings

Turbines	Without wf	With wf	Scenes
1 - 5	7.43	5.87	2
6 - 10	6.51	5.20	7
11 - 15	7.61	5.45	6
16 - 20	6.55	4.80	4
21 - 25	7.04	4.77	1
26 - 30	7.79	5.18	3

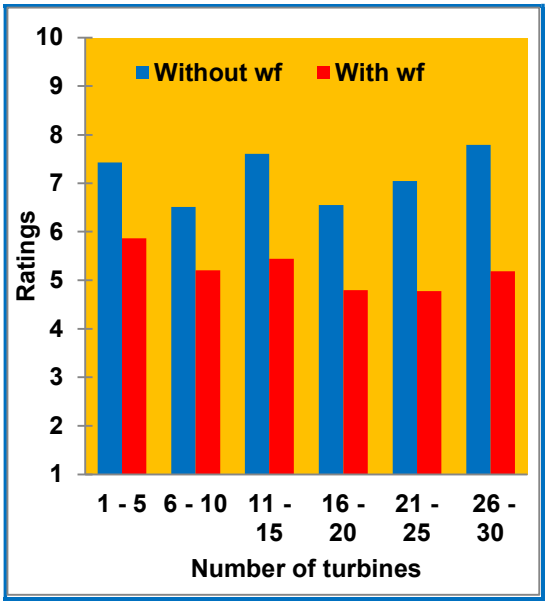
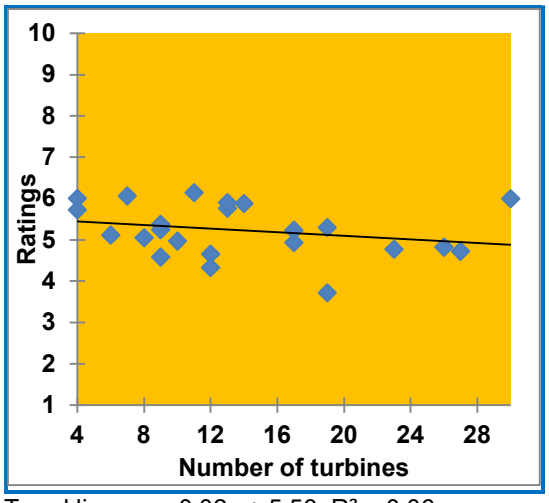


Figure 5.45 Influence of groups of turbines on ratings



Trend line: y = -0.02x + 5.53, R^2 = 0.06

Figure 5.46 Influence of the number of turbines on ratings

Table 5.53 applies the algorithm derived above to predict the rating for up to 60 turbines.

Table 5.53 Predicted ratings for the number of turbines

Turbines	Rating
1	5.51
5	5.42
10	5.31
15	5.21
20	5.10
25	4.99
30	4.88
40	4.67
50	4.45
60	4.23

Based on y = -0.0216x + 5.5307

Height of turbines

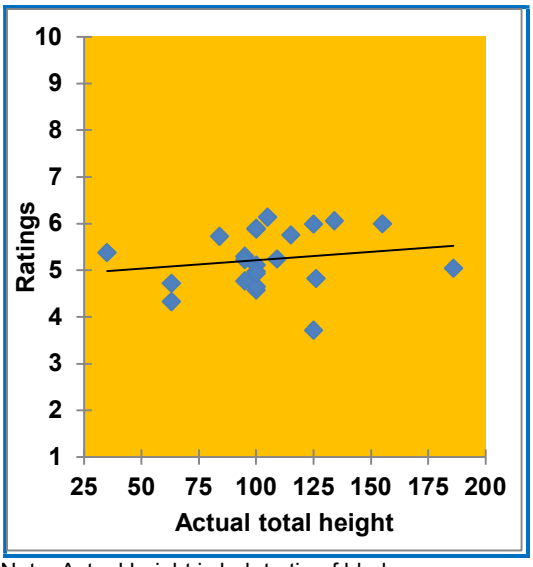
The height of the turbines is of two types: firstly, there is the actual height of the hub and blades, and secondly, there is the visual height of the turbines as observed in the field. The visual height is a function of both the actual height of the turbines and the distance from the observer.

Table 5.54 summarises the influence of actual and visual height on ratings, and Figures 5.47 and 5.48 illustrate the effect. Ratings actually increased slightly with greater actual height of turbines and the height as viewed in the field.

In both cases, the differences in rating for various heights for scenes with wind farms were significant:
Actual height: F = 243.30, df = 1, 44, p < 0.000
Visual height: F = 154.58, df = 1, 44, p < 0.000

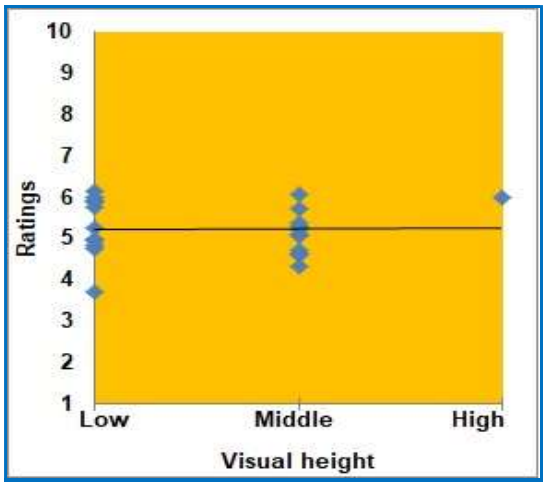
Table 5.54 Influence of turbine height on ratings

Actual height	Without wf	With wf	Scenes
25 - 50	7.55	5.38	1
51 - 75	7.11	4.53	2
76 - 100	6.91	5.19	11
101 - 125	7.04	5.37	5
126 - 150	7.54	5.45	2
151 - 175	7.82	6.00	1
175 - 200	6.82	5.05	1
Visual height			
Low	7.21	5.29	11
Medium	6.87	5.11	11
High	7.82	6.00	1



Note: Actual height is hub to tip of blade
Trend line: y = 0.004x + 4.85, R^2 = 0.03

Figure 5.47 Influence of actual height on ratings



Trend line: y = 0.021x + 5.20, R^2 = 0.0004

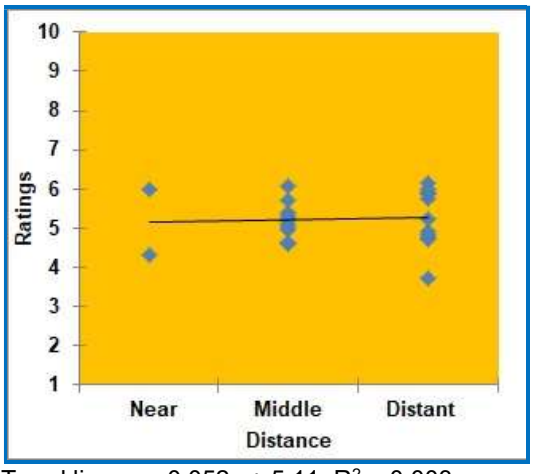
Figure 5.48 Influence of visual height on ratings

Distance to turbines

The distance to turbines was classified into near, middle and distant. Table 5.55 and Figure 5.49 summarise the ratings. Distance had virtually no influence on ratings. The difference in ratings between the various distances was significant: F= 223.27, df = 1, 44, p < 0.000

Table 5.55 Influence of distance to turbines on ratings

Distance	Without wf	With wf	Scenes
Near	7.31	5.17	2
Middle	6.74	5.21	10
Distant	7.33	5.26	11



Trend line: y = 0.052x + 5.11, R^2 = 0.003

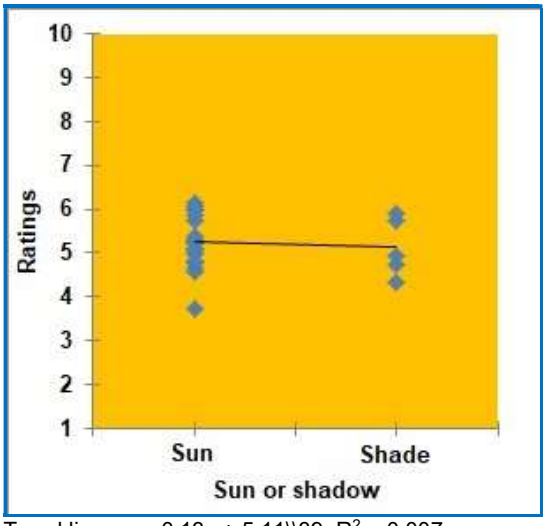
Figure 5.49 Influence of distance to turbines on ratings

Turbines in sun or shade

While most of the turbines were in the sun, some despite the presence of clouds, a few were in shade. Table 5.56 indicates the difference in ratings of turbines in sun or shade. The trend line in Figure 5.50 suggests a mild decrease in ratings for shaded turbines. The difference in ratings between sunlight and shade was significant: F= 185.30, df = 1, 44, p < 0.000.

