Scenic Perceptions of the Visual Effects of Wind Farms on South Australian Landscapes

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Abstract
A survey of the visual effects of wind farms was undertaken in South Australia, with the aim of quantifying the impact of wind farms on the perceived scenic quality of landscapes. In the study a total of 311 participants assessed the scenic quality of a photographed landscape in 68 coastal and inland locations where wind farms could be located, both without wind farms and with wind farms digitally added to the scene. A key finding of the study was that wind farms generally had a negative effect on landscapes of higher scenic quality but a positive effect on landscapes of lower scenic quality. The negative visual effects of a wind farm did not reduce appreciably with distance. White, blue or grey coloured turbines were preferred over tan or rainbow hues, but this finding was based on a small number of scenes. Limitations of the study included using static views of wind farms and having an insufficient number of scenes to assess the influence of the number of turbines on scenic quality ratings. The study concluded that wind farms should avoid areas of higher perceived scenic quality, particularly on the coast, and be located in areas of lower scenic quality. The study adds to the growing body of international research on community attitudes to wind farms, and contributes useful knowledge for future planning of wind farms in Australia. These research results should assist communities, government agencies and the wind energy industry and improve the planning and design of wind farms by taking community perceptions into account.

KEY WORDS *wind farms; perceived scenic quality; visual impact; South Australia*

ACRONYMS

AusWEA	Australian Wind Energy Association
ACNT	Australian Council of National Trusts

Introduction

Wind farms have been constructed in many countries as a way of increasing the generation of renewable energy and reducing dependence on fossil fuels. Paradoxically, while addressing one environmental concern they have also been opposed on environmental grounds, with opposition to the construction of wind farms being based on their perceived negative impact on the environment, and particularly on landscape quality. To enable a better understanding of this issue a survey of the visual effects of wind farms on scenic quality was undertaken in South Australia, to provide quantitative information on the effect of wind farms on the perceived scenic quality of coastal and agricultural landscapes, and to contribute useful knowledge for future planning of wind farms in Australia.

Context

Global wind generating capacity increased substantially from 4.8 GW in 1995 to 74 GW at the

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end of 2006 (Global Wind Energy Council, 2007, 8). Commitments by many countries to substantially increase the share of renewable energy will result in further growth in the number of wind turbines. In 2007 the European Union committed to 20% of its electricity being generated by renewable energy by 2020 (European Union, 2007: http://ec.europa.eu/energy/energy_policy/index_en.htm, accessed 18 June 2007) and the United Kingdom (UK) to 10% by 2010 (8% from wind) and 20% by 2020 (DTI, 2007, 14). Commitments by Australian States include: New South Wales to 10% by 2010 and 15% by 2020 (NSW Government, 2006, 3); Victoria to 10% by 2016 (Victorian Government, 2006, 8); South Australia to 20% by 2014 (SA Government, 2007, 22), and Western Australia to 6% by 2010 (Carpenter, 2007, 13). Global wind generating capacity is expected to more than double to 150 GW by 2010 (WWEA, 2007, 12). Assuming turbines average 1.5 MW, there will be over 100 000 turbines operating throughout the world by 2010. Most of these will be in Europe, the United States, India and China.

Wind farms can present a range of environmental effects – noise, blade glint and flicker, electromagnetic interference, bird strike and soil erosion – but generally these can be mitigated. On the other hand, because of the size of turbines (which since 1990 have typically grown in height from 50 m, rated at 0.25 MW, to over 120 m, rated at over 2 MW), together with the large number of turbines in a wind farm and their location in often scenically attractive areas, visual effects are not so easily addressed. For example, the Planning Panel appointed to enquire into the wind farm proposal near Portland in Victoria found:

> World experience (in the USA, Denmark, UK and the Netherlands) suggests that landscape will normally be the single most strongly argued issue in any wind farm permit decision. (Planning Panels Victoria, 2002, 29)

The Countryside Commission, England's rural landscape watchdog, expressed concern in 1996 that 'England's scenic countryside [was] in danger of becoming a "wind farm wilderness"' (Stevens, 2006, 8). With prescience, Sylvia Crowe said much the same fifty years earlier:

> From a nation, as opposed to a sectional viewpoint, the need to consider the countryside as a whole and to balance the national wealth of consumer goods against the national wealth of a beautiful landscape should be a matter of course. (Crowe, 1958, 10)

