A COMMUNITY WIND TURBINE FOR

APPLETON AND SPAUNTON

FEASIBILITY STUDY

Produced for the Appleton and Spaunton
Community Energy Group

Final

by
North Energy Associates Ltd

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PROJECT BRIEF

North Energy associates Ltd were commissioned by the Appleton and Spaunton community energy group to look at community wind energy as part of their ongoing community energy action plan.

We were asked to look at the following:

1. The most suitable site nearby for a wind turbine
2. Turbine types and size
3. Planning
4. Economic feasibility
5. Grid connection
6. Other community wind projects in UK
7. Other issues – e.g. low flying

CONTENTS

WHY A WIND TURBINE?

Figure 1 A Bonus 300kW wind turbine

Although rare in the UK, community- owned or operated wind turbines are more common in Denmark, Germany and Sweden. Residents decide to invest in a turbine and build it on an agreed site, for the benefit of individual investors and of the community.

A community wind turbine could be installed to reduce the carbon footprint of the Appleton & Spaunton community. The recent energy study has shown that the residents of Appleton and Spaunton are having a larger than average impact on the environment because of their reliance on solid fuels for heating.

Wind turbines are one of the most cost effective renewable energy technologies, and their development over recent years has made them reliable, quiet and effective. Across the world there are tens of thousands in operation producing clean, green electricity.

A turbine could make a “green” visual statement about the villages, and show the rest of the world that the villagers have a strong commitment to the global environment.
In the UK most wind turbines have been installed in wind farms in high, open areas, by external development companies. This has resulted in a severe “not in my backyard” backlash, not seen to the same extent in other countries.

Why is this? One of the reasons appears to be that in other countries where pioneering wind developments took place, such as Denmark, Germany and Sweden, there was a ground swell of community wind turbines erected by groups of local investors coming together to build and operate wind turbines and wind farms. This meant that local residents were involved in creating their “own” wind farm. Local investors could be seen to be making money in investing in the windfarm and more investment came in. There were substantial tax incentives for these investments. Unfortunately no incentives were made available in the UK and there has been reliance on a market mechanism for development. However, even in this more difficult climate some pioneering souls have set up community wind developments. They are:

- Baywind Energy Co-operative
- Findhorn Foundation
- Bro Dyfi Community Renewables
- Cwmni Gwynt Teg

And more recently:

- Gigha Renewable Energy Company
- Westmill Wind Co-operative
- Fenland Green Power Co-operative
- Boyndie Co-operative
- Energy4All (an umbrella group for wind developments)

Two pioneering schemes in Wales are still going, and have strengthened local energy networks despite never having been able to install turbines, they are:

- Awel Aman Tawe
- The Arts Factory

Some of these will be investigated in more detail later on in this report.

WHAT IS THE CRITICAL SUCCESS FACTOR?

According to the Centre for Alternative Technology, "what makes for a successful community energy scheme is a strong social network with a "critical actor", a leader who can drive the project forward and inspire others to get involved."

A community wind turbine could be installed to help reduce Appleton & Spaunton residents' carbon footprint. The turbine could also make a "green" visual statement about the villages, and show the villagers' commitment to the global environment.

However, it is clear from CAT's analysis of projects that "community buy-in" is needed at a very early stage.

SOME REASONS NOT TO INSTALL A WIND TURBINE –

Figure 2 A Vestas 225kW wind turbine

North York Moors National Park - tight planning constraints

The village and suitable close surrounding sites (north of the A170) are all within the National Park. The National Park is the Planning Authority and planning within National Parks is subject to very tight constraints.

It cannot be hidden – visual intrusion

The problem with wind turbines is that they have to be sited where they "see" plenty of wind. They cannot be hidden and so will always be a visible feature in the landscape.

Community ownership is not straightforward

The community ownership of wind turbines is not easy or straightforward in the UK. Unlike Denmark, Sweden and Germany there is no encouragement or tax incentives for people to set up and join community energy schemes in the UK. Community schemes such as Baywind, Bro Dyfi, and Gigha have all faced difficulties. Some community initiatives such as the Awel Aman Tawe scheme near Neath in South Wales have failed to materialise despite substantial effort because of some entrenched local opposition.

Climate change is someone else's problem

The energy study carried out for Yorkshire Forward showed that Appleton and Spaunton have high per-capita greenhouse gas emissions because of their reliance on solid fuel for heating. Clearly residents of Appleton and Spaunton are having a more than average impact on the planet.

SITE SELECTION

Three sites were initially identified in the local area, each of which could be used for the site of the Community Wind Turbine. Each site has both pros and cons and these are outlined below.

The sites are

1. Spaunton Hill Top Farm
2. Appleton Common
3. Spaunton Quarry

SITE -1 SPAUNTON HILL TOP FARM

Figure 3 View over Spaunton Hill Top Farm to moors

Spaunton Hill Top Farm is the windiest site of the three investigated. However, there are two serious problems with this site. The grid connection is very poor, and the views of the hill from the moors are likely to make gaining planning permission for this site very difficult.

Grid Connection

The existing grid connection for Spaunton village is single phase, which cannot be used for a wind turbine connection. The current connection is inadequate even for the farms, which cannot operate electrically powered machinery above a few kilowatts. A three phase supply capable carrying at least 300kW is required for a turbine connection of the size envisaged.