Table 5.56 Influence of sunlight on ratings

Distance	Without wf	With wf	Scenes
Sunlight	6.94	5.26	18
Shade	7.56	5.13	5



Trend line: y = -0.13x + 5.11\\39, R^2 = 0.007

Figure 5.50 Influence of sunlight on ratings

Summary of the influence of factors on ratings

The foregoing analysis of the factors which influence ratings comprised four environmental factors (weather, land form, land use, vegetation) and four related to the wind farms (turbine height, turbine numbers, distance and sunlight or shade). The rating of all scenes without the wind farms was 7.07 and the rating with the wind farm reduced to 5.23, a difference of 1.84. The contributions to this overall means by each individual factor can be assessed. This is assessed by subtracting the individual means of each factor from the overall means. Figure 5.51 and 5.52 show the results.

As would be expected, the positive differences are nearly balanced by the negative differences. For scenes without wind farms, the cropping land use had the largest difference from the overall mean, 1.27, followed by flat land form, 0.95. For scenes with wind farms, the largest difference occurred in the height of turbines, 151 - 175 m (-0.77) and 51 - 75 m (+0.70). The differences from the overall mean are generally larger for the scenes without wind farms than those with wind farms.

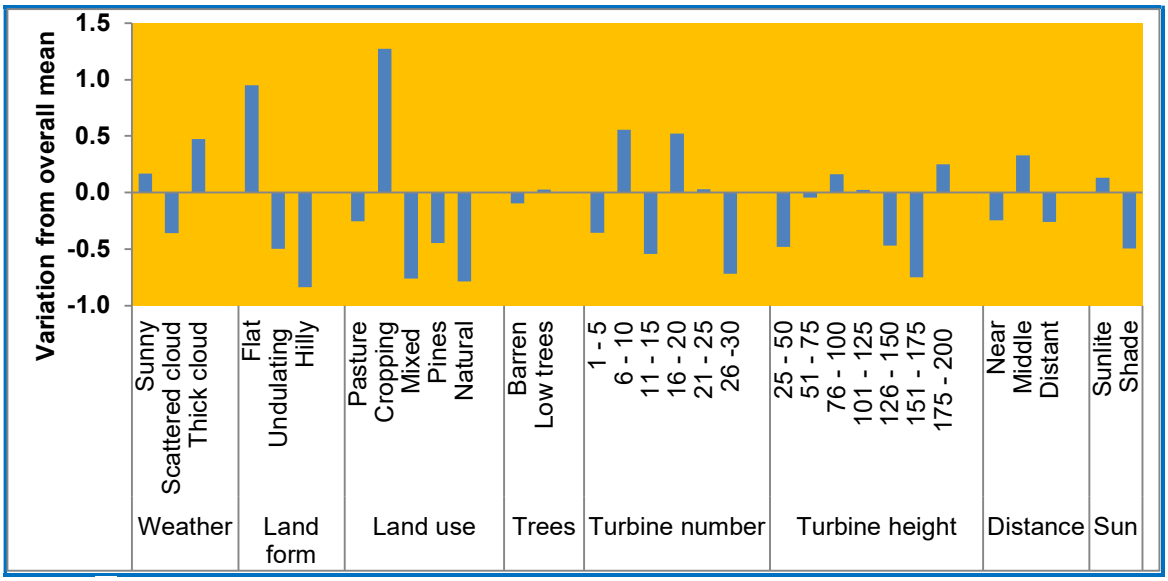
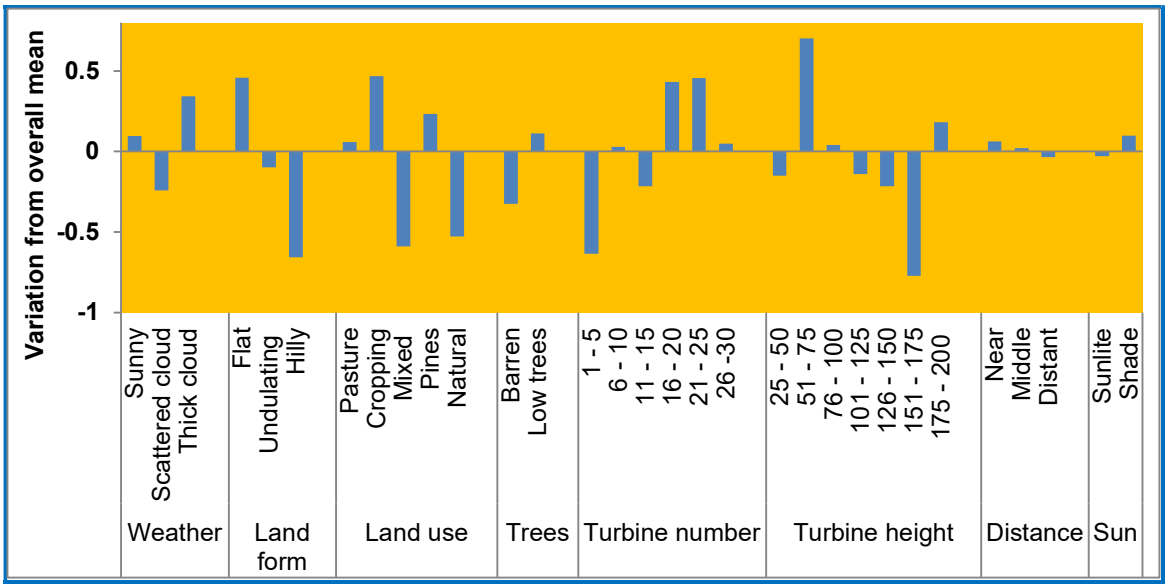


Figure 5.51 Scenes without wind farms - Difference between overall mean (7.07) & factor means



23 scenes

Figure 5.52 Scenes with wind farms - Difference between overall mean (5.23) & factor means

The context of the wind farms, their environment, affects their ratings and although it was a small effect, it was generally statistically significant.

Environmental factors

Weather Scenes with scattered cloud achieved higher ratings than sunny scenes and thick cloud did not have as large a depressing effect on ratings as expected. The presence of snow in the scene lifted ratings slightly.

Land form All ratings increased with the hilliness of the terrain, flat land recording the lowest ratings.

Land use The highest ratings were for natural scenes followed by mixed cropping and grazing.

Vegetation The vegetation generally comprised low trees or was quite barren. The absence of any trees lowered ratings the most.

Wind farm factors

Number of turbines Increasing the number of turbines slightly decreased ratings.

Height of turbines Ratings increased slightly with greater actual height of turbines and the height as viewed in the field.

Distance to turbines Distance had virtually no influence on ratings.

Sunlight or shade Shaded turbines rated slightly lower than those in sunlight.

5.11 REGRESSION ANALYSIS

Multiple regression analysis was used to identify the contribution of environmental factors and wind farm characteristics to the rating.

Without wind farm. Environmental factors

ANOVA F = 5.01, df = 5, 22, p = 0.005
$R^2 = 0.60$
Y (rating) = 4.00 + 1.05 land form + 0.68 vegetation + 0.19 land use - 0.33 snow - 0.07 weather

The algorithm, which explains 60% of the variance in the data, indicates that the ratings were influenced mainly by the land form, vegetation and land use. The presence of snow and the weather had only a minor influence.

With wind farm. All factors

ANOVA F = 3.20, df = 11, 22, p = 0.03
$R^2 = 0.76$
Y (rating) = 2.92 + 0.73 land form + 0.48 distance + 0.26 vegetation + 0.12 weather + 0.09 visual height + 0.07 land use + 0.01 number turbines + 0.002 actual height - 0.35 snow - 0.27 sun shade - 0.26 turbine groups

The algorithm, which explains 76% of the variance in the data, indicates that environmental factors – land form, vegetation and weather play a strong role in determining the ratings for scenes with wind farms, with distance being the main wind farm factor. The number of turbines, their height and whether in sun or shade played very minor roles.

With wind farm. Only wind farm factors

ANOVA F = 0.55, df = 6, 22, p = 0.76
$R^2 = 0.17$
Y (rating) = 2.92 + 0.53 distance + 0.32 visual height + 0.025 number turbines + 0.02 sun shade + 0.003 actual height - 0.30 turbine groups

The correlation coefficient, 0.17, is much lower than that for all factors (0.76) and indicates that the algorithm explains only 17% of the variance. The algorithm indicates that distance to the wind farm is the dominant factor followed by the visual height in the field. The remaining factors – number of turbines, whether in sun or shade, their actual height and groups of turbines, are of minor influence.

The analysis shows that for scenes without wind farms, that land form, vegetation and land use had the main influence. For scenes without wind farms when all factors were included, the environmental factors of land form, vegetation and weather were influential along with the distance to the wind farm. When only wind farm factors were included, the distance to the wind farm and their visual height as seen in the field were the major influences.

5.12 THRESHOLD OF ACCEPTABILITY

Earlier in Section 3.8, Threshold of visual impact, the work of Cohen, Stamps and Palmer was examined as means of providing insights into acceptable thresholds of visual impact. Using Cohen's Standardised Mean Difference formula (D = mean scene after – mean scene before/ population SD), the following thresholds were defined (Table 5.57).

Table 5.57 Criteria of visual impact

Criteria	Stamps	Palmer
Trivial, too small to be noticed	0.2	0 – 0.2
Medium effect, noticeable by not adverse	0.5	0.2 – 0.5
Large effect and adverse	0.8	0.5 – 1.1
Unreasonably adverse		>1.1

Applying these criteria to the data produced the following number of scenes in each category (Table 5.58).