Surveys of residents regarding proposed wind farms, in widely separate surveys in North Carolina (Grady, 2002) and Scotland (MORI, 2005; 2006a and b), found that spoiling the view/scenery was the topmost concern, far greater than any other issues. In Denmark, Germany and Sweden, most wind farms are communally owned and local residents are generally supportive (Hammarlund, 2002; Nielsen, 2002; Schwahn, 2002). However, some landscape-related publications in these countries have described this destruction of scenic beauty as a 'catastrophe' and claimed that 'the beauty of our landscape (was) in danger' (Hoppe-Kilpper and Steinhäuser, 2002, 88). Perceptively, opponents of a wind farm near an Area of Outstanding Natural Beauty on the Isle of Wight argued that the root of the problem lay with conflicting national policies, with renewable energy targets advocating wind farms clashing with a policy to preserve, enhance and protect the best landscapes from major developments (Stevens, 2006, 34).

On the other hand, a survey in Ireland found overwhelming support for a wind farm in the local area, clean energy being the main justification, while the landscape impacts were the main reason for opposition (Sustainable Energy Ireland, 2003, 12, 13). Using photomontages of wind farms in different landscapes the survey found, contrary to expectations, that most respondents were positive about the likely visual impact regardless of how they had previously rated the scenic beauty of the same landscape. Respondents who lived near a wind farm were largely positive and were generally in favour of more wind farms. A survey in Spain, however, found that protection of wildlife ranked higher than landscape preservation (Álvarez-Farizo and Hanley, 2002, 113).

Paradoxically, most surveys of residents near operating wind farms in the United States and United Kingdom have found that after initial concern, opposition to the wind farm waned. Wind farms, 'once greeted with hostility, evolved toward a less resentful sort of accommodation and acceptance' (Pasqualetti, 2001, 699). Surveys of UK residents near wind farms following their construction (BBC Wales, 1994; Exeter Enterprises, 1994; Renewable Energy, 1994; Robertson Bell Associates, 1994; 1997; 1998a; 1998b; 2002; Dudleston, 2000; MORI Scotland, 2003), and of tourists (MORI Scotland, 2002;

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NFO System Three, 2002), have shown that by far the majority of participants supported the wind farms, with no survey indicating a majority negative view.

In Australia, opposition to wind farms has been strongest in Victoria, particularly in respect of the wind farm proposed on Cape Bridgewater near Portland. Following inquiries and appeals (Victorian Coastal Council, 1998; Victorian Civil and Administrative Tribunal, 1999; Planning Panels Victoria, 2002; Mercer, 2003), the proposal was approved by the Victorian Government. In South Australia, public opposition to the Sellicks-Myponga proposal resulted in the proponent abandoning turbines proposed along the prominent Sellicks Hill (Planning SA, 2003).

Because the landscape impacts of wind farm proposals were problematic for the industry, resulting in uncertainty and delays, in 2003 the Australian Wind Energy Association (AusWEA) and the Australian Council of National Trusts (ACNT) announced an agreement to work together on a joint *Wind Farms and Landscape Values – National Assessment Methodology* to ensure landscape protection during the growth of the wind industry (AusWEA/ACNT, 2003; 2004). The consultants released a discussion paper in 2004 which was finalised following review in 2005 (Planisphere, 2004; 2005). This concluded:

> There is growing unity of the need for consistent, transparent and comprehensive consideration of the special values of the landscapes in which wind farms might be sited, and there is a desire for consistent and adequate community involvement in this. (Planisphere, 2005, 25)

In early 2007, the project's *Wind Farms and Landscape Values Foundation Report* (AusWEA/ACNT, 2007) was released and was subject to Australia-wide consultation. The report discussed the landscape values of a wind farm and surrounds, the depiction, modelling and understanding of the visual impact of a wind farm, and options for siting, design and mitigation. A draft National Assessment Framework of the visual impacts of wind farms was proposed covering the following four steps:

1. preliminary landscape assessment and full landscape assessment;
2. description and modelling of the wind farm in the landscape;
3. assessment of the impacts of the wind farm on landscape values, and
4. Development of management and mitigation measures.

