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Wind Turbines In The Landscape: Final Report & Script

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"WIND TURBINES IN THE LANDSCAPE"

FINAL REPORT & SCRIPT

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BACKGROUND TO THE PROJECT

1.1 Over the last few years, the exploitation of wind energy in the U.K. has been encouraged by Non Fossil Fuel Obligation (NFFO) Power Purchase Contracts. These have been awarded to several developers for a host of wind farm schemes. Many of these schemes have experienced considerable delays at the planning stage whilst the full implications of the environmental impact of the development has been fully considered. In some cases, the decision as to whether to award a wind farm project planning permission or not has only been resolved following public inquiry.

1.2 In retrospect, these delays were inevitable because the planners had little or no experience of the implications of granting permissions to wind farms in the U.K. The novelty of this type of development led to several issues having to be considered for each scheme. Principal issues have been visual impact, noise, public accessibility, cost-effectiveness of scheme, justification of high windspeed sites, electromagnetic interference, flora and fauna, long-term local benefits, etc. Of these, it is visual impact that is the most difficult to evaluate or to agree a consensus opinion on. The principal visual impact issues are:

- dominance of wind turbine generators (WTGs) in the landscape
- influence of distance from site
- acceptability of large numbers of WTGs in a single grouping
- colour of WTGs
- acceptability of rotor movement
- influence of number of blades
- blade reflection and glinting

1.3 The assessment of visual impact is complex and highly subjective, although methodical approaches to assessment can be taken [1]. It is this subjectivity that has made the consideration of the current NFFO PPC sites so difficult. When planning applications for these schemes were made, the lack of experience of wind farms in the U.K. meant that all visual impact evidence was based upon past experience. This experience includes machines already erected in the U.K. and abroad, as well as visual evidence provided by the developers e.g. photomontages and, in some cases, videomontage simulations [2,3]. The influence that each of the visual impact factors listed above might have on the overall visual impact of a scheme had to be judged by planning authorities with little or no concrete evidence immediately available. Consequently, misconceptions and doubts abounded.

1.4 The already announced third NFFO tranche has resulted in a large number of planning applications for wind farms. However, judging from the responses to the enquiries we have made to appropriate County Planning Officers and despite their experiences of dealing with previous wind farm applications, it is evident that the visual impact of wind farms continues to be a major planning issue and that planners still require impartial and detailed evidence to assist with their planning judgements of future applications.

1.5 The aim of this project was to produce a video film where the visual impact issues associated with current UK wind farms are addressed. The video is targeted to an audience of planners, planning committee members, planning consultants, environmental organisations and the public to assist their consideration of wind farm planning applications. It is also intended that the video be readily available to wind farm developers for use in consultative activities and to accompany their planning applications. It is both timely and appropriate to use video media for the study of this specific environmental issue. This report contains only a brief description of the activities undertaken and a transcript of the final video production.

BRIEF DESCRIPTION OF THE PROGRAMME OF WORK

2.1 The pre-production activities principally concerned the identification of current views and practices to visual impact and its assessment from existing literature and informal interviews with planning officers, developers and environmental consultants. The familiarity and working experience of the project team (Dr AJ Robotham and Mr T Cook) with visual impact issues meant that little of what was gained from this activity was new or unknown to them. However, it was important to identify specific people who had between them a broad cross section of experiences of wind farm development in the UK and who were willing to share their knowledge and express opinions on visual impact issues. The project team were delighted by willingness of organisations and individuals to participate in the project. This meant that a group of people was readily assembled who were representative of the broad cross-section of professionals who have had first hand experience of visual impact issues.

2.2 The production phase of the project included on-site filming of some of the NFFO wind farms in Cornwall, Wales and Cumbria, though the use of existing film taken from other sources has assisted in providing a variety of images of wind farms. The major activity in this phase was the interviewing of the volunteer participants. Each interviewee was sent a list of questions prior to the interview to ensure each was adequately prepared with their answers. The list of questions formed the basis of the interview, but where appropriate or opportune, additional questions were asked for clarification purposes or in response to new issues being addressed. In total, over five hours of interviews alone were recorded on film.