A quotation has been received from NEDL following an enquiry concerning upgrading the connection to Spaunton Hill Top Farm and installing a wind turbine. These new grid connection costs are very high (£370,000) because this will involve the construction of several kilometres of new three phase overhead lines. This would have to be carried out without seriously disrupting existing supplies to customers. This would involve lengthy negotiations over wayleaves too.

This cost almost immediately rules out the use of the Spaunton Hill Top site for a wind turbine, as the connection cost would make it almost impossible to make a wind project financially viable.

Visibility

The other major problem with this site is its visibility from the moors and the moor roads. Close visibility from Hutton le Hole may not be a problem because of the steepness of the escarpment. However, the hill top is very visible from the outer parts of Lastingham and a wind turbine would be seen from there. Visibility from the moors and moor roads would be very high and the turbine would become a very prominent feature in the landscape.

SITE 2 APPLETON COMMON

Figure 4 View of Appleton Common

Appleton Common is a good site for a wind turbine. It is relatively open, with scrubland vegetation of around 2m high, and open views to the south. To the west there are trees surrounding the quarry, so a site away from these trees would be best.

For a site located at National Grid Reference SE7270 8705 (see Figure 5), there would need to be a short access track across the common from the road to allow construction access and access for the crane to erect the turbine. After that it would be used infrequently for turbine maintenance. This could be a stone track, and some method of locking it with a barrier or gate will be required to stop other traffic using it.

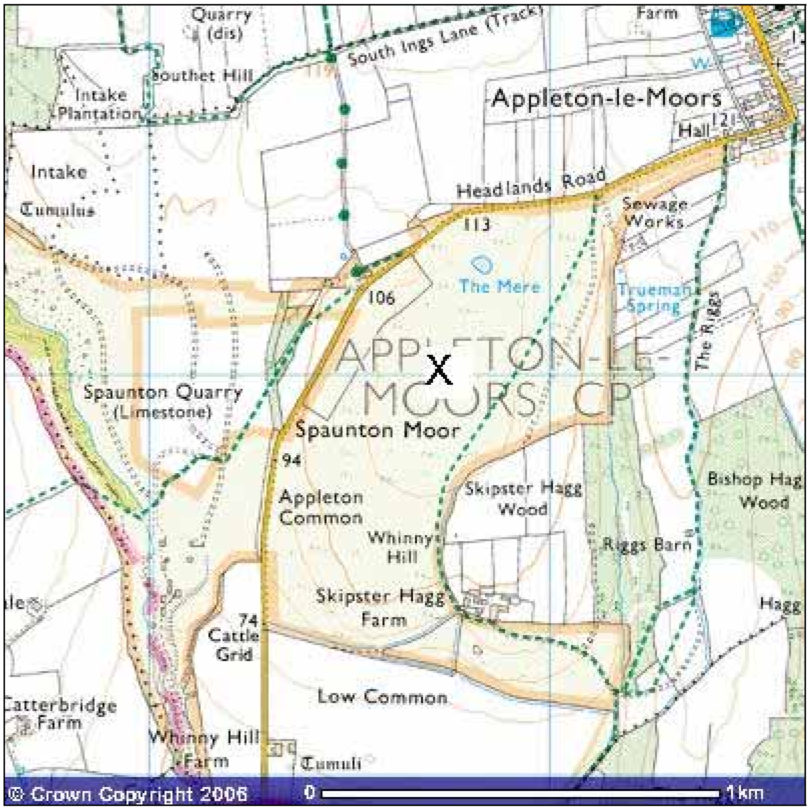


Figure 5 Site Map – Appleton Common, turbine marked with an X

Grid connection

There is a good three phase electricity grid connection from the nearby existing quarry supply. An extension to this to the base transformer for the wind turbine would be needed, approximately 500m long, requiring either an overhead pole line (cheaper) or a trench and buried cable (more expensive) depending on planning considerations. Spaunton Quarry has good existing connection which could serve the Quarry site or the Common site but it may be dismantled if action is not taken soon.

Wind Resource

Appleton Common is less windy than the Spaunton Hill Top area. The wind speed on higher Appleton Common is approx 6.0 m/s at 25m above ground level. This should be sufficient to make a viable wind energy scheme.

Visibility

A turbine on the Common would be visible from the south west end of the village, from the village road and, at a distance, from the A170. However, it is unlikely to be seen from the nearby moorlands to the north of Hutton le Hole. The turbine may be visible from the highest moor roads, but the distance will be such that it will be a minor feature of the landscape.

In its favour it is a less sensitive site from the Landscape Sensitivity Assessment point of view than the Spaunton Hill Top site. This assessment was carried out for the "Delivering sustainable energy in North Yorkshire" Renewable Energy Study report. The area is in

Typology ULA and the sensitivity is Medium-High. (Extracts from the report are relevant – given in Appendix 1.)

Land management

Also in its favour is that Appleton Common is common land already managed by the community through the ancient "Leat Court" system. So it is seen as a common resource for the good of all, and it may be possible to extend the existing system to manage the turbine, and benefit from income generated.
In addition there is a good three phase grid connection from the nearby existing quarry supply.

SITE 3 SPAUNTON QUARRY

Figure 6 Spaunton Quarry (photo North Energy)

Visibility and planning

Spaunton Quarry site is what is known as a "brown field" site, as it will be a closed site soon. A site at the north end on either un-quarried ground or ground restored to its former level could be suitable for a wind turbine. The turbine cannot be placed on the base level of the quarry, where the buildings currently are situated, as it would not "see" any wind.