In July, 2007, the project was completed and submitted to the two contracting organisations for their consideration and approval. It is expected that the Framework will be incorporated into the Best Practice Guidelines. The ACNT will consider its incorporation into the ACNT Energy Infrastructure and Transmission Siting Policy.

To put this approach into operation, however, requires a deeper understanding of the impact of wind farms on landscape values than is provided by existing studies. With few exceptions, these studies have tended to be coarse in their discrimination of the factors influencing landscape perception, and have not adequately explored the three-way relationships among people, wind farms and the landscape. The evidence from previous research raises several questions, in particular:

1. Are there landscapes where wind farms would not be supported by the community?
2. Is there a threshold in landscape quality which tips support into opposition?
3. Is it possible to discriminate community reactions more than merely for or against the wind farm?
4. How do community reactions vary with the size and number of turbines and the types of landscape in which they are located?

A survey was undertaken to explore these questions.

Research design

The study examined perceptions of the visual effects of wind farms in selected landscapes in South Australia. The objectives were to:

1. measure the influence of wind farms on perceived scenic quality in a range of landscapes;
2. develop a predictive model to assess the likely visual effect of wind farms on perceived scenic quality in these landscapes;
3. assess the relative influence of specific attributes (such as distance, number and hues of turbines) on perceived scenic quality, and
4. develop guidelines for wind farm siting and development based on the findings.

The research design measured differences in the ratings of the perceived scenic quality of a scene

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with and without a wind farm, to determine whether the wind farm had a positive or negative influence and the size of that influence (Hull and Bishop, 1988). Use of the same scene for rating with and without the wind farm meant that all the other features of a scene were identical and remained constant in both scenes. Photographs were used in preference to field assessments as it has been established that colour photographs can give similar ratings as do field assessments (Shuttleworth, 1980; Kellomaki and Savolainen, 1984; Trent *et al*., 1987; Brown *et al*., 1988), provided that the photographs met certain criteria:

1. the photographs were in colour;
2. a sufficient number of photographs covered the area and range of features, and
3. the photographs were in standardised format (horizontal), non-artistic in their composition, provided good lateral and foreground context to scenes, covered a single landscape unit, and showed representative scenes.

The use of photographs as surrogates offered obvious advantages over transporting large groups of people to locations to rate actual scenes. Photographs are particularly appropriate in the evaluation of hypothetical alterations to the landscape, as in this study, and they enable widely separated locations to be rated on a comparable basis. A 10 point rating scale was used to measure the visual quality of a scene (from 1 = very low to 10 = very high), and a minimum of 300 adult participants were required to rate the scenes.

Study implementation

South Australian landscapes where wind farms had been proposed or in which suitable wind regimes existed were photographed using a Nikon SLR F60 camera with a 50 mm lens. Scenes were selected to represent both proposed (35 scenes) and potential (33 scenes) wind farm sites. AusWEA's (2002) *Best Practice Guidelines* was used to assist in the selection of suitable sites. The sites were located on the coast and on inland agricultural land. Photoshop™ was used to remove clouds from the photographs so that all turbines were viewed against blue sky in order to standardise the scenes. Photomontages were prepared using Photoshop™ to insert standard 100 m high wind turbines into the original photographs. Whereas Hull and Bishop (1988) used similar scenes, the use of digital methods allowed the same scene to be used with and without the turbines. The turbine size was scaled appropriately with distance based on a formula developed from measurements of a large structure of known height (a power station chimney) at distances from 0.5 to 10 km. The formula compares the height of a 100 m wind turbine, as measured by an A4 size photograph, with the distance of the view:

$$Y = 33.46X^{-1.0446} \quad (1)$$

where Y = height in mm on the photograph enlarged to A4 and X = distance in kilometres. To assess the influence of distance on visual impact, the distance to the mid point of turbines from the observer was measured in all scenes.

The turbines shown were coloured white except in three scenes where a range of hues was applied; white, grey, blue and tan. In two separate scenes, the turbines were coloured red, orange, yellow, green, blue, indigo and violet (rainbow colours) in order to further assess the role of colour on the perceived visual impact of turbines. The scenes used were of flat agricultural land. In three scenes the number of turbines was varied between six and 13 in an attempt to examine the influence of the numbers of turbines on visual impact. Again, scenes of flat agricultural land were selected. Although the number of scenes used to examine the influence of colour and turbine numbers was small, the results could indicate an area for further research.