2.3 The post-production phase was lengthy and difficult. The sifting through the recorded interviews to identify elements suitable to include in the final production proved to be most difficult. To ensure the video did not become too long, it was necessary for the selected interviews to be linked by a simple narration. The project team is satisfied that the full scope of visual impact issues have been more than adequately considered by the interviewees, and therefore the prepared script merely provides continuity between each interview. Where appropriate, the visual images have been chosen to illustrate each issue as it is considered in turn.

PROJECT OUTCOME

3.1 The outcome of the project is a broadcast quality video film. The project team is satisfied that the issues concerning wind turbines in the landscape have been adequately addressed by a group of people suitably qualified or experienced to provide clear guidance and representative opinion about the visual impact of wind turbines in the landscape. No attempt has been made to draw any conclusions from this work; the film merely provides a broad outlook on the issues of visual impact. It is left to the viewer to form an opinion about whether wind turbines are acceptable or not in the landscape. However, is is hoped that each viewer will be better able to make that judgement with the fuller understanding of the issues of importance discussed in the film.

REFERENCES

1 Robotham, A.J., Quilleash, P.: Visual Impact Assessment - There's more to it than meets the eye! Proc. BWEA14, Nottingham, March, 1992.

2 Robotham, A.J.: A novel method of depicting the visual impact of wind turbine sites. Proc. BWEA12, Norwich, March, 1990.

3 Robotham, A.J.: Progress in the development of a video-based wind farm simulation technique. Proc. BWEA14, Nottingham, March, 1992.

"WIND TURBINES IN THE LANDSCAPE"

SCOPE

The purpose of this investigation is to consider the issues of visual impact and to draw upon the experience that has been gained as a result of the first wind farm schemes built in the UK.

INTRODUCTION

The energy in the wind has been exploited by many generations. Its traditional use for grinding corn or pumping water provide us with familiar images of windmills.

Lately, however, the appearance of the electricity generating wind turbine has started to alter these perceptions of how wind energy can be used.

In particular, where several wind turbines are grouped together in a wind farm, it is the appearance of these modern machines as a whole that evokes a wide range of emotions about their acceptability in the landscape.

> Andrew Garrad, Garrad Hassan and Associates
>
> "There is no question at all of the fact that wind energy can produce a lot of electricity, particularly in the UK. But if it does, you will be able to see windmills here and there. To my mind that is actually a good thing; it makes people conscious of the fact that electricity has to be produced somewhere and the fact you can see a windmill doing it means it is being done cleanly. But that is not an opinion shared by the whole of the British population."

The United Kingdom is one of the windiest places in Europe and so it has a potentially large wind energy resource.

> David Lindley, National Windpower Limited
>
> "Britain is perhaps the most fortunate country in Europe. If you look at Holland, the wind resource is mostly on the northern coast of the Netherlands; Germany its on the northern coast. In Britain, we've got good wind resource distributed all the way from Cornwall and Devon, up through Wales, into the Pennines, Yorkshire, through to Scotland."
>
> "We certainly see that, as a minimum, we should be aiming to supply 10% of the UK's electricity needs from wind power, and that would require something of the order of 20,000 turbines of the current latest size."

The commercial exploitation of this potential continues to be encouraged by the Government, and in particular by the Non-Fossil Fuel Obligation, or NFFO (Appendix A). NFFO requires public electricity suppliers to obtain certain amounts of their electricity from renewable resources.

Gerry Swarbrick, South West Electricity

"I think we've (SWEB) made quite a significant contribution to the development of wind farms in this country. Our attitude is that wind farms deserve to be given a chance; deserve to be demonstrated on a commercial basis."

"We've also had a major contribution in the sense that we've invested in three of the early wind farms; we have a stake in approximately 20 MW of wind farms in this country now, that's a sizeable proportion when you think that there's about 100 MW installed, about a fifth in that sense. And we are very keen now to go on and develop more wind farms and look for further opportunities to invest in this developing resource."

While the generation of electricity by wind power has a number of benefits over conventional means (See Appendix B), wind farms are not without their critics.