The quarry is currently winding down its operations as it has not been allowed to expand further. This means that, over the coming months, it will be restored in line with its restoration plan.

This site may possibly be easier for planning, since, although still in the North Yorkshire Moors National Park, it is an ex-industrial site. The site is a little less visible from road than the common site.

Wind resource

It will have lower wind speed than other sites in the area, because it is both slightly lower than the common (by 6 – 8 m depending on the final site chosen), and it is somewhat surrounded by some mature and a number of recently planted trees which will also diminish the wind resource, in comparison with the more open aspect of the common.

Grid connection

There is a very good grid connection to the quarry. The quarry has some heavy power consuming equipment such as crushers screens and conveyors which all need three phase power to run them

Finally it may be possible to “engineer-in” an access road & foundations during restoration of the quarry, if this is agreed quickly.

PLANNING CONSIDERATIONS

POTENTIAL IMPACTS OF THE PROJECT

a) Landscape and visual impact

This is the key issue and will require the preparation of photomontages from a number of viewpoints agreed with North York Moors National Park Authority (NYMNPA). A "Zone of Visual Influence" ZVI map will need to be prepared.

A key test of the planning application will be whether the proposal undermines the objectives that underpin the purpose of National Park designation, namely protection of the landscape. This is central to the planning case.

The community energy group will need to discuss landscape impact issues at an early stage with the National Park planners.

b) Ecology

The community energy group will have to consult with NYMNPA and English Nature to determine if there are any ecological issues affecting the site.

c) Archaeology

In the next stage an early consultation with the County Archaeologist will be required to determine if there is any sensitivity at the chosen site.

d) Noise

Given the separation between the proposed turbine and the nearest dwellings, we do not anticipate any difficulties regarding noise disturbance from the turbine.

The community energy group will have to consult with the Environmental Health Officer at the District Council at an early stage to ascertain his requirements on the issues of noise. This may entail noise measurements over 24 hour periods, but this requirement is determined by a decision of the EHO. In our opinion, such measurement should not be required for the Appleton Common site.

e) Shadow Flicker

The possibility of shadow flicker affecting the properties closest to the turbine would need to be investigated in the next stage of work. These properties are far enough away from the turbine that this should not be a problem but it will need to be confirmed for the planning authorities.

f) Aeronautical issues

The CAA and MoD have been asked for their opinion on the likely effects on aeronautical radar and aircraft operations. A response is awaited.

The NATS radar system has an online tool for checking the likely impact on air traffic control radar for overflying traffic. From this tool it is clear that a turbine in the Appleton area is likely to have a low or no impact on their operations.

The villages are in MoD Low Flying Area 11. In these areas the lowest height of flying should be 250 feet. Turbine tip heights of less than this should not cause a problem for the MoD but they must be formerly consulted at the right time. The initial consultation forms have been sent to the Defence Estates Safeguarding section.

The Fylingdales Radar is nearby and we would expect the Defence Estates Safeguarding Section to respond promptly if this was an issue. No response has yet been received.

g) Telecoms and TV issues

Consultations have commenced with OFCOM and the telecommunications operators. From their reply it would seem that there are no microwave fixed links within 500m of the Appleton Common site. Operators of the Joint Radio Company scanning telemetry service also have no objections.

Interference with TV and radio should be followed up in the next stage of the project.

TECHNICAL CONSIDERATIONS

SITE WIND SPEEDS

Annual Mean Wind Speeds have been obtained from the national data based on a 1km x 1km grid square atmospheric model data, (ETSU-NOABL database).

1. Spaunton Hill Top approx 6.3 metres/second at 25m Above Ground Level
2. Appleton Common approx 6.0m/s at 25m AGL on higher common
3. Quarry site approx 5.7m/s at 25m AGL depending on position and trees reducing the wind resource

These wind speeds are OK for a wind turbine project, and are likely to be a paying – proposition.

ENERGY OUTPUTS

With the above annual mean wind speeds, the energy output from a 225kW wind turbine are estimated to be in the region of:

1. Spaunton Hill Top 550,000 kWh
2. Appleton Common 500,000 kWh
3. Spaunton Quarry (higher areas), 450,000 kWh.

500,000 kWh of wind electricity would displace 218 tonnes of CO2 about 10% of the village’s carbon footprint!

WIND TURBINES FOR THE COMMUNITY

Figure 7 A Vestas 225kW wind turbine

Wind turbines are currently available in a sizes ranging from tiny turbines rated at 300 watts for roof tops to gigantic 5 megawatts (MW) turbines for installation offshore. Turbines for onshore wind farms are now built in the range 850kW to 3MW by a number of large wind turbine manufacturers. Smaller wind turbines are not in widespread manufacture in Europe, but are widely available as second-hand machines from the “re-powering” of Danish and German wind farms with larger turbines. These second-hand turbines vary from 100kW to 600kW and are of various ages and number of running hours. Clearly using these is a matter for caution, but, like second-hand cars, you get what you pay for.

Recently (May 2006) news has been announced that new 225kW turbines are imported from India, where they have been manufactured by Vestas RRB.