The survey comprised 160 scenes. There were 68 scenes without a wind farm, 68 of the same scene with a wind farm, and 14 extra scenes to assess colour and distance. Because it was considered likely that viewing wind farms would be novel for participants, the first ten scenes were repeated at the end of the 150 scenes and the first ten ratings discarded. Thus a total of 160 scenes were rated but only 150 scenes analysed. Apart from the first and last 10 scenes, the remaining scenes were arranged in random order. The rating instrument listed the scenes from 1 to 160 with a column for ratings. It was headed with a rating scale from 1 (very low) to 10 (very high) together with brief instructions. Information about the participants was sought covering age, gender, education, birthplace, familiarity with regional South Australia, and whether the participant had seen a wind farm and if so where. The survey was anonymous, and did not include anyone with a commercial interest in the results.

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Participants in the survey were contacted in three ways:

1. through sessions at which the scenes were shown to groups of participants comprising tertiary students, planners and environmental professionals;
2. distributing a CD of the survey, with instructions, to South Australian Department for Environment and Heritage worksites and undertaken by participants at their PCs, and
3. by placing the survey on an Internet site and inviting 65 individuals, representing a wide range of backgrounds, to participate in the survey and to forward the invitation to others at their worksite.

The Internet site was developed using ColdFusion web scripting language with a 95 compression rate for JPEG downloads. Lower compression rates could be used if participants had broadband or high speed modem internet access.

Conduct of the survey comprised the following steps:

1. the instructions provided a brief outline of the purpose of the study, and asked participants to rate each scene on the basis of its perceived scenic quality. The survey comprised a Powerpoint™ slide show with each scene displayed for 7 seconds;
2. six introductory scenes were then shown of a range of typical agricultural and coastal landscapes without wind farms and then six scenes with wind farms. These were not rated;
3. all 160 numbered scenes were then shown;
4. following completion, the participants were thanked and the rating sheets collected. In Internet surveys the responses were automatically forwarded to the database immediately after rating each scene.

The surveys were conducted between June and August 2003. Sessions gained 134 participants and 37 completed the CD survey. The Internet survey was the most rapid and efficient, gaining 280 participants in seven days after which it was terminated. Total participation numbered 454 persons; however some Internet participants did not complete the entire survey. In all, 161 out of the total 280 participants rated all 160 scenes, and a further 150 participants completed between 150 and 160 scenes. The 311 participants who completed 150 or more scenes were selected for analysis.

To evaluate the representativeness of the sample of respondents, their characteristics were compared with 2001 Census statistics for South Australia (Australian Bureau of Statistics, 2002). The main differences were that the respondents were younger compared with the State population, were more likely to be male and Australian-born, and were far better educated. The possible influence of these differences between the sample and the general population of South Australia were tested by evaluating whether respondent ratings varied by age, gender, education and birthplace. As shown in Table 1, except for education, there was very little difference in the ratings within each characteristic. This suggests that, although the survey sample differed significantly from the population, the ratings are unlikely to have been greatly affected by these differences.

Results

The overall mean of scenes without wind farms was 6.15 (Standard deviation 1.23) but the presence of wind farms reduced this to 5.49 (SD 1.28). The difference of 0.66 was significant:

Table 1 Average ratings by participant characteristics.

Participant characteristics	Average rating					
	1	2	3	4	5	6
Age	5.61	5.77	5.68	5.79	5.71	5.62
Gender	5.69	5.73				
Education	5.67	6.08	5.63	5.76		
Birthplace	5.67	5.85				

Participant characteristics and (number in each category): Age groups: 18–20 (38), 21–30 (96), 31–40 (69), 41–50 (62), 51–60 (40), 61–75 (5); Gender: male (171), female (137); Education: no qualification (64), diploma/certificate (17), degree (138), higher degree (87); Birthplace: Born in Australia (249), born overseas (62).

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t = 7.77, df 310; p = 0.000. As a mean of all scene means, this difference should be taken as merely indicative rather than definitive. The ratings for *without wind farm* and *with wind farm* were both normal distributions. The coastal and inland scenes were analysed separately.

Coastal scenes

The presence of wind farms reduced the overall mean of perceived scenic quality rating of the 21 coastal scenes by 1.52, from 7.61 to 6.09, a significant difference: t = 14.06; df 310; p = 0.000. Again the difference is only indicative. Figures 1 and 2 illustrate a typical example.