The change that a wind farm makes to the appearance of the countryside can be considered unwelcome by some.

Andrew Garrad, Garrad Hassan and Associates

"The renewables have become an increasingly serious form of electricity throughout Northern Europe, but there is a price to pay. The price to pay is that if you have a windmill producing electricity economically it will be in an exposed place. Presumably if it's not in an exposed place it won't be working properly. So there is pollution from windmills which is visual pollution. Now personally I see them as symbol of new clean technology producing clean power; other people see them as a blot on the landscape."

There was little or no experience of wind farms in the UK when the first NFFO projects were being planned. Because of differences in opinion about their acceptability, many schemes experienced delays at the planning stage. In some cases the decision to award a wind farm planning permission has only been resolved following public inquiry.

At the first inquiry, the Countryside Council for Wales made a case against a wind farm in mid-Wales.

Eira Hughes, Countryside Council for Wales

"The Mynydd Cemmaes site raised a number of concerns because it was so close to the Snowdonia National Park and, therefore, a public inquiry ensued."

Visual impact was the major concern.

Eira Hughes, Countryside Council for Wales

"Because of the proximity of the site to the Snowdonia National Park, part of the setting of the National Park, and also because the wind turbines were sited on the skyline. It was the first development in Britain existing where major wind turbines were sited in such a visually obvious site. There was some uncertainty as to whether or not their potential visual impact could be measured in advance. Subsequence experience, I have to say I've had experience of this, it is very difficult to assess the visual impact of wind turbines and they actually make a

greater impact on the landscape than is often obvious from the designs presented at the planning application stage."

In Devon, none of the initial schemes have proceeded beyond the planning stage.

Malcolm West, Devon County Council

"Within the county we've had a total of nine applications for planning permission for wind farms, totally 143 individual wind turbines. Of those nine applications to date, five of them have actually been refused planning permission, of which two have gone to appeal. Of the remainder, one of them has been withdrawn ... and there are three current applications remaining undetermined."

"There is understandable caution in the District Councils at the present time about what is seen as a new technology and the particular impacts that these wind farms will have on landscape and on local communities."

REVIEW OF WIND TURBINES AND WIND FARMS

So what is a wind turbine?

Well, in visual terms, the wind turbine consists of three elements:

The rotor, which converts the energy from the wind into mechanical power.

The nacelle, which houses all the equipment necessary to convert the power into electricity.

And the tower, which supports the nacelle and rotor and around which these elements rotate to face in to the wind.

The tower is usually solid in appearance and between 30 and 40 metres high. The rotor will have two or three blades and a diameter between 30 and 35 metres.

It is the movement of the rotor that makes it unique amongst all other structures seen in the landscape.

So what then is a wind farm?

Andrew Garrad, Garrad Hassan and Associates

"I don't think that's ever been carefully defined. UK development varies from a single machine, up to 300 kW machine, on a farm through to the biggest wind farm, which as you know, is 103 machines in mid-Wales. So there certainly isn't a common feature in terms of size except, perhaps, that if you looked at the most popular size it's around 10 MW."

"The machines I suppose are of a commonish size. There is a variety from 300 to say 500 kW, but I think we are seeing a concentration of machines around the 4 to 500 kW mark."

David Lindley, National Windpower Limited

"The fact that we came to wind farm development late, later than Germany or Holland, Denmark; even later than Spain - they had wind farms in Spain before we had them here; wind farms in Greece before we had wind farms here. So the fact that we've come to it late in this process means we're getting the latest technology. So the wind turbines here are generally bigger, on average, than the wind turbines that have been erected in those countries I've mentioned. In England and Wales, for example, in the nineteen wind farms, that is something like 400 turbines with an average size of 300 kW. Whereas the average size in Denmark is something of the order of 50 to 60 kW; its much smaller. So we are using our resource more efficiently; fewer machines consuming less land, less landscape."

The feature that makes the UK wind farms unique is not so much the number of wind turbines on a site or the type of machine being used, but the nature of the landscape locations in which they have been sited.