Example:
Second-hand Vestas 225 kW turbine
Diameter 27m (87 ft)
Hub height 33m (108 ft)
Total height to tip 46.5m (152 ft)

Figure 8 A second-hand Vestas 225 at the Green House, Annfield Plain, County Durham. North Energy carried out the initial feasibility study for this building

Most new wind turbines are much, much bigger – 3 to 4 times these dimensions and with up to 10 times the output.

ECONOMIC FEASIBILITY

INDICATIVE COSTS

The costs for a wind turbine consist of all of the following items:

- Capital cost of the turbine
- Delivery to site
- Hire of cranes
- Hire of installation engineers
- Excavation of the foundation
- Installation of the foundation
- Installation of access track
- Excavation of cable trench
- Installation of cable
- Installation of transformers, switch gear and meters
- Electrical connection costs
- Costs for wayleaves
- Cost of commissioning
- Costs for Electricity Distribution Network Operator for witnessing G59 tests

Because the site has not yet been decided upon, and no measured quantities are available, only overall estimated budget cost is available. This should suffice for the initial economic feasibility calculations, but more work will need to be done to refine costs in the next stage of work.

For a 225kW refurbished second-hand turbine on the Common, costs should be around £120,000 installed and the scheme would have a 10 -12 year life. Of this cost, about half will be for the turbine and the balance made up by all the other site costs involved.

The cost of the second-hand turbine itself is likely to be around £60,000.

New turbines in the 250 - 400kW range are available but are less cost effective.

In comparison a new “mega” 2MW wind turbine would be around £1.5 million and would have a 20 year life

INCOME TO THE PROJECT

Sales of electricity

The electricity from wind turbines has a value when it is sold onto the national grid. However, this value is much less than domestic customers pay for their electricity, because there are substantial costs in delivering electricity to consumers which have to be covered in the difference between selling and buying. Also wind energy is unpredictable and has to be used when available, which also means it is of relatively low value to electricity supply companies.

Value taken in these calculations is 3.5 p/kWh day rate and 2.5 p/kWh night rate. This reflects the recent rise in energy prices.

“Renewable Obligation Certificates”

Renewable Obligation Certificates (ROC) are tradeable certificates which can be sold by the turbine operator to electricity suppliers, who are obliged to purchase a certain number of certificates. The base price of certificates was originally set at £30 per MWh (=3 pence per kWh) and the price cannot fall below that level. These ROCs are trading currently at £40.65 per MWh (=4.065 p/kWh) as per April 2006.

Because the price is likely to change over the life of a scheme, a value of 3.0p/kWh is the most pessimistic value. Although the ROCs are likely to be worth more than this, there are transaction costs which need to be allowed for, so the value to a small generator (which this turbine is classed as) is likely to be less than the current market selling price over the full life of the scheme. So a value of 3.5 p/kWh will be used for the projection here.

OUTGOINGS

Capital cost (less grants)
Maintenance costs
Land rental / rates
Operation of the Community Wind Organisation

SURPLUS

Possibilities for the surplus are that part goes to the investing shareholders and part goes to a Community Fund for local benefit. The allocation of the funds will have to be decided during the formation of the organisation.

ECONOMIC PROJECTION

A simple economic projection has been used. The cumulative cash flow over the life of the project is shown in Figure 8 below. This is simplistic but gives an easy to understand view of the basic economics. It is assumed that there is no opportunity cost of capital (ie they are calculated on straight line repayments over 12 years). Clearly there are many variables which will affect the cost, and extensive economic modelling could be carried out. However based on the above simple figures:

Turbine capital cost £120,000 installed
Turbine output 500,000 kWh per year
ROC at 3.5 p/kWh
Electricity selling price = 3.5 p/kWh day, 2.5 p/kWh night

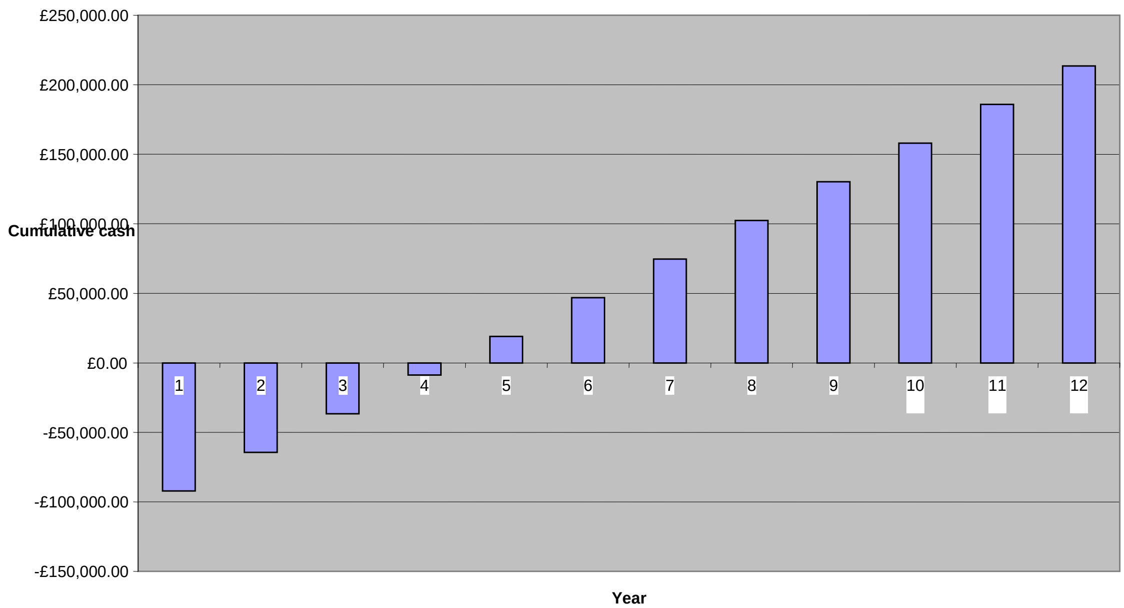
With these figures the annual value of income is around £34,000.