The influence of scenic quality on the size of the difference between the ratings without and with a wind farm is shown in Figure 3, in which the 21 coastal scenes are arranged in descending order of scenic quality without a wind farm. Generally the difference was largest where the landscape quality was high and narrowed as the landscape rating decreased. To further assess this relationship linear regression was used to derive trend lines for the data.

The equation for the trend line for scenes without a wind farm:

$$y = -0.146x + 9.27, \quad R^2 = 0.96 \qquad (2)$$

The equation for the trend line for scenes with a wind farm:

$$y = -0.078x + 6.92, \quad R^2 = 0.36 \qquad (3)$$

Where y = rating and x = scene number arranged in descending order of ratings without wind farms.

Although the correlation coefficient (R^2) for the scenes with the wind farm was only 0.36, the data were considered to provide a basis for indicative prediction. Based on the two trend lines, Table 2 indicates the likely effect of a wind farm in a coastal scene of known landscape quality rating. It shows that wind farms lead to an appreciable loss of perceived visual quality in the top four categories of landscape quality, suggesting that these coastal landscapes (the majority in the survey) should be avoided in wind farm construction. Based on the known rating of a given landscape, Table 2 may be used to indicate the likely effect of wind farms on perceived scenic quality in South Australian coastal areas. The author measured and mapped the

Figure 1 Coastal scene without wind farm (rating 8.68).

Figure 2 Coastal scene with wind farm (rating 6.63).

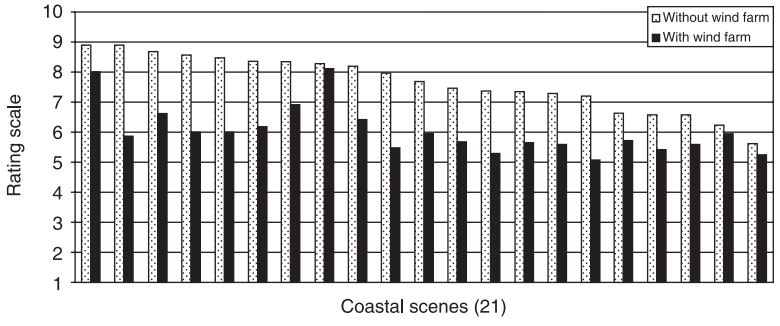

Figure 3 Coastal scenes arranged in descending order of rating.

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Table 2 Predicted effect of wind farms on ratings of coastal scenic quality.

Rating without wind farm	Rating with wind farm	Difference
10.0	7.3	–2.7
9.0	6.8	–2.2
8.0	6.2	–1.8
7.0	5.7	–1.3
6.0	5.2	–0.8
5.0	4.6	–0.4

scenic quality of South Australia's coast (www.environment.sa.gov.au/coasts/viewscapes.html, accessed 18 June 2007) (Lothian, 2005) as a basis for this assessment.

The South Australian coast is 4760 km in length and of this nearly 2100 km (44%) are rated 7 or 8 (there are no 9 or 10 rated areas). Leaving aside the areas occupied by national parks (865 km), 1230 km are rated 7 or 8. Although this appears extensive, over two-thirds lie on the western Eyre Peninsula or the far west coast. These areas are generally remote from the electricity transmission system, rendering their use for wind farms problematic. A policy to avoid areas rated 7 and 8, would affect only 400 km, about 8% of the entire South Australian coast.

The effect of distance was also analysed. Hull and Bishop (1988, 100) stated that 'intuition suggests that visual impact decreases as distance ... increases'. Using computer-generated images of 15 wind turbines adjusted for distance, Bishop (2002, 715) found that the visual impact dropped rapidly after 4 km and was below 10% at 5 km. At 20 km only 10% of people recognised the objects. The effect of including a wind farm in a scene would therefore be expected to diminish with distance from the scene. To assess this effect the differences in the landscape quality rating with and without the wind farm were compared with the distance of the scene from the viewer (Figure 4). Scenes closer than 3 km distance showed the greatest negative effect on scenic quality ratings, with reductions in the ratings ranging from −0.3 to −3.0. On the other hand, for the three most distant scenes, between 7 and 9 km, the reduction in ratings was similar, ranging from −0.2 to −2.2. The scattered data yielded an almost horizontal trend line with a low correlation coefficient ($y = 0.897x - 1.08$, $R^2 = 0.07$), and provided no basis for prediction. While the data show that the negative effect of a wind farm does not reduce appreciably with distance, the conflict with other research findings suggests a need for further study.