Andrew Garrad, Garrad Hassan and Associates

"The terrain on the whole in the countries where there is a higher penetration of wind energy is different. The most active countries presently - Denmark, Northern Germany, the Netherlands - all those countries have essentially flat terrain, often have linear features within the terrain and do not have the sort of hilly terrain that we have. If you look further south, where activity is starting to be quite prolific, for example in Spain and Greece, then there are again completely different features; the terrain tends to be rather more rugged."

The choice of a site is principally determined by its wind energy potential. The wind turbines have to be carefully arranged across a site to maximize energy capture. Sufficient spacing must be allowed between machines to ensure that each is able to operate to its full potential. The wind turbines will be spread over a large area of which only about 1% will be occupied by the turbines themselves.

During the construction phase, land disturbance can be unsightly. Access roads to each wind turbine will be necessary for heavy vehicles.

Each turbine is connected to a transformer by an underground cable. The transformer will be linked to a central distribution point from where high voltage electricity is fed to the local grid via overhead cables. The close proximity of a strong grid connection is yet another factor that affects the commercial viability of a site.

Andrew Garrad, Garrad Hassan and Associates

"The major issues facing someone looking for a wind farm site are, first of all, there must be wind, particularly in the context of NFFO where the market is competitive. Very small changes in the wind resource can produce quite a big change in the commercial viability of the farm. But it's no good having a windy place unless you can feed that electricity into the low-voltage grid, 11 or 33 kV, in some cases 66 kV, and that is an important consideration. So access and wind."

VISUAL IMPACT ISSUES AND ASSESSMENT METHODS

Once a potential site has been found by a developer the evaluation of the wind farms's likely visual impact can begin.

Tim Kirby, Ecogen Limited

"When you look at what makes a good or viable wind farm, the visual impact is, perhaps, second only to the wind resource. The wind resource is the thing which tells you whether there's technical possibility, but I think its visual impact that you've got to really look at carefully before you commit resources to try to get planning permission on something that might be impossible."

The first step is to map the Zone of Visual Influence; the ZVI.

The ZVI map shows where any part of the development is likely to be visible. It also enables a check to be made of any sensitive viewpoints where the sight of the development might be of particular concern. Where this occurs, it may be possible to change the layout of the wind turbines. In this way, the developer can attempt to minimise the visibility of the wind farm during the initial design.

Tim Kirby, Ecogen Limited

"The best and easiest way to hide wind turbines, for those that want them hidden, is to put them close to existing ones, because at least they have only got to keep their eyes averted from or avoid one particular spot. This was an argument we very much put forward with Llandinam. If you were to split that in to four 25-wind turbine sites, 26-wind turbine sites, perhaps leave one of them at Llandinam, but then try to find three equally good sites in Wales, I don't doubt that, firstly, if you were to look at the ZVIs and look at the visibility footprints it would be much larger if you'd split them into four separate groups. The site at Llandinam could accommodate that sized scheme."

Because the ZVI is so important, great efforts have been made to improve the accuracy of the mapping process.

Computer based representations of the landscape and the wind turbine layout across the site enable the ZVI to be computed.

The same computer models can be used to generate wireframe diagrams. These show the degree of visibility of each machine from a viewpoint. These diagrams are a basis for photomontages which illustrate more realistically the wind farm's appearance.

Photomontages are usually provided by developers in support of a planning application. A video based montage technique adds a further degree of realism by showing rotor movement.

All these techniques provide a source of visual evidence from which the extent of visibility and the scale of the wind farm in the landscape can be evaluated.

But the assessment of visual impact goes deeper than visibility. In what way is the relationship between the wind turbines and the surrounding countryside important?

Eira Hughes, Countryside Council for Wales

"They should be distributed in the landscape in a way that is sensitive to the character of that landscape. In Wales that usually means a slightly irregular layout and making sure each individual wind turbine actually fits in to the landscape neatly."

"But at the end of the day, there's no substitute for fairly detailed landscape analysis by a competent person in order to assess whether a particular proposal is acceptable or not."

Chris Blandford, Chris Blandford Associates

"The character of the landscape and the topography are very much to do with whether a wind farm does or does not fit into a landscape."