Costs for maintenance of £1,200 per annum have been allowed for, and “other annual costs” of £5,000. This would allow the project to pay someone for half a day a week to do the books and other project administration as well as allowing for rates and other costs.

With these assumptions, this will give payback in a little over 4 years.

The overall conclusion is that the project should be a paying proposition.

Cumulative cash flow – Second-hand 225kW , Straight 12 year with no interest payments



OTHER SUCCESSFUL UK COMMUNITY WIND ENERGY PROJECTS

EXAMPLE -BRO DYFI COMMUNITY RENEWABLES PROJECT

Figure 9 The opening of the Bro Dyfi Community Wind Project

The Bro Dyfi Community Wind Project is in Mid-Wales, near to Centre for Alternative Technology in Machynlleth.

Using a second-hand 75 kW wind turbine which was Installed 2003. It is incorporated as a community energy co-operative, with 55 local shareholders. There is a Community Energy Fund which also benefits from the surplus generated.

EXAMPLE – "THE DANCING LADIES OF GIGHA" 1

Figure 10 Photo - The "Dancing Ladies of Gigha"

This is a community based project, on the small Scottish Island of Gigha using three second-hand 225kW turbines. The wind farm owned by a Limited Company which was set up by the community trust. It was funded using combined grant, equity and loan finance.

Project cost £400,000

Income (£75,000 pa) goes into a community fund

Figure 11 Switch-on ceremony at Gigha

FINDHORN WIND TURBINES

The Findhorn Eco-village in North East Scotland has recently installed 3 second-hand wind turbines to supplement the single 100kW wind turbine that has been running for many years.

BAYWIND

A Cumbrian co-operative which began 9 years ago with a 5 turbine windfarm at Harlock Hill and has recently expanded to own one turbine on Haverigg II windfarm. The co-operative has both local and national shareholders, and their windfarms produce enough power for 2500 homes. Investments are currently paying out 7.2% gross.

Baywind used some of its income to run an energy efficiency scheme in the local area, and recently set up Energy4All to spin out the community co-operative idea.

Baywind Energy Co-operative Ltd, Unit 33, Trinity Enterprise Centre, Furness Business Park, Barrow in Furness, Cumbria LA14 2PN
Tel 01229 821028, fax 01229 826075

ENERGY4ALL

Energy4All was set up as a spin off from Baywind. It has helped a number of organisations to form, including:

- Westmill Wind Farm Co-operative, based in Oxfordshire and now building the windfarm after having raised £4.3 million in capital from shares.

- Fenland Green Power Co-operative which has been set up to purchase 2 of 8 wind turbines at the Deeping St Nicholas site in the Fens.

- Boyndie Co-operative in Aberdeen is hoping to launch a share issue soon for its stake in a wind farm.

CONCLUSION

Three sites near Appleton and Spaunton were considered, and their advantages and disadvantages assessed. They were Spaunton Hill Top Farm, Appleton Common and Spaunton Quarry.

A good grid connection is currently available at Spaunton Quarry, although when the quarry closes this may be dismantled, so it needs to be safeguarded. Sites further from this connection are likely to have increasingly expensive grid connection costs. The site at Spaunton Hill Top Farm is eliminated because of the very high costs of grid connection (£370,000).

In our opinion the best site for a turbine would be on Appleton Common. A site on the higher parts of Spaunton Quarry could be suitable but the wind availability will be less because of a height difference and the surrounding tree plantations reducing windspeeds.

A wind turbine project using a second-hand 225kW turbine is likely to be economically viable at the Appleton Common site. It would have a payback of four to five years. Paybacks will be longer at the Quarry site.

The main planning problem with this project is likely to be the visual impact on the North York Moors and the area surrounding the villages. Most of the other potential planning "show stoppers" such as noise, microwave links and aeronautical radar do not appear to be a problem at the Appleton Common or Quarry sites.

Setting up a community wind energy project is not straightforward, and the energy group should begin discussions with other community groups who have successfully implemented projects. It is essential that the local community "buys in" to the idea of a community wind turbine.

If the community does want a wind turbine, then it will have to begin informal consultations with the planning authority, the North York Moors National Park very soon, to get a steer on the chances of this project going ahead.

NEXT STEPS

1. Discussions within the local community to get Community "buy in"
2. Discussions with successful community Wind energy schemes elsewhere in the UK
3. Approach the planning authorities
4. Approach statutory consultees
5. Take the project on from there.