Inland scenes

The presence of wind farms reduced the mean perceived scenic quality of the 47 inland scenes by 0.26, from 5.47 to 5.21, a small but significant difference: t = 3.282, df 310, p = 0.001. Again this difference should be taken as merely indicative rather than definitive. Figures 5 and 6 illustrate a typical example.

Where the scenic quality rating of scenes without wind farms was below 5, the rating with the wind farm was always higher (Figure 7). To further assess this relationship trend lines were again derived using linear regression for the data.

The trend line equation for scenes without wind farms is:

$$y = -0.058x + 6.81, \quad R^2 = 0.96 \qquad (4)$$

and that for scenes with wind farms is:

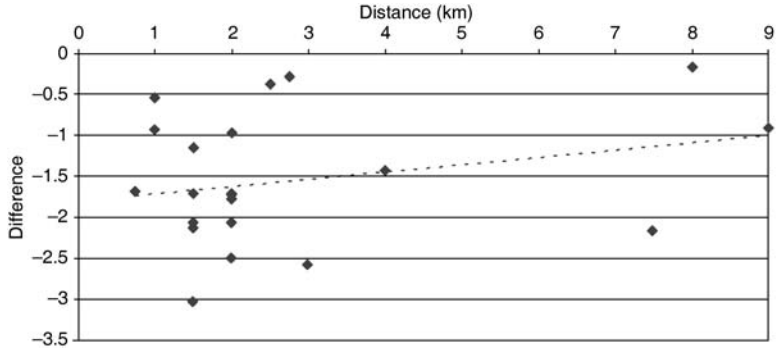

Figure 4 Effect of distance on wind farm impact in coastal areas.

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Figure 5 Inland scene without wind farm (rating 4.26).

Figure 6 Inland scene with wind farm (rating 4.94).

$$y = -0.024x + 5.819, \quad R^2 = 0.56 \qquad (5)$$

where y is the rating and x the scene number arranged in descending order of ratings without wind farms.

Table 3 Effect of wind farms on ratings of inland landscape quality.

Rating without wind farm	Rating with wind farm	Difference
7.0	5.9	−1.1
6.0	5.5	−0.5
5.0	5.1	+0.1
4.0	4.7	+0.7
3.0	4.2	+1.2

The trend lines derived for the two data sets indicated that the cross-over rating was 5.1; above a rating of 5.1 the wind farm generally detracted from scenic quality while below it the wind farm generally enhanced scenic quality. This infers that in lower quality landscapes, the presence of the wind farm added interest in an otherwise perceptually mediocre landscape and thus enhanced its perceived scenic quality.

Table 3 indicates the likely effect of a wind farm in an inland scene of known landscape quality rating. The author has measured and mapped South Australia's landscape quality at a broad level (South Australian Atlas: www.atlas.sa.gov.au/products/other/a3qual.pdf; accessed 18 June 2007; Lothian, 2000) as a basis for this assessment.

An analysis of the influence of distance on the addition of a wind farm to a scene suggested that the negative effect actually increased with distance (Figure 8), which is counter intuitive (Hull and Bishop, 1988) and contrary to Bishop's (2002) findings. Up to 7 km, wind farms had both a positive and negative influence but beyond this