When considering the visual impact of a wind farm proposal, the assessor must attempt to evaluate the change it will make to the character of the landscape. How will he do this?

Chris Blandford, Chris Blandford Associates

"He takes into account, obviously, the visibility; how much one can see it from a given place."

"There is also the business of the intrinsic character and quality of a landscape, which is not necessarily looked at by anybody, but nevertheless has great value. And a landscape architect will usually combine those two judgements. He needs to carefully distinguish between them but he usually looks at both. The second very definitely needs a quite detailed landscape assessment which begins to tie down the character and quality of the landscape."

Rachel Nutman, Lake District National Park

"The sort of approach we would take is the degree to which this feature is seen; from how wide a landscape; from how close up; from how far away and whether it is dominant and intrusive; whether it actually affects the feel of the area you are in, or whether it is just something minor that you glimpse from one or two viewpoints and is not a dominant feature. But there are no hard and fast rules; it's very much a very careful assessment of its impact from many viewpoints."

National Parks, Areas of Outstanding Natural Beauty (AONBs) and Sites of Special Scientific Interest are at the top of the landscape classification hierarchy, making wind farm development in these regions difficult to justify.

Rachel Nutman, Lake District National Park

"There have been no major applications for renewable energy in the National Park. We have approved two single turbines on two individual farms which are acceptable visually because they are no higher than the size of a two-storey building."

A wind farm located outside protected areas but which has a significant visual influence on these may also prove unacceptable.

Rachel Nutman, Lake District National Park

"The National Park Authority objected very strongly to the wind farm at Kirby Moor because it feared, and its fears have been realised, that the turbines would be seen from within the National Park looking out. And this does affect the enjoyment and appreciation of the Park, not only from looking in but from inside looking out, because they are alien, intrusive, vertical masts in a very attractive landscape."

Marcus Trinick, Bond Pearce Solicitors

"At Cemmaes, the Secretary of State (for the Environment) agreed with the Inspector that the turbines were elegant structures and preferable to the 400 kV pylons which are already present in the countryside. At Penrhys, in the area of Rhondda Borough Council, the Inspector, who was an architect and therefore to some extent perhaps more qualified than others to make a judgement, felt the turbines had almost "sculptural purity of form"; that was the phrase he used."

"At Ovenden Moor, the Secretary of State found that a wind energy development was an appropriate use in a rural area. Now if any subsequent Inspector or, indeed, the Secretary of State, is going to disagree with that kind of view, he's got to give very good reasons for doing so, and none have done so, so far. "

Peter Edwards, Delabole wind farm

"We had a survey done by Exeter University; this was funded by the Department of Energy. Before the wind farm was up, 53% were against a wind farm and only 17% were for it. But after it was up and people could see for themselves that they were not going to be ugly monstrosities, a second survey was done and it dramatically changed with 85% in favour. Absolute acclaim for wind energy I think."

Ian Martin, Cornwall County Council

"The landscape around Delabole, although it is sandwiched between a coastal AONB and an inland AONB, the landscape at Delabole itself is cris-crossed by pylons and various other things and is a bit flat and not particularly attractive. We felt the wind turbines in those circumstances would not significantly detract, particularly I would suspect that's all there is to see from various points of view. So from that point of view we're quite happy. Carland Cross was a surprise, and I'm speaking personally now. I thought Carland Cross would be much more significant; I though it would detract from the landscape, bearing in mind its location on the top of a ridge from which Cornwall sort of slopes away either side. In fact, what I hadn't accounted for was the drama of Carland Cross. It really does come across you. You sweep down the A30, you suddenly come round the corner and there are these machines in front of you. The theatrical effect of these huge machines sweeping the skies is really quite astonishing; I've heard several people make that particular point. Far from detracting from the landscape, you could argue that, in a wild and not particularly significant hill top, Carland Cross has actually added something to it."

The assessment of visual impact is further complicated by the need to consider the reduced scale of wind turbines with increased distance from site; whether the wind turbines appear on the skyline or

against landscape backgrounds; the choice of colour and finish of wind turbines; the effects of ambient light and blade reflection; acceptability of rotor movement and perceived interference of in-line rotors; the effects of weather conditions.