APPENDIX 1 APPLETON & SPAUNTON WIND TURBINE FEASIBILITY STUDY

RECOMMNEDED PLANNING GUIDANCE FROM "DELIVERING SUSTAINABLE ENERGY IN NORTH YORKSHIRE" REPORT

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Recommendation 7: Stand-alone Renewable Energy Criteria Based Policies

- *14. Development plans should:*
- *positively encourage the development of all forms of renewables and give support to the 2010 and 2020 subregional targets for renewable energy;*

- *set out how the local authorities anticipate they will contribute towards the sub-regional target;*

- *require the need to consider the social, environmental and economic benefits of proposals at a national, regional and local level as material considerations that should be given significant weight in the decision making process;*

- *set out the criteria in which renewable energy proposals will be permitted, covering issues such as:*

appropriateness of the location and scale of the proposal in relation to:

  - *its impact on visual amenity and the character and sensitivity of the landscape (state that size, location and design of proposed development should be informed by landscape character assessment);*
  - *the potential for cumulative impacts;*
  - *accessibility by road or public transport.*
  - *need to avoid unacceptable environmental or amenity*
  - *impacts (such as noise, dust, odour etc.);*
  - *need to ensure that the proposed development does not compromise the 'openness' of the green belt;*
  - *need to ensure that the proposal does not compromise the objectives of nationally designated areas;*
  - *need to ensure that the proposal does not compromise the integrity of internationally designated areas and features and/or species of nature conservation importance.*
  - *express positive support for developments of an appropriate scale within National Parks and AONBs. State that size, location and design should be informed by landscape character assessment; and*
  - *express positive support for the development of community renewable energy schemes.*

3.94. Recommendation 7 sets out the key issues which it is suggested the local planning authorities of North Yorkshire should consider when drafting criteria based policies on stand
alone renewable energy developments.

Development plans should:

- *positively encourage the development of all forms of renewables and give support to the 2010 and 2020 sub-regional targets for renewable energy;*
- *set out how the local authorities anticipate they will contribute towards the sub-regional target.*
- *require the need to consider the social, environmental and economic benefits of proposals at a national, regional and local level as material considerations that should be given significant weight in the decision making process.*
- *set out the criteria in which renewable energy proposals will be permitted, covering issues such as:*
- *appropriateness of the location and scale of the proposal in relation to:*
  - *its impact on visual amenity and the character and sensitivity of the landscape (state that size, location and design of proposed development should be informed by landscape character assessment);*
  - *the potential for cumulative impacts;*
  - *accessibility by road or public transport.*
- *need to avoid unacceptable environmental or amenity impacts (such as noise, dust, odour etc.);*
- *need to ensure that the proposed development does not compromise the 'openness' of the green belt;*
- *need to ensure that the proposal does not compromise the objectives of nationally designated areas;*
- *need to ensure that the proposal does not compromise the integrity of internationally designated areas and features and/or species of nature conservation importance.*
- *express positive support for developments of an appropriate scale within National Parks and AONBs. State that size, location and design should be informed by landscape character assessment;*
- *express positive support for the development of community renewable energy schemes.*

Scales of Renewable Energy Development

5.35. The following section defines a series of scales of renewable energy development that were used by this study in order to assess sensitivities and constraints to development within North Yorkshire. The definitions of scale are not intended to suggest that these are the types of development that are considered appropriate within North Yorkshire. The purpose is simply to set out generic parameters against which sensitivities and constraints can be assessed. The scales of technologies that were considered in the sensitivity analysis and the guidance are outlined below:

Wind

5.36. For wind, a three tier approach was taken to the assessment as follows:

5.37. The overall landscape sensitivity was assessed as sensitivity to wind turbines with a tip height of 100m. This is the size of a typical commercial wind turbine of 2-2.5MW, which are the turbines which are most likely to come forward for development in North Yorkshire in the near future. Larger turbines are also being used for some development proposals, guidance on the consideration of larger turbines is given in Chapter 6.

5.38. For the purposes of developing the guidance, three potential scales of development were considered in terms of appropriateness and sensitivity. These three scales of development were adapted from the AEAT 2004 study1:

- *a small scale development – 1-5 turbines (100m to tip);*
- *a medium scale development – 6-25 turbines (100m to tip); and*
- *a large scale development – more than 25 turbine (100m to tip).*

5.39. The sizes of current windfarm developments within the UK vary from one or two turbines to over 100 turbines. The likely number of turbines for wind development proposals in the North Yorkshire area was considered, and three scales of windfarms, as set out above, were deemed to be the most likely to be developed in the area.

5.40. The definitions of small, medium and large windfarm developments used here have been selected on the basis of scales of windfarms used in other regional sensitivity and capacity studies, on the basis of current windfarm proposals across the UK, and in agreement with the Steering Group.

5.41.There are clear caveats that need to be made with regard to these somewhat arbitrary boundaries. The difference in potential visual impact between proposals of 25 and 26 turbines is clearly different from those between proposals of 5 and 62 turbines, or between 1 and 2 turbines. For this study the definition of a 'small' windfarm development has been taken as 1 to 5 turbines of the standard commercial turbine of 100m high, and has been used to draw up general sensitivity assessment and guidance for small scale windfarms. This is distinct from developments of small turbines.

5.42. There has been considerable debate as to the concept of 'small scale' with respect to windfarm development, reflecting the need to define the appropriate scale of both development (number of turbines) and size of turbines for a given landscape. What may be considered a small scale development in, for example, an industrialised landscape, may be considered large, or too large in a narrow, enclosed valley landscape. In addition, the definition of small scale can be linked to the concept of thresholds of acceptability – which is particularly affected by values placed on the landscape. As such, what may elsewhere be considered small scale, may be considered large and unacceptable in a designated landscape such as a National Park or AONB. This is particularly pertinent where PPS22 refers to 'small scale developments', but does not attempt to define them. Bearing this in mind, it is important to stress that this landscape sensitivity study does not include an assessment of value placed on the landscape, such that the concepts of value and acceptability are not considered, and that a definition of 'small scale' best fitting to North Yorkshire as a whole, has had to be used.