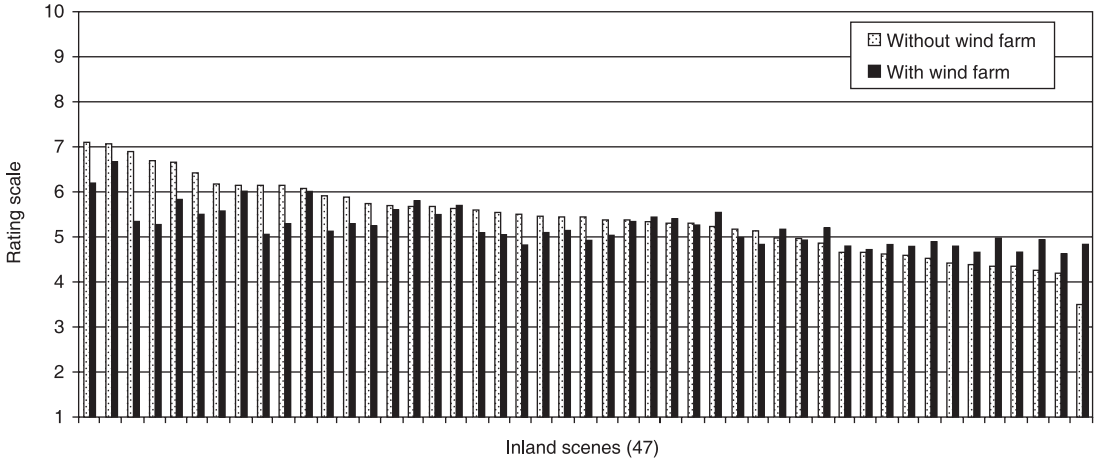

Figure 7 Inland scenes arranged in descending order of rating.

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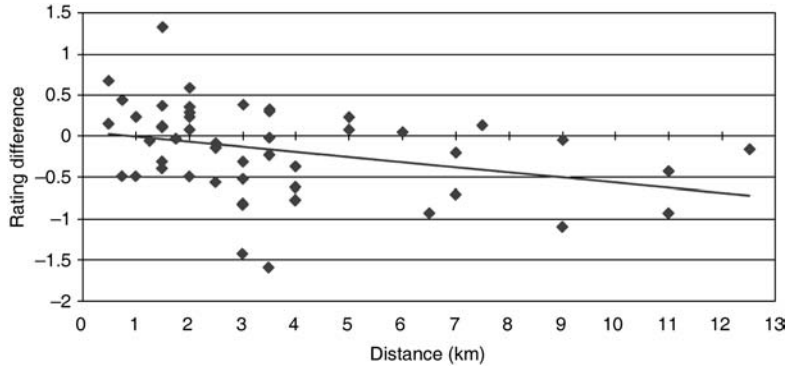

Figure 8 Effect of distance on wind farm impact in inland areas.

Figure 9 Flinders Ranges 3 km (rating 5.5).

Figure 10 Flinders Ranges 11 km (rating 5.3).

distance, the effect was almost wholly negative. The trend line had a negative slope but its correlation coefficient was too low to be definitive (R^2 = 0.10). The differences in the ratings by distance were significant (p = 0.000) in all but one distance category – that near the viewpoint at 1–1.99 km distance.

In a further test of the effect of distance, ratings of the addition of a wind farm were compared for the same scene in the southern Flinders Ranges at distances of 3 km and 11 km (Figures 9 and 10, Table 4).

The results indicated that the effect was greater at the farther distance, similar to that suggested above. However, the difference was not statistically significant (t = –0.24, df = 310; p = 0.81). Additional testing and consideration of the influence of other factors visible in the scene would be necessary to establish any clear pattern regarding the effect of distance. It is possible, however, to conclude that the negative visual effects of the wind farm did not reduce with distance.

Table 4 Influence of distance on ratings of Flinders Ranges scene.

Distance (km)	Without wind farm	With wind farm	Difference
3	6.4	5.5	–0.9
11	6.7	5.3	–1.4

Turbine characteristics

Two other aspects of the visual impact of a wind farm were tested; number of turbines, and their colour. In three scenes the number of turbines in each scene was varied from six to thirteen, but the results indicated no clear relationship with ratings of landscape quality. It is possible that the range in numbers may have been too small to identify any change in perceived impact. To test the effect of different colours on the perception of turbines, a range of hues was used in

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Table 5 Ratings of turbine hues.

Hue	Green Point	North Lake Alexandrina	Woakwine
None	4.6	4.4	5.7
White	4.8	4.8	5.6
Blue	4.8	4.9	5.6
Grey	4.9	4.4	5.4
Tan	4.5	4.6	4.8
Rainbow	3.5	3.5	

three scenes. The background hues of each scene were a similar straw colour with blue skies. Blue was the preferred colour in two scenes (equal with white in one) and grey in the other scene (Table 5, Figure 11). White, blue and grey were similar in two scenes and white, blue and tan in the third scene. Most marked were the rainbow hues which rated well below the other colours. The differences between the ratings of the colours were significant ($p = 0.000$) for each scene.