PLAN-LED DEVELOPMENT

The subjective nature of visual impact assessment remains complex and open to a wide variety of interpretations. Does this present the planning authority with any difficulties?

> Marcus Trinick, Bond Pearce Solicitors
>
> "Yes, hugh difficulties. The landscape assessor; the landscape architect; whoever is going to assess the project from an objective point of view, can tell the planning authority from where you are going to be able to see certain machines. To some extent he can provide a view on the acceptability of those machines in the landscape. The land-use planner, the planning authority, can give guidance on the policies relating to a particular landscape. But overlaying all that, you've got the subjective reaction of the planning committee, and that's the one the developer's interested in, and more important, perhaps, the subjective reaction of the local community. And we're talking here about the intrinsic qualities of the landscape, rather than what can be objectively measured."

Wind farm development in the UK has been on an *ad hoc* basis with each proposal having to be considered on its own merits.

What attempts have there been to formulate a more structured approach?

> Chris Blandford, Chris Blandford Associates
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> "Our work to date has concentrated on what we've called the plan-led approach and it tries very hard to find the right compromise between the needs of the developer needing to build wind farms and to some degree find the right capacity of the environment or the landscape in which to put those wind farms."
>
> "(In Chris Blandford Associates' landscape impact assessment for wind turbine development in Dyfed) A combination of factors was combined really to produce what we called the feasible areas where it was technically feasible for wind farms to take place; it may or may not be suitable in environmental and landscape terms, but it was certainly technically feasible. And there were ten of those. And each one of those ten feasible areas was then looked at in detail to understand the capacity of the landscape to absorb medium sized wind farms and large-sized wind farms in order to determine what capacity the county has as a whole in environmental terms."
>
> "It has assisted the district authorities in identifying on the ground, geographically, search areas which are deemed suitable for wind farms."

Cumbria County Council have been involved with South Lakelands District Council and ETSU in producing a report into renewable energy in Cumbria.

> John Hetherington, Cumbria County Council

"Quite early on, because we recognised that these were raising really quite interesting issues - how you balance landscape impact against the benefits of renewable energy - we thought it would be useful to follow the background and look at what's involved with the various technologies, particularly wind. For nearly two years now we've been involved with ETSU in putting a report together on renewable energy in Cumbria and the planning implications of renewable energy."

"I think what we've recognised is that wind energy developments raise a number of concerns and a most obvious one in a county like Cumbria with landscapes which are of national significance, not just the National Park but some of the landscapes on the periphery of the National Park throughout the county are important and valued historic features. And so it's been the case of having to find ways of, perhaps, how can we support renewable energy? How can we see the contribution it can make and recognise that its got an important contribution as a non-fossil fuel source, and wind energy in particular? And we've been able to concentrate on developing our techniques, our ways of appraising landscape. So that we are not just sort of saying arbitrarily that we don't like it, but how can we help make this process of deciding whether a particular development is acceptable in landscape terms a little bit more scientific, a little bit more rigorous?"

Cornwall County Council has just published a similar document.

Ian Martin, Cornwall County Council

"As far as renewable energy is concerned, the County Council took the initiative and made some fairly serious and detailed inquiries into renewable energy before coming up with policies that we now have as an addendum, an adjunct, to our Structure Plan."

"As a result of our energy project, which was a three year exercise, we came up with a series of maps which indicated areas where wind farm development would be totally unacceptable because they were AONBs or similar national designations and areas, by contrast, where wind farms might be acceptable all other things being equal."

Devon County Council in conjunction with West Devon Borough Council and ETSU have undertaken a study which investigation planning for renewables in Devon.

Sue Penaluna, West Devon Borough Council

"The council's very keen on looking at renewable energy and all forms of energy efficiency and protection of the environment. They've been very supportive of our drafting our own policy for wind power generation and they've been extremely supportive in the joint study we've done with Devon County on renewable energy in Devon generally."

"I think its main role would be in policy formulation and guiding developers to the most appropriate locations within the district. And we have attempted to do that in our Local Plan to show where the most appropriate sites could be within the district without being too specific."