5.43. It should also be made clear that while this study has defined small scale developments as 1 to 5 turbines of 100m to tip, those landscapes in which sensitivity to even small scale commercial developments was considered to be high, have been considered further with regard to smaller turbines. For this, smaller scale, domestic scale wind energy developments, i.e. turbines of up to 50m tip height, have been considered.

Appendix 4 (of Delivering Sustainable Energy in North Yorkshire) contains the discussion of sensitivity of the landscape areas to large, medium and small scale

[1] AEA Technology (2004) Planning for Renewable Energy Targets in Yorkshire and Humber 2004
[2] AEA Technology (2004) Planning for Renewable Energy Targets in Yorkshire and Humber 2004

commercial developments, and, where appropriate, further notes and discussion regarding the potential sensitivity and capacity of the area for domestic scale turbines. Notes are also included on where the value placed on the landscape (through designation), may affect the capacity of that landscape to accommodate turbines. This discussion is not a capacity study, but aims to highlight potential issues that should be noted when considering capacity.

5.56. The main components of a wind energy development that may have an impact on the landscape and on visual amenity are the wind turbines, access roads, electrical sub-station, pylons and control building. In relation to wind turbines, key characteristics relate to factors such as:

- *landform and topography;*
- *landcover patterns;*
- *scale and enclosure;*
- *remoteness and tranquillity;*
- *settlement density and pattern;*
- *key landscape elements and features;*
- *landmarks and visible built structures;*
- *views; and*
- *skyline.*

Larger and Smaller Scale Developments

6.18. The sensitivity study has used standardised scales of development to draw up broad guidelines for sensitivity. It is important to recognise that most actual applications will vary from these standards. In particular, as discussed above, the trend is for increasing sizes of turbines (heights and blade diameters) to be proposed. Some current applications propose turbines of up to 125m to blade tip, and this may increase with the further development of technology.

6.19. In distant views of windfarms on open landscape, the increase in size of the machines may not be noticeable, but for smaller scale landscapes where the size of the turbines can be related to recognisable elements in the landscape such as trees and houses, the larger turbines are more likely to have an effect on the perceived scale of the landscape, potentially dwarfing other features.

6.20. In contrast, smaller turbines will be more appropriate in situations such as in designated landscapes, and landscapes judged to have higher sensitivity. In particular, single turbines or small groups (up to about five) of turbines of a small size (less than 50m high), associated directly with farmsteads or local settlements, may be appropriate for locations within National Parks and AONBs, where the sensitivity to 100m high turbines has been considered to be high.

The North York Moors National Park

6.58. The North York Moors National Park comprises areas of upland moorland which have been cut by a series of branching dales. To the west and north the moors are defined by dramatic and sinuous escarpment. South facing slopes are by contrast more gentle. The National Park runs up to the North Sea coast and includes a series of bays and steep sea cliffs. As in the case of the Yorkshire Dales National Park, there are extensive views from higher ground and uninterrupted skylines make an important contribution to the experience of the landscape on the moors and within the dales. The *moors form a dramatic and widely visible skyline when viewed from within the Vale of York and Teesside to the north. They are less prominent in views from within the Vale of Pickering.*

6.59. The wind sensitivity map indicates that almost the entirety of the National Park has been identified as having a landscape that is of high sensitivity to wind energy development. This reflects a number of the factors described in the previous paragraph including the importance of uninterrupted views and skylines, the lack of scale features in many of the moorland areas, and the small scale and historic patterns of settlement and landcover within the dales. Fringe areas to the south and west, at the foot of the scarp, were judged to be of medium-high sensitivity, and the area immediately around Scarborough was judged to be of medium sensitivity, reflecting the influence of the built up area on the character of the landscape.

6.94. Criteria for locating windfarms include both physical and perceptual criteria. There may well be conflicts where one site will result in a reduced impact on one criterion, but an increased impact on another. These will need to be weighed up through a site specific landscape and visual impact assessment. Impacts on landscape character and visual amenity may be positive as well as negative.

Physical criteria

Landform, shape and scale – the landscapes of North Yorkshire tend to be relatively large in scale in relation to the UK as a whole. The landform, shape and scale is critical in evaluating whether the landscape can accommodate large scale features such as windfarms. For example, in theory a large scale strong landform may accommodate large scale features because the turbines will be in scale with the landscape. Landscape pattern can affect the overall landscape scale. For example, areas with a large scale landform may be inappropriate for large scale wind turbine development if the landscape is characterised by an intricate landscape pattern, for example as a result of ancient field systems. The Countryside Agency guidance on landscape character assessment35 provides useful guidance in defining landform and landscape pattern. In addition, Scottish Natural Heritage's Guidelines on the Environmental Impacts of Wind Farms36 also provides some useful explanation on landform and how it may relate to wind turbines.