The contrast between a turbine and its background has also been shown to be a factor in the visual impact of a wind farm (Shang and Bishop, 2000). The contrast of the wind turbines against the sky and the land was assessed subjectively on a three-grade scale of contrast; low, medium and high, based on black and white prints. The ratings were averaged for each level of contrast and a low level of correlation between ratings and contrast was detected (0.3). The highest contrasting scenes were those within 1 km, whereas the more distant scenes, at 2.5 km, were either of low or medium contrast.

Overall the results suggested a preference for white, blue or grey turbines, with the differences between these being very small. The tan hue was less preferred and the rainbow coloured turbines were least preferred. The contrast the colour presented against its background indicated a slight relationship between ratings and the degree of contrast. The highest contrasting scenes were closest and the more distant scenes offered less contrast. These findings must be regarded as tentative, being based on a small sample of scenes, but they indicate an area for further research.

Conclusion

This study set out to measure the effect of wind farms on perceptions of landscape quality in coastal and inland landscapes in South Australia. The results reported above point to several conclusions. First, peoples' perception of the visual impact of a wind farm depends on the scenic quality of the landscape, with the addition of a wind farm generally decreasing ratings of quality in high-quality landscapes and increasing them in low-quality landscapes. Second, there is no evidence of the number of turbines or the distance of the viewer having an effect on the perceived impact of a wind farm on landscape quality. Third, the colour of wind farms and turbines did affect perceptions, and perhaps the contrast between turbines and their background is also a factor. However, because of the small samples involved in examining the effect of the number of turbines, and their distance, colour and contrast, further research on these aspects would be justified. Based on these

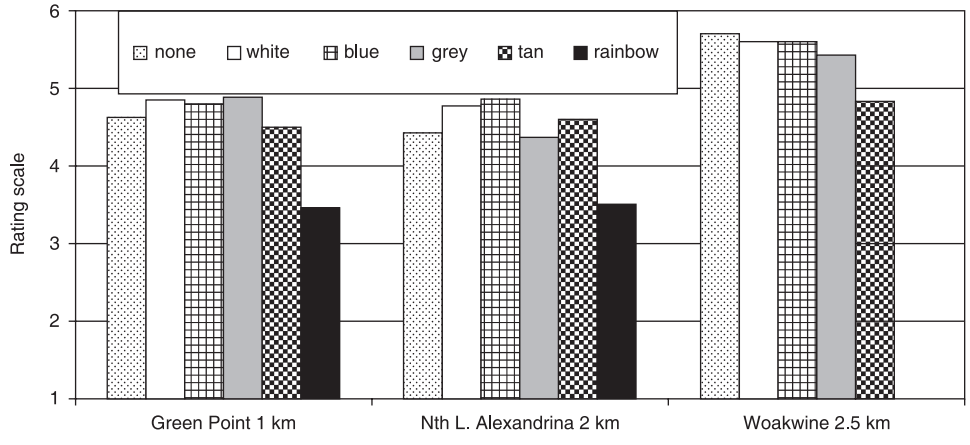

Figure 11 Rating of turbine hues.

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findings, it appears likely that the negative visual effects of wind farms could be diminished if more scenic locations, both coastal and inland, were avoided. In South Australia this would affect around 8% of the available coast. It is acknowledged that, if this means that wind farms have to be located slightly inland from the coast, this may reduce the wind speed and hence the viability of the project, but this cost may be justified if it protects scenic quality and ensures community support. Careful choice of colour in relation to the background of the turbines when observed by a viewer could also help reduce its perceived impact.

The information required to apply these findings on community perceptions is a map of wind resources, preferably at a regional level and containing sufficient detail for the initial selection of potential wind farm sites, and a map of landscape quality, again preferably at the regional level. South Australia has the advantage of having both wind energy maps (Energy SA, 1988) and landscape quality maps (Lothian, 2000; 2005a; 2005b; 2007). Although some other States have mapped wind resources (for example New South Wales and Victoria) and some scenic resource mapping has been conducted, more systematic mapping is needed at a State level based on scenic quality surveys of the general community in order to plan adequately for wind farm development.[1]

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NOTE

1. A more detailed account of this study is available on the author's website: www.scenicsolutions.com.au.

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