The Countryside Council for Wales have produced a Wind Power Policy Document which lists factors to take into account when assessing proposals.

Eira Hughes, Countryside Council for Wales

"We produced a Wind Turbine Power Station Policy Document, which has quite an extensive checklist at the back which embraces all the best advice available at the moment on factors to be taken into account in assessing wind turbine power stations and also setting out CCW's concerns about the potential impact of wind turbines on, especially, National Parks, designated areas and very sensitive pieces of countryside."

"We would like to see developers bring forward proposals for much smaller wind turbine sites and working those up in some detail with the local planning authority and taking in to account the sort of considerations we've outlined in our wind turbine Policy Document."

These studies will feed into County Structure Plans and Local Plans to help guide future applications.

As a result of these initiatives the key issues of planning and the public acceptability of wind farms are being addressed (See Appendix C).

CONCLUDING REMARKS

Sue Penaluna, West Devon Borough Council

"I would have said that the assessment of visual impact is extremely subjective. One person may find a structure in the landscape extremely beautiful and sculptural and somebody else may find it a blot on the landscape."

Eira Hughes, Countryside Council for Wales

"There is a tendency to refer to them as windmills and most people have a clear idea of how high a windmill is and imagine that wind turbines are something similar, but in fact they are very much larger. It's important to realise that these are quite large, industrial type machines and do make a very considerable impact over a wide area."

Ian Martin, Cornwall County Council

"At the moment they are new and they are highly visible when people look at them. I think in five years time or so they will be much more easier to assimilate than they are at the moment."

Tim Kirby, Ecogen Limited

"I think that there's no substitute for actually getting people close by a real operating, modern technology turbine so that they can, at least, see and hear what the things are like, close at hand, for their own personal and direct experience."

Peter Ridgeway, South Lakelands District Council

"There are a number of wind farms now within the country. I think their impact covers a wide range of physical settings and a lot of planners ought to be able to mix and match the particular wind farm they visit to help assess the impact they will experience within their own area."

Rachel Nutman, Lake District National Park

"It's a paradox and an irony that the highest landscape in the National Park is most suitable for wind energy by the fact that it's got the height, but is also the most attractive landscape."

"Let's remember that the National Parks are our areas of countryside that are of the highest quality, so they must be protected for long-term future generations for their scenic quality."

Malcolm West, Devon County Council

"We shouldn't really be hiding this technology; it is a new technology and its appropriate that it should actually be seen to stand for what it is."

Chris Blandford, Chris Blandford Associates

"Wind farms in the landscape I think is what I would like to see as the objective for wind farm development in this country, whereby the wind farm fits into the landscape rather than be dominant over it."

Tim Kirby, Ecogen Limited

"A Llandinam site, which isn't entirely criticism free I know, but that's close on a third of the wind turbines installed in Britain at present and, I think, if you could come up with some measure of accumulated grief that there's perhaps less per MW with Llandinam than there is on some of the smaller sites."

Chris Blandford, Chris Blandford Associates

"Based on some of the research work, we found in Wales one thing that is coming through loud and clear is that wind farms have turned out to be rather more visible than, perhaps, was first thought and certainly argued for at the first public inquiries."

Ian Martin, Cornwall County Council

"Visual impact is really in the eye of the beholder. It's something that's not seen as abstract. It depends very much upon the viewpoints from which a particular wind farm can be seen and, of course, depends upon the background against which the wind farm is seen. Of course , it then comes down to subjective assessment of what is and what is not acceptable."

Chris Blandford, Chris Blandford Associates

"As familiarity increases, we may well find that there is more of a reaction against the visual impact of wind farms as we see them more commonly and indeed as, perhaps, greater numbers are viewed from single places and you get a sense of proliferation and accumulation occurring."

Eira Hughes, Countryside Council for Wales

"The important thing from CCW's perspective is that these wind turbine power stations should be well clear of National Parks, AONBs, national nature reserves and that they should be well designed and well landscaped. We have in our Wind Turbine Power Station Policy Document set out a detailed checklist on landscape and visual matters to assist ourselves and developers in assessing the impact of a wind turbine power station development, and I think they will find that very helpful."