Table 5.58 Application of criteria to survey data

Visual impact	Stamps	Scenes
Small	0.2	0
Medium	0.5	3
Large	0.8	3
Very large	>0.8	16
Visual impact	**Palmer**	**Scenes**
Possibly go unnoticed	0 – 0.2	0
Noticeable but not adverse	0.2 – 0.5	3
Adverse	0.5 – 1.1	8
Unreasonably adverse	>1.1	12

Threshold

These findings suggest that the majority of scenes created a large and adverse visual impact. However, it could also suggest that the criteria are too extreme and should be enlarged.

Buchan (2002) noted that it is both the magnitude and the significance which determine visual impact. While agreeing on the magnitude of the visual impact, the significance is disputed.

5.13 VISUAL IMPACT PREDICTIVE MODEL

An objective of the study was to derive a model to predict the likely visual impact of wind farms with applicability Australia-wide. The model is based on the survey's findings as reported in this chapter.

The model comprises the following components:

1. Derive the scenic quality of the area where a wind farm is proposed.

This can be achieved through applying generic criteria as derived by the author in various regions.

2. Derive the visual impact using algorithms derived:

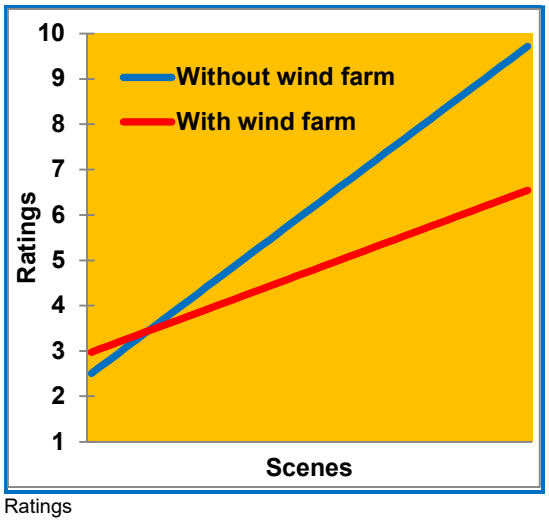
Without wind farm: $y = 0.15x + 5.31$, $R^2 = 0.89$
With wind farm: $y = 0.07x + 4.36$, $R^2 = 0.61$

Where y is the scenic quality, x is the scene number.

Table 5.59 simplifies this by providing the ratings predicted by each algorithm at approximately 0.50 intervals. This can be used to predict the likely scenic quality with the wind farm present. Figure 5.53 illustrate the model.

Table 5.59 Predicted scenic quality ratings

Without wind farm	With wind farm
3.09	3.27
3.54	3.48
4.13	3.78
4.57	3.99
5.01	4.21
5.45	4.43
6.04	4.72
6.48	4.94
7.07	5.23
7.51	5.45
7.95	5.67
8.54	5.96



Ratings

Figure 5.53 Model of predicted scenic quality ratings

5.14 COMMENTS AT THE END OF THE SURVEY

The opportunity to comment generally on the survey or on wind farms was provided at the end of the survey and of the 805 respondents. A total of 205 (25.5%) provided comments (Table 5.60). The comments are shown verbatim in Appendix 4.

Table 5.60 Comments at end of survey

Theme	N	%
Survey - positive	11	5.37
Survey - negative	24	11.71
Wind farms - positive	40	19.51
Wind farms - negative	76	37.07
General comment	54	26.34
Total	205	100

The majority of comments about the survey were negative – too long, slow to do, did not include the wider landscape, quality of photos. However, there were also positive comments – interesting, useful, good and clever survey, interested in results.

The largest set of comments was about wind farms, 20% of the total being positive and 37% negative.

Positive comments about wind farms included:

- Wind farms enhance and add interest to the landscape
- Can be inspiring in remote landscapes
- Elegant – aesthetically quite beautiful
- Need for more renewable sustainable energy
- Reduce dependence on fossil fuels
- Visual reminders of the need to accept climate change
- Needed to save the planet
- Layout and optimum number of turbines
- Prefer turbines to electricity pylons and power lines
- It's a price worth paying
- Beautiful feats of engineering, a positive human invention

Negative comments about wind farms included:

- Too many wind farms present
- Blot on the landscape, horrid urban structures, destroy all landscapes
- Dreadful monstrosities
- Waste of money, not cost effective.
- No environmental benefits
- Not green because of the CO_2 produced in manufacture
- Of benefit only to the landowners developers and operators.
- All they farm is subsidies for the rich.
- Low frequency emissions that are dangerous to humans and animals.
- Remove all the steel and fibreglass, lub oils from our hills and farms. Cover over the thousands of miles of wind farm access tracks.
- I absolutely hate the effect that windfarms have on the Scottish landscape.
- The over deployment of industrial wind particularly in Scotland has devastated communities, the environment and wildlife and at huge cost to the consumer.
- Given the densely populated country we have and the love of countryside, I see little chance for wind farm acceptance on land.
- The wind farm near to me has blighted the lives of over 3000 residents in that there is now severe television interference.
- Frankly they blight the landscape. The development closest to me on the Romney Marsh was fought vigorously on both visual impact and sustainability (it took 4 to 6 times the concrete pour they stated to make the bases). And yet objections by Parish, Town and District councils were ignored. This is not democracy, it is not even moral. The green lobby hold sway over a weak planning system to the detriment of natural countryside beauty…Each and every time the land owner reaps all the reward and nothing comes back to the local community.

General comments included:

- Wind farms are far better than coal or gas powered power stations.
- Offshore farms are acceptable.
- Community impact with regards noise and other factors all need to be considered.
- How you intend to analyse scientifically the findings of what is a very subjective emotional experience for me.
- Clearly very subjective and your view point can stem from your beliefs and very of climate change.
- Do they always have to be white? Surely less obtrusive if a muddy green, or pale blue?
- It will be interesting to see conclusions!
- Surely there are desolate places in which to build these wind farms.
- Pre-application 'consultation' visual-isations always understate the perceived appearance of turbines against a previously clear uncluttered horizon.
- Thank you for showing me so many beautiful skyscapes.
- Far too often wind turbines are too close to each other and in too big a number.
- It really depends where there are situated. Offshore is best.
- Happy with wind farms offshore, onshore farms are a blot on the landscape.
- Pylons are undesirable but are less obtrusive and known as necessary.

- We have to be careful in trying to save the planet that we do not destroy its beauty.
- All of the landscapes were bleak and clearly support only an impoverished biodiversity and heavily modified by human interventions and deliver few natural processes such as flood attenuation, groundwater recharge or atmospheric carbon sequestration. The sterility of these landscapes is very depressing.
- Perhaps if more thought were given to the symmetry of the structures within the landscape they would look better ... or maybe if they weren't bright white but green [say] they would look better.
- I live in Cumbria and I found the landscapes in your photographs pretty dull. We get much worse foisted on us in much more beautiful surroundings.
- I found this interesting as it challenged my own perceptions of what I found acceptable and unacceptable in landscape. (The) more the landscape was obviously altered by man (roads, plantations, pylons, arable etc.), the more accepting wind turbines seemed to be.
- Prefer to see solar panels where hedges can protect the landscape.

CHAPTER 6 CONCLUSIONS

Based on the responses of nearly 800 councillors and staff from councils, a Britain-wide Internet survey quantified their attitudes towards wind farm, their visual impact and the acceptability of wind farms in England, southern Scotland and northern Wales.

Key findings

Key findings from the survey are:

- Compared with the English and Welsh, Scottish respondents gave the highest ratings of scenes without wind farms and the lowest ratings of scenes with wind farms.

- Of the English respondents, 63% found wind farms acceptable, but in Wales the figure was 49% and in Scotland, 34%. This suggests that the threshold of acceptability of wind farms has been passed in Scotland and is approaching it for Wales.

- The highest proportion opposed to wind farms was in north and south Scotland, both 55%, followed by south Wales, 50%, and north Wales, 43%.

- While 70% of local councillors and 61% of country councillors strongly supported wind farms, only 41% of staff were in favour.

- While 12% of local councillors and 7% of country councillors opposed wind farms, 31% of staff opposed them.

- While both local and county councillors generally found wind farms acceptable, many of staff rated the wind farms as very unacceptable; 33% of the staff found them very unacceptable compared with 11% of county councillors and 9% of local councillors.

- The respondent's attitudes towards wind farms, whether positive or negative, shaped their ratings of scenes with and without wind farms. Those opposed to wind farms rated scenes without them the highest and scenes with them, the lowest, a difference in ratings of nearly 6. Conversely for those in favour of wind farms, the difference in rating was only 0.6. This conclusively showed that attitudes affect ratings.

- Attitudes toward wind farms also shaped their acceptability by respondents, with those in favour finding most wind farms acceptable while those against them finding virtually all wind farms unacceptable.

Project objectives

The objectives of the project were threefold:

1. To assess the attitudes of councillors and senior council staff in Britain regarding the visual impacts of wind farms and their acceptability;
2. To determine whether a threshold of acceptability can be derived from the survey;
3. To derive a predictive model of the visual impact of wind farms in Britain.

The first objective was fulfilled with nearly 800 councillors and staff from England, Scotland and Wales participating in the survey and providing information on their attitudes regarding the visual impact of wind farms and their acceptability.