Nature of the skyline

Open skylines may provide an opportunity to accommodate a well placed windfarm that may act as a visual focus. However, prominent skylines are highly visible thus making any windfarm highly visible. Skylines that have important focal features such as landform features or historic buildings are less likely to be able to accommodate windfarms. It is important to ensure that wind turbines do not detract from, or compete with, important focal points.

Landscape pattern and foci

Landscape pattern results from a combination of landcover and land use patterns - field boundaries, distribution of woodland, settlements and transport infrastructure can all contribute to landscape pattern. The characteristic landscape pattern will inform the most appropriate configuration of turbines. For example, areas characterised by geometric patterns (such as rectilinear field boundaries, liner ditches/shelter belts and straight roads) may be most suited to turbines located in rows or on a grid, whereas areas *characterised by amorphous patterns (such as irregular fields or unenclosed areas) may be suited to more irregular groups of turbines. Focal points, for example church 3 towers or other prominent elements, contribute to landscape pattern and are important visual elements in the landscape. It is important to ensure that wind turbines do not detract from important focal points or compete with such elements.*

Openness/enclosure

The sense of enclosure provided by topography or vegetation may indicate the ability of a landscape to provide screening for ground level buildings or infrastructure associated with windfarm developments. Open areas, such as moorland areas, would provide little screening for access tracks and these may result in adverse impacts. The sense of enclosure may also inform the spacing needed between adjacent windfarms or turbines. For example, areas with a sense of enclosure (undulating or wooded areas) may be able to accommodate turbines at a higher density than open and exposed areas (such as open moorland or marshland), because inter-visibility between adjacent structures will be reduced.

Character of the built environment

The presence of settlement may influence the location of windfarms. For example, if a windfarm is too close to a settlement it may overshadow the settlement or dominate the character of the settlement which may be much smaller in scale. Significant contrasts of scale may occur between turbines and buildings. However, where settlement is extensive and built form large in scale, it may provide more opportunity for turbine development. There may be brownfield sites on the edges of large settlements that could accommodate turbines without detrimental impacts on tranquillity or natural features. However, it should be noted that sites close to settlements may result in increased impacts on visual amenity – this balance of impacts will need to weighed up through assessment.

Transport network

The transport network will indicate where access tracks associated with windfarms may be most easily accommodated. For example, in moorland areas, the absence of transport infrastructure means that any new access tracks are likely to result in significant impacts on the landscape.

Landscape features

Direct effects on specific landscape features could result in adverse impact on landscape character where those landscape features are key characteristics of that landscape. For example, the loss of an old mine building in a landscape characterised by industrial archaeology related to mining would result in adverse impacts on landscape character. On the other hand development may present opportunities to enhance degraded areas and landscape features. For example the development of a windfarm may provide opportunities to clean up despoiled land or restore derelict features and bring redundant land back into use.

[3] The Countryside Agency and Scottish Natural Heritage (2002) Landscape Character Assessment: Guidance for England and Scotland CAX 84. Scottish Natural Heritage (2001) Guidelines on the Environmental Impacts of Windfarms and Small Scale Hydroelectric Schemes.

Cumulative impact

Cumulative impact may occur where the visual envelopes of more than one windfarm overlap. This may result in a dominance of windfarms in one area and these may alter the intrinsic character of the area. Although the cumulative impact of locating numerous windfarms may change the landscape character of a particular area, this can form part of a strategic planning policy which enables other areas less suitable to this type of development to remain devoid of windfarms.

Perceptual Criteria

Sense of remoteness/wildness
North Yorkshire has many rural areas and some remote areas. The introduction of moving elements such as wind turbines may significantly affect the sense of remoteness and solitude that are key elements of some landscapes. Landscapes that have experienced some degree of modification and reduced naturalness may be able to accommodate turbines more comfortably than more remote areas.

Impacts on visual amenity

The Zone of Visual Influence (ZVI) is the area from which a development is potentially visible as determined by topography. The large size of wind turbines means they are likely to have a large ZVI. Topography and other intervening features on the ground may also affect the extent of the ZVI. For example, in areas where the topography is very flat and there are few screening elements, the ZVI is likely to extend over a great distance. 'Receptors' may experience impacts on visual amenity as a result of a development. `Receptor' is defined as a representative individual or group of people, for example residents, visitors or walkers, or an area used by people for a certain use, for example a footpath, garden, house or recreation ground. The Second Edition Guidelines on Landscape and Visual Impact Assessment37 provides many examples of ZVIs and provides an accepted terminology in assessing impacts on visual amenity. Scottish Natural Heritage's Best practice guidance on the visual assessment of windfarms38 is also a useful reference.

Inter-visibility with adjacent landscapes

It will be important to consider views of the windfarm from adjacent landscapes. For example, sites that are adjacent to designated areas such as National Parks, Heritage Coasts or AONBs may be visible from these landscapes. The critical factor will not be how far the development is from the designated area boundary, but the significance of impact on views from the designated area.

Landscape value

Some landscapes are valued for their scenic quality. They may be valued at the national scale (National Parks, Areas of Outstanding Natural Beauty and Heritage Coasts), or at the local scale (local landscape designations in the Structure and Local Plans). These landscapes may be particularly sensitive to large scale elements such as wind turbines, which would alter the perception of that landscape. The impact of the windfarm on landscape value will depend on whether the characteristics of the windfarm relate to the characteristics of the landscape which are valued. It will be important to assess the potential impact of a development on the characteristics for which the landscape is valued.