John Hetherington, Cumbria County Council

"Let's get the balance right between the objective of supporting renewables and equally the objective of conserving our important resource of landscape and similar heritage."

Andrew Garrad, Garrad Hassan and Associates

"The environmental constraints are as important, if not more important, than the resource. If you haven't got any wind then clearly the thing won't work; won't be viable. But's there's no sense in going to a very windy place if it's not going to be possible to get planning permission and it is not going to be acceptable to the public."

APPENDIX A: OPERATIONAL WIND FARMS WITH NFFO POWER PURCHASE CONTRACTS

The following table lists those wind farms with NFFO Power Purchase Contracts that were build and known to be operational by January 1994. The list is not a complete list on wind farms in the UK nor does it include those sites either at the planning stage or under construction.

Operational wind farms with NFFO power purchase contracts				
Generator	Project Site	Turbine Type	No. of WTGs	Total Rated Capacity kW
National Wind Power	Cemmaes	WEG	24	7200
	Kirby Moor	Vestas	12	4800
	Cold Northcott	WEG	21	6300
	Llangwyrfon	WEG	20	6000
Yorkshire Water Enterprises Ltd	Chelker Reservoir	WEG	4	1200
	Ovenden Moor	Vestas	23	9200
	Royd Moor	Bonus	13	5850
Wind Electric	Delabole	Vestas	10	4000
Abbey Produce	Ramsey	Vestas	1	250
EcoGen	Penrhyddlan	Mitsubishi	43	12900
	Llidiartywaun	Mitsubishi	60	18000
	Rhyd-y-groes	Bonus	24	7200
Blyth Harbour	Blyth Harbour	HMZ	9	2700
Carter Wind Turbines	Orton Airport	Carter	10	3000
Century Steels	Penistone	Vestas	1	200
Cornwall Light & Power	Goonhilly Downs	Vestas	14	5600
D Gillson & Son	Haworth	Vestas	1	225
Windstar Turbines	Werfa	Wind Harvester	10	500
Oil Tools Offshore Services	Winterton-on-Sea	Vestas	10	2250
Perma Energy	Taff-Ely	Nordtank	20	9000
RES	Carland Cross	Vestas	15	6000
	Coal Clough	Vestas	24	9600
J Stobbart & Sons	Heskett 1 & 2	Vestas	2	600
Windcluster	Haverigg Airfield	Vestas	5	1125

APPENDIX B: BENEFITS OF WIND ENERGY

Wind turbines convert a low-grade, renewable energy source into a high-grade energy source in the form of electricity. The accessible wind energy resource in the UK is about 300 terrawatt hours per year, but it is not feasible to exploit this resource to its full potential. While the installation of land based wind turbines has its drawbacks, the principal benefits of using wind energy to generate electricity are understood to be:

(a)10% of the UK's current electricity demand can be acceptably supplied from wind energy.

(b)Zero carbon dioxide emmissions.

(c)Wind turbines are easily decommisioned at the end of their lifetime.

(d)Cost of electricity is about 7p/kWh.

Source: Technology Status Report 001 Wind Energy, DTI, May 1993.

APPENDIX C: PLANNING STUDIES

DTI/ETSU studies completed or at the stage of a draft final report

Devon Planning Study: West Devon Borough Council and Devon County Council

Durham Planning Study: Durham County Council

Cumbria study: South Lakeland District Council and Cumbria County Council

Cornwall study: Six district councils and Cornwall County Council

Ongoing studies

Gwynedd Planning study: district councils and Gwynedd County Council

South Wales involving the Standing Conference of Local Authorities

Southern planning study: counties of Hampshire, Berkshire, Isle of Wight, Oxfordshire, Dorset and Wiltshire

Devon Community study

Durham County Council: strategy for renewable energy development

Local Authorities which have undertaken their own work

Lancashire County Council: wind

Leicestershire County Council: especially looking at small and community type developments

Others

Landscape Impact Assessment for Wind Turbine Development in Dyfed: Chris Blandford Associates

Wind Energy Resource in Powys: Dulas Engineering Ltd and Powys County Council