The second objective was examined and data derived but more research is needed on the threshold of acceptability of wind farms (see Section 5.12).

The third objective, a predictive model, was achieved (see Section 5.13).

Strengths and weaknesses

Strengths of survey included:

- It contained scenes of wind farms from across Britain and participants also from across Britain.

- Participants comprised councillors of district and county councils who are charged with responsibility for approving wind farms.
- Participants also included senior staff from the councils.
- Participants rated the scenic quality of the landscape with and without the wind farm
- Participants also rated the acceptability of the wind farm.

Weaknesses of the project include the following:

- While the images were of static turbines, not of rotating turbines, Grimm (2009) found little difference in their rating compared with static turbines;
- It could be alleged that the survey was biased to those who favoured wind farms which is an issue with all self-selected surveys. However, the survey was sent across all councils and all had the opportunity to participate.

Respondent comments

The feedback included many positive comments from participants. Comments were received by email during the survey, on familiarity with wind farms, on being in favour or against wind farms, and, at the end of the survey, final overall comments.

Over 200 comments from participants were received being 25% of respondents. In addition, 300 participants, nearly 40%, asked to receive a summary of the survey's findings.

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APPENDIX 1

SURVEY SCENES

1 Without wind farm 9174 75

Scene: 1
Rating: 5.57
Location: Kettering, England,

2 With wind farm 9174 75

Scene: 2
Rating: 4.58
Wind farm: Burton Wold
ANOVA difference:
F = 45.43, df = 1, 1191,
p = 2.50E-11

3 Without wind farm 9180 81

Scene: 3
Rating: 6.03
Location: Huntingdon, England

4 With wind farm 9180 81

Scene: 4
Rating: 4.65
Wind farm: Red Tile
ANOVA difference:
F = 89.82, df = 1, 1147,
p = 1.40E-20

5 Without wind farm 9210 13

Scene: 5
Rating: 4.15
Location: West of Scunthorpe England,

6 With wind farm 9210 13

Scene: 6
Rating: 3.72
Wind farm: Keadby
ANOVA difference:
F = 11.09, df = 1, 1203,
p = 0.0009

7 Without wind farm 9228 31

Scene: 7
Rating: 5.93
Location: North of Goole, England

8 With wind farm 9228 31

Scene: 8
Rating: 5.24
Wind farm: Twin River
ANOVA difference:
F = 11.86, df = 1, 1212,
p = 3.30E-06

9 Without wind farm 9244 45

Scene: 9
Rating: 5.98
Location: North of Goole, England

10 With wind farm 9244 45

Scene: 10
Rating: 5.11
Wind farm: Rusholme
ANOVA difference:
F = 35.62, df = 1, 1196,
p = 3.20E-09

11 Without wind farm 9254 55

Scene: 11
Rating: 6.11
Location: North of Beverley, England

12 With wind farm 9254 55

Scene: 12
Rating: 4.97
Wind farm: Hall Farm ANOVA difference:
F = 62.97, df = 1, 1213,
p = 4.70E-15

13 Without wind farm 9266 67

Scene: 13
Rating: 6.82
Location: South of Bridlington, England

14 With wind farm 9266 67

Scene: 14
Rating: 5.05
Wind farm: Fraisthorpe ANOVA difference:
F = 175.8, df = 1, 1200,
p = 1.50E-37

15 Without wind farm 9334 37

Scene: 15
Rating: 7.04
Location: North of Eyemouth, Scotland

16 With wind farm 9334 37

Scene: 16
Rating: 4.77
Wind farm: Drone Hill
ANOVA difference:
F = 302.65, df = 1, 1208,
p = 1.20E-60

17 Without wind farm 9338 39

Scene: 17
Rating: 8.10
Location: North of Preston, Scotland

18 With wind farm 9338 39

Scene: 18
Rating: 5.76
Wind farm: Quixwood Moor
ANOVA difference:
F = 340.94, df = 1, 1198,
p = 3.50E-67

19 Without wind farm 9340 41

Scene: 19
Rating: 8.03
Location: North of Preston, Scotland

Scene: 20
Rating: 5.88
Wind farm: Demonshiel
ANOVA difference:
F = 208.48, df = 1, 1203,
p = 9.40E-57

20 With wind farm 9340 41

Scene: 21
Rating: 8.16
Location: North of Preston, Scotland

21 Without wind farm 9342 43

Scene: 22
Rating: 5.90
Wind farm: Demonshiel
ANOVA difference:
F = 319.3, df = 1, 1201,
p = 1.60E-63

22 With wind farm 9342 43

Scene: 23
Rating: 7.42
Location: Oxton, Scotland

23 Without wind farm 9365 68

Scene: 24
Rating: 4.73
Wind farm: Dunlaw 1
ANOVA difference:
F = 409.49, df = 1, 1200,
p = 1.40E-78

25 Without wind farm 9379 81

Scene: 25
Rating: 6.81
Location: Oxton, Scotland

26 With wind farm 9379 81

Scene: 26
Rating: 4.33
Wind farm: Dunlaw 2
ANOVA difference:
F = 337.2, df = 1, 1191,
p = 1.60E-66

27 Without wind farm 9396 00

Scene: 27
Rating: 7.33
Location: Stowe, Scotland

28 With wind farm 9396 00

Scene: 28
Rating: 4.94
Wind farm: Long Park
ANOVA difference:
F = 340.63, df = 1, 1203,
p = 3.60E-67

29 Without wind farm 9413 14

Scene: 29
Rating: 7.44
Location: Oxton, Scotland

30 With wind farm 9413 14

Scene: 30
Rating: 4.83
Wind farm: Toddleburn
ANOVA difference:
F = 403.17, df = 1, 1198,
p = 1.60E-77

31 Without wind farm 9451 54

Scene: 31
Rating: 8.53
Location: West of Hawick, Scotland

32 With wind farm 9451 54

Scene: 32
Rating: 6.14
Wind farm: Glenkerie
ANOVA difference:
F = 334.82, df = 1, 1211,
p = 3.20E-66

33 Without wind farm 9468 69

Scene: 33
Rating: 7.82
Location: Abington, Scotland

34 With wind farm 9468 69

Scene: 34
Rating: 6.00
Wind farm: Clyde Extension
ANOVA difference:
F = 186.5, df = 1, 1192,
p = 1.50E-39

Scene: 35
Rating: 8.51
Location: South of Moffat, Scotland

35 Without wind farm 9475 76

Scene: 36
Rating: 5.99
Wind farm: Minigap
ANOVA difference:
F = 348.57, df = 1, 1191,
p = 2.00E-68

36 With wind farm 9475 76

Scene: 37
Rating: 7.64
Location: Crawford, Scotland

37 Without wind farm 9502 03

Scene: 38
Rating: 6.06
Wind farm: Clyde
ANOVA difference:
F = 150.83, df = 1, 1207,
p = 9.40E-33

38 With wind farm 9502 03

Scene: 39
Rating: 7.67
Location: North of Glenluce, Scotland

39 Without wind farm 9631 32

40 With wind farm 9631 32

Scene: 40
Rating: 5.30
Wind farm: Carscreugh
ANOVA difference:
F = 339.99, df = 1, 118,
p = 5.70E-67

41 Without wind farm 9639 42

Scene: 41
Rating: 7.04
Location: North of Glenluce, Scotland

42 With wind farm 9639 42

Scene: 42
Rating: 5.23
Wind farm: Carscreugh
ANOVA difference:
F = 174.89, df = 1, 1201,
p = 2.30E-37

43 Without wind farm 9669 70

Scene: 43
Rating: 7.55
Location: Angelsey, Wales

44 With wind farm 9669 70

Scene: 44
Rating: 5.38
Wind farm: Trysglwyn
ANOVA difference:
F = 272.68, df = 1, 1183,
p = 2.80E-55

45 Without wind farm 9693 94

Scene: 45
Rating: 7.03
Location: Holsworthy, England

46 With wind farm 9693 94

Scene: 46
Rating: 5.73
Wind farm: Holsworthy
ANOVA difference:
F = 106.76, df = 1, 1214, p = 4.80E-24

APPENDIX 2

INTERNET SURVEY

Invitation

SURVEY OF THE VISUAL IMPACT OF WIND FARMS IN BRITAIN

Wind farms have become a feature of the British rural landscape and their numbers may increase in future.
A key issue is their visual impact on the landscape - i.e. their effect on the aesthetics of the landscape. Communities have objected to wind farms for this reason.
This project aims to identify factors which affect the perception of the visual impact of wind farms and see if this can be predicted. This is a personal project and no client is involved.
The success of the survey depends on having many people participate.
I invite you to take part by rating the scenic quality of the scenes. I believe you will find it very interesting.
No qualifications or experience are required and responses will be anonymous.
To participate, simply click on the following link: https://www.surveymonkey.com/r/VY5SFNF
Please forward this to anyone else you think might be interested. You can indicate at the end of the survey if you would like to see the results. Please direct any queries to me: lothian.andrew@gmail.com
Thank you for your assistance in this important project.
Dr Andrew Lothian
Scenic Solutions
www.scenicsolutions.world

Page 1

VISUAL IMPACT OF WIND FARMS IN BRITAIN

Introduction

Wind farms are a feature of the British rural landscape and their numbers may increase in future.

A key issue is their visual impact on the landscape - i.e. their effect on the aesthetics of the landscape. Communities have objected to wind farms for this reason.

This project aims to identify factors which affect the perception of the visual impact of wind farms and see if this can be predicted.

This project contains a total of 46 scenes, 23 without a wind farm and 23 with the wind farm. They are shown in random order. The wind farms shown are located in England, Wales and southern Scotland.

No qualifications or experience are needed but participants should be at least 18 years old.

At the end you are given an opportunity to comment and to request a summary of the survey's results.

For any queries, please contact Dr Andrew Lothian: lothian.andrew@gmail.com

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INSTRUCTIONS

How it works

You will be shown a photo of a scene and asked to rate its scenic attractiveness – i.e. how much you like the landscape.

Simply click a number to rate your answer on the scale.

For the scenes containing a wind farm you will also be asked how acceptable or unacceptable you find the wind farm in the scene.

Click the NEXT button to move on to the next scene.

How long will it take?

The survey should take 10 – 15 minutes to complete.

There is no time limit.

Please rate every scene.

Hints

Use the entire rating scale, don't just sit in the middle.

Judge each scene on its merits.

Trust your initial instincts. Don't think too much about your response.

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IMPORTANT NOTE

If the survey stops after you have completed the demographic entries, it probably means your Internet browser needs updating –e.g. Internet Explorer, Google Chrome, Mozilla Firefox.

The following browsers are required to operate the survey: Google Chrome 18 & later, Mozilla Firefox 24 & later, Internet Explorer 9 - 11, Safari 7 or later, Microsoft Edge

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DEMOGRAPHIC DETAILS

Please fill in the following details.

Age

- **18-24**
- **25-44**
- **45-64**
- **65+**

Gender

- **Male**
- **Female**

Education

- **No qualification**
- **Certificate, Diploma, Foundation Degree (Levels 4 & 5)**
- **Bachelor Degree (Level 6)**
- **Higher Degree – Masters, PhD (Levels 7 & 8)**
- **Other (please specify)**

Birthplace

- **Within the UK**
- **Europe**
- **Other (please specify)**

Postcode

For UK residents, please enter the first two letters of your postcode.

Are you a councillor?

- **On a county council?**
- **On a local district or borough council?**
- **Not a councillor**

Council name

Do you work for a council?

- **At a county council?**
- **At a local district or borough council?**
- **I don't work for council**

Council name

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How familiar are you with wind farms?

- Never seen one
- Seen a few
- Seen many

Comment

Do you live near a wind farm?

- No
- Yes
- If yes, how far away is it?
- 0 - 2 km
- 2 - 5 km
- 5 -10 km

Comment

Attitude to wind farms

- Against
- In favour
- It depends
- Don't know

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The photos of the landscapes with and without wind farms follow. The order is randomised.

Example scene with wind farm

Rate the scenic quality of this scene from 1 (low) to 10 (high)

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

How acceptable or unacceptable do you find this wind farm?

○ Very Acceptable ○ Acceptable ○ Neutral ○ Unacceptable ○ Very Unacceptable

Example scene without wind farm

Rate the scenic quality of this scene from 1 (low) to 10 (high)

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

END OF SURVEY

Thank you for completing this survey.
The website: **www.scenicsolutions.world** has information on past surveys and about measuring landscape quality.
Please contact Dr Andrew Lothian with any queries **lothian.andrew@gmail.com**
Please write any comments about wind farms or the survey in the box below.

Comment

If you would like to receive a summary of the results of this survey, enter your email address below. Please allow several months before you receive this.

Email address:

APPENDIX 3

ACCEPTABILITY OF WIND FARMS BY POSTCODE AREA – FREQUENCY

Postcode Area	Respondents	Very Acceptable	Acceptable	Neutral	Unacceptable	Very Unacceptable	Total
South West England							
Bristol	19	127	102	33	25	14	301
Bath	11	45	105	7	22	2	181
Exeter	6	3	39	7	31	46	126
Gloucester	27	129	144	40	57	23	393
Plymouth	5	6	30	11	4	1	52
Salisbury	4	33	31	5	0	0	69
Torquay	4	37	55	2	0	0	94
Truro	5	47	47	18	2	1	115
Taunton	7	58	30	29	38	6	161
South East England							
Bournemouth	17	149	95	17	8	3	272
Brighton	11	70	107	22	23	11	233
Canterbury	8	69	55	21	11	0	156
Guildford	16	107	94	41	39	29	310
Guildford	16	107	94	41	39	29	310
Kingston upon Thames	7	41	45	2	5	2	95
Oxford	22	164	126	34	27	28	379
Portsmouth	5	44	33	3	8	2	90
Reading	5	18	11	8	9	0	46
Redhill	16	48	69	36	54	21	228
Rochester	11	59	58	31	29	3	180
Swindon	7	22	69	20	27	0	138
Southampton	17	100	131	32	54	2	319
Tunbridge Wells	24	103	133	61	68	47	412
East of England							
Cambridge	7	21	68	17	11	0	117
Chelmsford	9	33	77	17	19	19	165
Colchester	9	13	53	30	28	8	132
Enfield	5	2	32	11	21	14	80
Hemel Hampstead	7	34	29	37	17	1	118
Ipswich	25	123	149	53	63	50	438
Norwich	16	62	84	38	25	19	228
Peterborough	8	24	48	13	49	13	147
St Albans	7	39	43	25	14	0	121
East Midlands							
Derby	8	21	65	35	30	33	184
Leicester	25	90	90	65	79	95	419
Lincoln	6	46	36	20	14	16	132
Nottingham	12	73	93	18	26	19	229
West Midlands							
Coventry	5	47	33	9	4	22	115
Stoke on Trent	9	27	79	16	32	5	159
Shrewsbury	8	43	26	31	13	33	146
Worcester	8	66	36	9	20	62	193

North West England

Blackburn	8	25	27	13	37	61	163
Carlisle	16	26	96	57	60	29	268
Chester	5	23	44	8	17	0	92
Lancaster	12	40	46	34	17	19	156
Liverpool	6	35	36	22	9	3	105
Manchester	9	36	65	23	13	1	138
Preston	9	33	61	36	16	9	155
Stockport	12	86	106	35	27	4	258
Warrington	5	61	10	3	0	0	74
Wigan	5	7	26	13	32	18	96
Yorkshire & the Humber							
Doncaster	6	66	23	2	2	0	93
Hull	6	40	58	15	3	8	124
Leeds	4	23	16	1	8	25	73
Sheffield	10	28	29	14	18	47	136
York	13	93	83	25	19	13	233
North East England							
Newcastle upon Tyne	6	47	12	6	4	27	96
Cleveland (Teeside)	13	27	51	29	68	16	191

ACCEPTABILITY OF WIND FARMS BY POSTCODE AREA - PERCENTAGE

Postcode Area	Very Acceptable	Acceptable	Neutral	Unacceptable	Very Unacceptable
South West England					
Bristol	42.19%	33.89%	10.96%	8.31%	4.65%
Bath	24.86	58.01	3.87	12.15	1.10
Exeter	2.38	30.95	5.56	24.60	36.51
Gloucester	32.82	36.64	10.18	14.50	5.85
Plymouth	11.54	57.69	21.15	7.69	1.92
Salisbury	47.83	44.93	7.25	0.00	0.00
Torquay	39.36	58.51	2.13	0.00	0.00
Truro	40.87	40.87	15.65	1.74	0.87
Taunton	36.02	18.63	18.01	23.60	3.73
South East England					
Bournemouth	54.78	34.93	6.25	2.94	1.10
Brighton	30.04	45.92	9.44	9.87	4.72
Canterbury	44.23	35.26	13.46	7.05	0.00
Guildford	34.52	30.32	13.23	12.58	9.35
Guildford	34.52	30.32	13.23	12.58	9.35
Kingston on Thames	43.16	47.37	2.11	5.26	2.11
Oxford	43.27	33.25	8.97	7.12	7.39
Portsmouth	48.89	36.67	3.33	8.89	2.22
Reading	39.13	23.91	17.39	19.57	0.00
Redhill	21.05	30.26	15.79	23.68	9.21
Rochester	32.78	32.22	17.22	16.11	1.67
Swindon	15.94	50.00	14.49	19.57	0.00
Southampton	31.35	41.07	10.03	16.93	0.63
Tunbridge Wells	25.00	32.28	14.81	16.50	11.41
East of England					
Cambridge	17.95	58.12	14.53	9.40	0.00
Chelmsford	20.00	46.67	10.30	11.52	11.52
Colchester	9.85	40.15	22.73	21.21	6.06
Enfield	2.50	40.00	13.75	26.25	17.50

Hemel Hampstead	28.81	24.58	31.36	14.41	0.85
Ipswich	28.08	34.02	12.10	14.38	11.42
Norwich	27.19	36.84	16.67	10.96	8.33
Peterborough	16.33	32.65	8.84	33.33	8.84
St Albans	32.23	35.54	20.66	11.57	0.00
East Midlands					
Derby	11.41	35.33	19.02	16.30	17.93
Leicester	21.48	21.48	15.51	18.85	22.67
Lincoln	34.85	27.27	15.15	10.61	12.12
Nottingham	31.88	40.61	7.86	11.35	8.30
West Midlands					
Coventry	40.87	28.70	7.83	3.48	19.13
Stoke on Trent	16.98	49.69	10.06	20.13	3.14
Shrewsbury	29.45	17.81	21.23	8.90	22.60
Worcester	34.20	18.65	4.66	10.36	32.12
North West England					
Blackburn	15.34	16.56	7.98	22.70	37.42
Carlisle	9.70	35.82	21.27	22.39	10.82
Chester	25.00	47.83	8.70	18.48	0.00
Lancaster	25.64	29.49	21.79	10.90	12.18
Liverpool	33.33	34.29	20.95	8.57	2.86
Manchester	26.09	47.10	16.67	9.42	0.72
Preston	21.29	39.35	23.23	10.32	5.81
Stockport	33.33	41.09	13.57	10.47	1.55
Warrington	82.43	13.51	4.05	0.00	0.00
Wigan	7.29	27.08	13.54	33.33	18.75
Yorkshire & the Humber					
Doncaster	70.97	24.73	2.15	2.15	0.00
Hull	32.26	46.77	12.10	2.42	6.45
Leeds	31.51	21.92	1.37	10.96	34.25
Sheffield	20.59	21.32	10.29	13.24	34.56
York	39.91	35.62	10.73	8.15	5.58
North East England					
Newcastle on Tyne	48.96	12.50	6.25	4.17	28.13
Cleveland	14.14	26.70	15.18	35.60	8.38

APPENDIX 4

COMMENTS AT THE END OF SURVEY

Here on Anglesey we feel that we have enough Windfarms in the North of the Island

Survey too long!
It seems that there is less impact on flat urbanized landscapes.

This survey requires too many button presses. Clicking on the score would be better if it did not fade the picture. OK buttons slow the process.

The windfarms enhance the scenery in many of the pictures

Rather repetitive
Wind farms possess NO Scenic Qualities, are a total Blot on the Landscape and are a needless waste of money.

Given the urgent need to produce more sustainable energy, I am prepared to see a lot more wind farms around the country, but some of the most remote natural beauty spots should if possible remain pristine
Generally I support wind farms but I believe the scale and context are important. Too many turbines crowded together, or turbines in areas of outstanding natural beauty are unacceptable to me.

The last slide picture did not show. It would have been to view the picture then the questions as I spent a lot of time scrolling up and down the page.
I think some of the shots were same place different views. I would prefer to see windfarms on lower levels to preserve as much if our gorgeous landscape as possible..

Fewer, taller turbines seem less intrusive than a proliferation.

Wind farms look better when spread out in small numbers. They also look more appealing on flat landscapes rather than on hills and valleys where natural beauty is marred!
Wind farms are far better than coal or gas powered power stations however more should be out at sea

Quite long, too many pictures for my liking.
The pictures only show a small sector of the relevant countryside and it is difficult to get a sense of place and therefore scenic quality from the pictures. I think that a single picture cannot give the true visual effect of a windfarm on the environment

Horrid urban structures.

Long! But thank you

Too long a survey

I generally feel that offshore farms are acceptable. Onshore farms that are best placed to capture maximum wind are very often place in very scenic upland locations and this is

unacceptable. I am also disturbed by the frequency with which wind turbines are placed around blind bends on major roads and motorways and can be a distracting shock to the uninformed driver.. well you did ask
Windfarms are not the clean energy producers that they claim to be. Millions of tons of concrete put into the hills and peat removed. Windfarms have not resulted in cheaper energy and green taxes added to our bills only add to the increase in fuel poverty.

I found that I rated scenic value lower when turbines were visible, showing the impact they have on the landscape. This was quite difficult to complete because of the number of images and the concentration required.

I found all of the wind farms unacceptable as they did not appear to be contained or hidden in any way by the landscape features and some were close to homes.

I can understand some of what this survey is trying to do, but the range of landscapes make it very difficult to discriminate between many not dissimilar scenes, many of which are quite 'meh' in my opinion.. I live in the Highlands where some much more extreme examples of 'unacceptable' in my opinion windfarms can be found. The issues for me are mostly around the acceptability or otherwise of turbines in a 'wild' landscape, far from demands of the central belt. This also brings additional infrastructure that can be just as intrusive. Hope the survey gives you the clear picture that I think you might want.
What do you want to preserve and why

"BIOFUELS, BIOMASS and WINDFARMS are destroying wildlife habitats at great speed, yet they do not produce any environmental benefits at all. They are remedies that are worse than the illness and should be abandoned immediately." "The World Council for Nature does not condone the destruction of nature in order to, supposedly, "save the planet". If the planet is at risk, it is from the corrupt alliance of "green" charlatans, subsidy-sucking speculators, and politicians. Together, they have created a monster which is causing more devastation worldwide than there has been in 5,000 years of civilisation." Mark Duchamp President
The photos do not show the full extent of the damage that wind farms do to the landscape as they do not show the effect of the rotating blades.

Very difficult to look at one thing in isolation. Community impact with regards noise and other factors all need to be considered as well as the landscape characteristics.

Windfarms aren't just about what you see above ground but also what is going on sub-surface. So a double negative impact on the environment. This survey just proves the point that wind farms, are planted in areas of important rural amenity, miles from where the electricity is required. Put them on Hampstead heath or Regent's park, Arthur's Seat? The countryside and rural areas are for all to use as an amenity.
They destroy all landscapes

The number of wind turbines in a given area makes a difference, where there are many in a small area, they overwhelm the view. The worst views were where there were pylons as well, I would rather see wind turbines than more pylons
Wind turbines not only completely destroy the beauty of our picturesque countryside, they do not produce much energy, they are certainly not 'green' because of the way they are manufactured and the carbon that is released when the foundations are dug out. They make people who live near them, ill and they aren't biodegradable, so what to do with the blades when they are decommissioned is a problem, they are dreadful monstrosities and should only be allowed far out at sea, so long as they don't disturb marine life.

It's not just about the scenic value. In Shetland Viking and Energy Isles are wanting to destroy pristine Peatlands for profit.

I would be very interested to know how you intend to analyse scientifically the findings of what is a very subjective emotional experience for me
There is no place in our landscapes for these money making monstrosities. They provide no benefit to our country, benefiting only the landowners, developers and operators.

I have yet to find a location that windfarms do not destroy the aesthetic beauty of an area. Wind farms are a blight on the landscape and a way for greedy people to make money as they never repay the cost of building them

Windfarms use so many resources to build (such as rare earths from china which cause untold pollution). All they farm is subsidies for the rich.

Ugly structures low frequency emissions that are dangerous to humans and animals.
I hope all the steel and fibreglass, lub oils are removed from our hills and farms. I also hope the thousands of miles of wind farm access tracks cutting across our beautiful country side are covered over. Wind power is a rabbit hole and we need modern developments to make good our energy requirements not medieval technology. The footprint of a wind farm is too large and a nuclear plant is less destructive with a small footprint per MWh production.

It took a lot longer than 10-15 minutes. More like 30-40.

I absolutely hate the effect that windfarms have on the Scottish landscape. Even when windfarms are refused planning by local authorities they are routinely over-ruled by DPEA or Energy Consent Unit, reporters are appointed by SNP government ministers and simply follow the party line and consent windfarms everywhere. Massive areas such as the borders, around Loch Ness and the Monadh Liath have been totally trashed by windfarms.

Money and wind estates are the route of all evil.

SEE: https://www.ref.org.uk/constraints/index.php The over deployment of industrial wind particularly in Scotland has devastated communities, the environment and wildlife and at huge cost to the consumer. The constraints and Forward Energy Trades paid to turn turbines off to protect the grid is reaching unsustainable levels.
Wind turbines are alien to the countryside. These rotating machines destroy the view.

These windfarms should not be allowed near people’s houses, and they should not be sited on peat and in an area known for its scenery, lochs and fish, wildlife and birds especially rare birds.

There was a question about are you for or against wind farms in general and I answered 'it depends'. I should have said 'for', especially now having seen how nice they can look in a landscape.

Any wind turbine completely destroys the scenic quality as do pylons

Very interesting - I hope the survey helps
The photo selection did not include attractive areas without detractors present, eg uplands were shown with forestry plantations rather than native woodland, so hard to give high scores and those given reflected the presence of detractors other than the windfarms too.

Clearly very subjective and your view point can stem from your beliefs and very of climate change - however I am sure the study will be useful
Really interesting to see my own reactions - I fundamentally find wind turbines elegant and that they frequently for me enhance a landscape. Of course I might feel differently if I lived next door to one. I am interested to see what you results are.

I prefer wind turbines to pylons.

Generally I feel multiples of windmills reduce the scenic attractiveness of all areas. If an area is not particularly scenic to begin with it is not too bad however if it is attractive to me I feel it is diminished by their presence overall

Within landscape - landscape led approach - solar easier to fit in landscape

Do they always have to be white? Surely less obtrusive if a muddy green, or pale blue?

We need more, supportive of sustainable energies

I consider them to be a necessary evil and are no better nor worse than electricity pylons.

Survey instructions ambiguous. All scenes rated as if no windfarm. Unlike grid pylons, windfarms are intrusive by virtue of the number of towers in one place and their motion.

Windfarms are essential but my preference is for them to fit into a flat or agricultural environment. I don't like it when they destroy beautiful scenery. That can occur when there are too many and they are too clustered.

it will be interesting to see conclusions!
Got punched drunk by the end
I do feel wind turbines could be more creatively blended into nature by adding natural foliage and planting to some part of the turbine

The photographic angle, the cloud formations, the light and shade have an impact on the scene with or without wind pylons, I dislike farming landscapes particularly but absolutely approve the wind farms in them.

There are far too many selections in this survey ... I nearly gave up and it was sheer persistence that led me to the end ...

haven't checked for internal consistency. - Very long.

I love to see wind farms and we need more to save the planet
Am against wind farms

Far more attractive than electricity pylons
Andrew Lothian

In some photos I think the wind farm actually enhances the landscape.

This might sound daft but is there any way of diminishing the visual impact by, say, using perspex parts?

Love off shore wind farms

Wind farms are the future
I am not against Windfarms but I do think we have to be careful where they are put. Those out in the sea are not too bad although I do wonder what it does to the birdlife. No one every mentions that.

Surely there are desolate places in which to build these wind farm's such as Saddleworth Moor

I have no problem with the aesthetics or noise, but serious reservations about relying on more of these bird blenders when nuclear energy could provide for all our needs.

I think I tended more to acceptable for farms I had actually seen (1 or 2 of them)

I think more people need to understand that renewable energy/ wind turbined are required not a 'nice to have', so ought to view them as a positive contribution to the wide benefits they bring.

Seascapes are as important as landscapes and their destruction should not be undervalued. Pre-application 'consultation' visualisations always understate the perceived appearance of turbines against a previously clear uncluttered horizon. Offshore wind is mostly 'inshore wind' as shallow depths and short cable to grid connection distances are preferred by developers.

I've never soon so many wind farms, most look beautiful and add to the landscape in the same way that a tower or castle would.

Wind farms should not be on prime agricultural land as this will be needed in the future. Once a wind farm has been built it can never be used for crops again

Personally I don't think we have much choice but to accept them. They are no more intrusive than pylons, and probably more aesthetically pleasing as they are more streamlined. Everyone is used to pylons marching across the landscape as they have been there for years. People will become accustomed to wind farms, as long as they are not too dense in any one area, and as long as they are not detrimental to health.

Most of these scenes weren't among the most beautiful I have seen. In fact, in some cases wind farms in my view add interest to the landscape and rarely spoil it. They are a damned sight more aesthetic in aspect than the power pylons with attendant cables we've been forced to live with over past decades.

I found looking at these that it was more acceptable to me if the windmills did not cover the whole field of vision, but were concentrated in part of the view. Also as I like mountain scenes, I care less about a view of fields and found sometimes the windmills added interest, but that could depend on the angle from which they are viewed

I think I don't mind windfarms higher up on the landscape in small clusters, but not huge numbers 'taking over' the landscape. They did not 'sit well' in the lake surrounded by hills and

forests. Completely ruined the natural landscape.

I find wind turbines very assuring on the landscape and over time they will become more acceptable as people get used to seeing them. They are much more aesthetically pleasing than pylons.

Benefits outweigh visual impacts generally

Wind Farms are more acceptable if not situated near to residential areas and where people visit to take in the view. Situated on hills spoil the view especially for visitors . Wind Farms are acceptable if built in appropriate areas. They have a place for energy and should be recognised as such.

I really think that in some cases the wind turbines improved the landscape

I did find that I was perhaps marking the photography rather than the scenes but perhaps this does not matter

Given the densely populated country we have and the love of countryside, I see little chance for wind farm acceptance on land

Personally I don't find farmland particularly scenic - thought there would be a more varied selection of locations eg coastal, industrial, post-industrial etc. Perhaps fewer pictures? felt like it was a bit too long

Wind farms are an essential part of our need for renewable energy

I believe wind and solar farms are essential to our future, and think wind turbines in remote areas can be inspiring sights, solar farms less so. I am used to seeing wind turbines in the mountains near where I live for half the year in the north of Portugal.

Most of those fields looked very industrial with or without wind turbines

Difficult to grade the quality of a scene without a reference. I suspect boring scenes may be enhanced with the inclusion of turbines.

Wind farms often look better on flat, boring land. Sometimes they improve the landscape.

Most scenes in the survey were of quite boring landscapes, many of which were actually enhanced in my eye by turbines. If the survey had included steep or coastal terrain, I would likely have viewed the turbines as less acceptable.

WE HAVE TO GET RID OF FOSSIL FUELS SO WE NEED WINDFARMS... BOTH ON SHORE AND OFF SHORE

An interesting survey - but do you need so many questions? The (few) pictures showing existing pylons were helpful as a basis of comparison (?) but could you also have shown some pictures of power stations and their impact on the landscape, not to mention industrial development, ugly and out of scale agricultural buildings and large housing developments. All contribute to ugly landscapes.

wind farms destroy any landscape due to their dominance

I think it depends on how the mills are spaced between trees. Too much regularity is annoying. Lots clumped together looks good or spaced apart looks good, but not a random mixture.

I quite like the elegance of them

Generally OK if line of ground behind wind farm is not broken up by towers of the wind turbines from viewers viewpoint

I would accept that some of the scenery suffers visually from the wind turbines, but it is a price worth paying.

I seem to prefer hills to flats and I think the wind turbines actually improve the landscape, especially the flats as it's more interesting to the eye (as well as to the heart / brain)

Thank you for showing me so many beautiful skyscapes. Does a falling branch in a forest make a sound, if no one hears it. Is a landscape beautiful, even if few live there? Onshore wind is the high tension (40k volts) pylon of our age. Think, if we had our time again, would we have marched pylons across this achingly beautiful land, we had another way? Put the onshore turbines in cities, and the rest out to sea

I don't see the point of offshore wind when there's is plenty of room on land. Wind farms are gene rally nicer than pylons

Have no issues with wind farms but too many in close proximity are not good

I found this really difficult- I have an interest.

Personally, I think wind turbines are much nicer looking than power lines.
Most of these landscapes were denuded hillsides where there should be forests or agricultural monoculture- prime sites for wind farms

Far too often wind turbines are to close to each other and in too big a number

I recognise a lot of these locations as being in South Lanarkshire, where I've learned to love the strange beauty of wind farms

Really poor photos, made most of the scenery boring and the angles and density of turbines changed the view. You had none at sea nor any single large ones. The survey was too long and boring!

I found many of the landscapes bland and featureless. If anything, the wind turbines improved them

Wind farms are an ever increasingly necessary to reduce the UK dependence on fossil fuels. Climate change is a proven fact which we are responsible for. The small amount of interruption to the scenic view is little cost and after a while they are accepted as part of the view. We need more to make us less dependent on gas etc.

Most acceptable where wind farms are less intrusive to the eye ie not too close to general view, not too many together.
If we need clean and sustainable energy, we must compromise with the aesthetics of the countryside
Do not like them. Blot on the landscape. Remind me of the film day of the triffids. You see them stationary when it is windy because the grid has enough power but still get annoyed about it.

The survey is too long. Should include some pictures of other industrial installations.

the only issues I had were backlit close-ups and crowded farms

It really depends where there are situated. Offshore is best.

Happy with wind farms offshore, onshore farms are a blot on the landscape
You didn't show any photos of off shore wind farms, which in many respects are less acceptable than on shore wind farms

Survey way too long

I was a member of the committee that approved the new horizontal pylons
There should be no wind farms on land

It i quite difficult to assess the visual impact. I am not sure whether, for example, the difference my score for scenes with or without cameras really correlates with how acceptable I find them. Furthermore I found myself thinking that I didn't like seeing wind turbines on low lying ground, looked at from above, but I didn't mind looking at them from below, but that might simply be because they look like they ought to work better on locally higher ground. Finally, while I mostly answered that I found the turbines acceptable it is certainly the case that pictures of wind turbines do come across as just that, as pictures of turbines, rather than as pictures of landscapes with turbines in. The turbine becomes the focus of the picture. Consequently if I had a particular love for a particular view which was familiar to me I might judge the impact of the wind turbine to be negative despite not minding them as an outsider simply being asked (albeit in a temporally confused way) to compare scenes with and without turbines.

Generally when placed at a lower density they are more acceptable. Also, they are better viewed from a distance than close up.

Our foot print is evident on our landscape my main concern regarding wind turbines on private land owned by individuals is what will happen to them in 20 years when the economics of there erection changes. Many farmers just abandon equipment when it is of no further use. For Pendle 3/4 150 foot turbines erected together could serve the area and keep all other areas clear.

They are like pylons, you don’t notice them after a while

No matter how necessary they will always be a blot on the landscape
The amount of scrolling was annoying - the pics should have preceded the scoring grids.

I marked some of the earlier pictures with windfarms in higher than I should as I thought I was supposed to try to envisage the scenery without the turbines. I realised after a bit that that was wrong. It all depends on whether the turbines are distracting. If they are so obvious that you are distracted by them away from the natural scenery then they become hideous. I like hills and trees not flat land. In some of the scenes the turbines are so in-your-face that they completely ruin the scenery.

Whilst not a great fan of wind farms I accept them for what they do as opposed to some of the alternatives. They are here to stay for now.

A clever survey, memory challenging. I acknowledge. There is a place and need for wind farms but, would prefer them to be off the coast and not situated in areas of great scenic

beauty. Wind farms inland should not be built in great clusters and should be smaller.

Generally, I see wind turbines as beautiful feats of engineering making the most of natural resources, but sometimes, if there are too many crowded on a wind farm, they clutter the landscape.

I think wind farms animate dull landscapes.

Ok
I live at Fairlight, E Sussex, on the eastern edge of the Hastings Country Park. The view from the “Firehills” car park across Romney Marsh and Rye Bay to the North Downs 40 miles away was one of the best in the country. It has been spoilt by the wind farm at Cheney? Farm. Although it is distant and the angle sub tended to the eye by the turbines is very small they still ruin a sensitive landscape. Oddly enough, when viewed from close up they are not offensive.

Wind farms spoil my views in the country side and are not acceptable
Photographs from a single view point (with or without wind farms) will be very subjective but wide shot photographs from a high point, e.g., from an escarpment above where a wind farm or farms are proposed will probably provoke very different responses.

Pylons are undesirable but are less obtrusive and known as necessary

Most of the scenic views were beautiful and completely ruined by the wind turbines. Over 120 of them have appeared in the sea off Littlehampton which I do not like BUT they are far enough out to be hardly noticeable so I guess these are acceptable.
Generally in favour of wind farms provided location and numbers are in sympathy with area and landscape

I fear that many questions is a little long to get as many people complete to the end. But hope the results are helpful and informative.

It was tricky grading them at first when you weren't sure how degraded the landscapes might be further on

Certainly took more than 15 minutes. Many will give up.

We need more wind farms and personally I don't find them particularly unattractive.

It is hard to really give judgements without seeing the wider setting.
Wind farms are visual reminders that we all need to accept climate change. I find them quite soothing to look at.

I like windmills I think they look like modern art. Your survey is too long I think. Some people may give up on it.

Wf a lot more attractive than pylons don’t like on flat land but ok on flat industrialised or mud flats etc.
I am influenced by factors other than wind farms. e.g. I prefer sunny days, scenery with mountains and hills rather than flat. Also, i find ugly manmade buildings far more intrusive and unacceptable than windmills

Offshore only. More efficient probably.

Love windfarms and what they stand for, but having taken the survey I realise that I like some settings more than others! A very good survey and I would be interested to receive feedback.

Very long! Hope you get useful data.
I would prefer that these are all off shore however if spaced out i don't see too much harm.

A bit too long

There are very few places where I would object to placing a wind-turbine. I think they are aesthetically quite beautiful and a positive human invention that will help us save our planet. Thank you for your work on this.

Hi. Interesting... I wonder how many I answered had the same score with or without the turbines? Probably a bit long for a survey. But thank you for doing this. I hope people respond
We have to be careful in trying to save the planet that we do not destroy its beauty
All of the landscapes were bleak and clearly support only an impoverished biodiversity and heavily modified by human interventions (or their animals) and deliver few natural processes such as flood attenuation, groundwater recharge or atmospheric carbon sequestration. The sterility of these landscapes is very depressing.

There is choice we need renewable energy!

I believe wind farms are essential, and in some cases actually add to the interest and attractiveness of the countryside.

I love wind turbines. I like windfarms but prefer when there is some uniformity in their arrangement. I especially like them when they are at the top of the landscape which often happens.

It took me much longer than you said, and I hit some problems with the survey software.
Wind farms can look extraordinary beautiful. Off shore always look better

Having traveled through the French countryside quite a lot I have seen that their wind farms don't seem to cause much of a problem

The wind farm near to me has blighted the lives of over 3000 residents in that there is now severe television interference that could have been rectified by the use of a shield on the transmitter, which the powers that be couldn't be.
Perhaps if more thought were given to the symmetry of the structures within the landscape they would look better ... or maybe if they weren't bright white but green [say] they would look better...

The flaw in the survey for me is that some of the scenes are restricted and you do not see the wider landscape. Also turbines move and the movement adds greatly to the impact on the landscape.

Thank you

Totally devasting for birds and other wildlife

A revealing survey. I am in favour of wind farms. When I see them in real life I think, yes, they are OK here. It was more difficult to judge the visual impact on small photos, sometimes close to the turbines, at other times from a distance. I was very aware of being inconsistent!

scenic should also be interesting. when there are lots of wind farm towers it is not interesting
Although aesthetics are important, Climate Change is the most pressing issue of our time. Renewable *incl. wind turbines) will be essential if we are to reach a zero carbon economy in time.

I tend to prefer hilly views and do not really like flat landscapes, I tend not to like looking at snowy/frosty views.
Frankly they blight the landscape. The development closest to me on the Romney Marsh was fought vigorously on both visual impact and sustainability (it took 4 to 6 times the concrete pour they stated to make the bases). And yet objections by Parish, Town and District councils were ignored. This is not democracy, it is not even moral. The green lobby hold sway over a weak planning system to the detriment of natural countryside beauty. Solar farms are not much better, although the visual impact is less from a distance close up they are ugly and prevent agriculture. Each and every time the land owner reaps all the reward and nothing comes back to the local community. Even wind arrays are sea are ugly. When or perhaps if you ever manage to capture wave power we might have a viable low visual impact system, but it is already looking too late.

Wind farms often look eloquent especially on hills or where trees hedgerows for curves Flat land less pleasing to the eye.
I found this interesting as it challenged my own perceptions of what I found acceptable and unacceptable in landscape. And I was questioned in some photos, especially in close ups of hills, where I wanted to see the wider aspects of the landscape to judge what I felt was acceptable. I felt that more the landscape was obviously altered by man (roads, plantations, pylons, arable etc), the more accepting wind turbines I seemed to be. Having said that, all landscapes have been altered by man in the UK, but I definitely want to keep the open fells and more 'natural' woodland areas protected in some way. And I am definitely biased against lowland landscapes! And I feel that any decisions about wind turbines and other big developments, have to be seen in the wider context and history of the landscape, proximity to homes, archaeology, nature conservation, viability etc.

I support extension of on shore wind farms. They must benefit the local vicinity in which they are located eg cheaper electricity or planning gain. Farmers should be paid a reasonable amount for having them located on their land.

Prefer to see solar panels where hedges can protect the landscape.
I really don't have a problem with putting windfarms anywhere, especially on land as it is one of the cheapest forms of generating electricity

Not enough (any) scenes with water - so no 9's or 10's

I live in Cumbria and I found the landscapes in your photographs pretty dull. We get much worse foisted on us in much more beautiful surroundings

Wind Farms are majestic & necessary to have renewable energy not fossil.

I was surprised at the massive improvement of each scene where windmills were erected.

Survey appears to repeat many scenes and may put people off from completing

I'd really appreciate it if somebody could put an end to the damage which is being done to the landscape for no sufficient reason (see my earlier comment). Thanks.
Melting ice, politicians failing to act on climate mayhem and money subsidizing fossil fuels- very unscenic. Thanks for your work

I want to see more wind farms on and off shore

Wind turbines don't generally offend the eye to me. One occasion I thing they add something to the scenery in a positive way and sometimes when they detract then it must be balanced against negative factors such as continued use of hydrocarbons to produce electricity.

The aesthetic qualities of a wind generator are not appreciated. The alternatives - nuclear, coal fired gas are not acceptable.
Being an island we should be using the power of the sea rather than these monstrosities.

I think wind farms can be attractive and even add to the scene. However I know that residents can find the noise even more troubling than the appearance.
There was no consideration given to off-shore windfarms in this survey.
Scenes offering wide and distant views seem to score highest and deserve most protection

Landscapes all a bit samey. The narrow field of view made it hard to judge scale - not sure if some of the wind farms had been edited in but they sometimes looked out of proportion as a result?

I like pylons and wind turbines and don't find them offensive - I prefer very rugged hilly terrains

A group of the early-mid scenes with a turbine projecting from a prominent wooded hilltop drove me to distraction and the hope that the prominent turbine would disappear

i think most views are fine; i suspect close up views are going to bother some people, but to me if anything some with pylons etc were enhanced. Very few highland scenes were depicted so few really dramatic views in my opinion.

As you can tell I have no objections to wind farms in general. You can also tell that I prefer hilly to flat scenery. What I have learned about my aesthetic response to wind farms from this survey: I prefer them in small groups. I like them set into a landscape. I think they go very well into hilly landscapes and are more overwhelming in flat. The survey was interesting but it took quite a long time. Pictures were repeated obviously for consistency but shorter might have been better . I wonder if some people might have got bored and switched off halfway through!

Interesting exercise, but very long. Confirmed in my own mind I really do not like windfarms.

In the main I am against wind farms in that I do not believe they are very cost effective.

I think it is unfortunate that all the photos were rural scenes. Had there been wind farms in highly industrial areas, and less high ones, I might have reacted more favourably. Had there been pictures in the ocean, I would have reacted very favourably. Had there been fewer, I might have reacted, on some occasions, in a more neutral way. This survey was too long though - I would have liked to stop half way as it took too much time.