Wind Energy

Introduction:

According to BWEA, the British Wind Energy Authority, in the UK currently there are 2896 large wind turbines with installed capacity of 4532MW, sufficient to supply over 2.5 million homes (based on annual household energy consumption of 4.7MWh).

Much attention has been paid recently to renewables as a potential source of fuel. The rising oil price and the logistics in supplying fossil fuel to remote areas are the main drive to Renewable as well as the environmental incentive. In remote locations, stand-alone renewable energy systems can be more cost effective than extending a power line to the electrical grid. In addition, the environmental benefits under the current international concerns on global warming makes such project much more valuable and rewarding.

The growth of renewable energy sources also stimulates employment, the creation of new technologies and new skills.

The new direction on renewable energy sets ambitious targets for all members states, such that the EU will reach a 20% share of energy from renewable sources by 2020 and a 10% share of renewable energy specifically in the transport sector. It also improves the legal framework for promoting renewable electricity, requires national action plans that establish pathways for the development of renewable energy sources including bioenergy, creates cooperation mechanisms to help achieve the targets cost effectively and establishes the sustainability criteria for biofuels. The new directive should be implemented by member states by early in 2010.

In a recent statement, Ed Miliband, UK Secretary of state for energy and climate change he spelled out the government strategy:

“Transforming the country into a cleaner, greener and more prosperous place to live is at the heart of our economic plans for ‘building Britain’s future’ and ensuring the UK is ready to take advantage of the opportunities a head”.

By 2020:

- More than 1.2 million people will be in green jobs.
- 7 million homes will have benefited from whole house makeovers, and more than 1.5 million households will be supported to produce their own clean energy.
- Around 40 percent of electricity will be from low-carbon sources, from renewables, nuclear and clean coal.
- We will be importing half the amount of gas that we otherwise world.
- The average new car will emit 40 percent less carbon than now.

Siting of Wind turbines:

The placement or “siting” of wind systems is extremely important. In order for a wind turbine system to be effective, a relatively consistent wind-flow is required. Obstructions such as trees or hills can interfere with the rotors. Because of this, the rotors are usually placed on towers to take advantage of the stronger winds available higher up. Furthermore, wind speed varies with temperature, season, and time of day. All these factors must be considered when choosing a site for a wind-powered generator.

The amount of wind energy available at any location depends on two sets of factors:

a) Climatic factors including: Time of day, Season, Geographic location, Topography, and Local weather.
b) Mechanical factors including: Diameter of rotor, and Type of Turbine

Utility-scale wind farms must have access to transmission lines to transport energy. The wind farm developer may be obligated to install extra equipment or control systems in the wind farm to meet the technical standards set by the operator of a transmission line.

Wind farm, offshore, or on shore

Planning constraints for wind turbines:

There is a number of planning related issues that may make it difficult for you to install a turbine on your site and it would be wise to ensure that you are not going to fall foul of any of these before proceeding.

- **Military installations.**
  Avoid these installations, especially if it is an air force base or communication centres.

- **Proximity to built-up area.**
  when housing estates are concerned, ideally consider a distance of at least 200m -300m depending on the size of the turbine.

- **Designated areas or listed buildings.**
  National parks or Areas of Outstanding Natural Beauty are more difficult to satisfy the local planning officer to install a wind turbine on it or near it.

Steps to planning and Building a Wind farm

There are many stages of development before a wind turbine/farm can be approved and built. Once a site has been selected for its good overall potential, work begins on several main tasks:

- **Consultation with the local authority**

It is extremely important to contact the local authority in the area where the turbine is considered before committing any time or costs. Engage them early in the planning process, answer any questions and/or concerns that they might have, and keep an open dialogue with them throughout the whole development.

- **Consultation with the public near the site**

The local community who are likely to be affected by the proposal must be met to present the project, solicit their feedback and seek their support. An advertisement in the local paper would be a good idea to inform the general public and invite them for a discussion and debate.

- **Land acquisition**

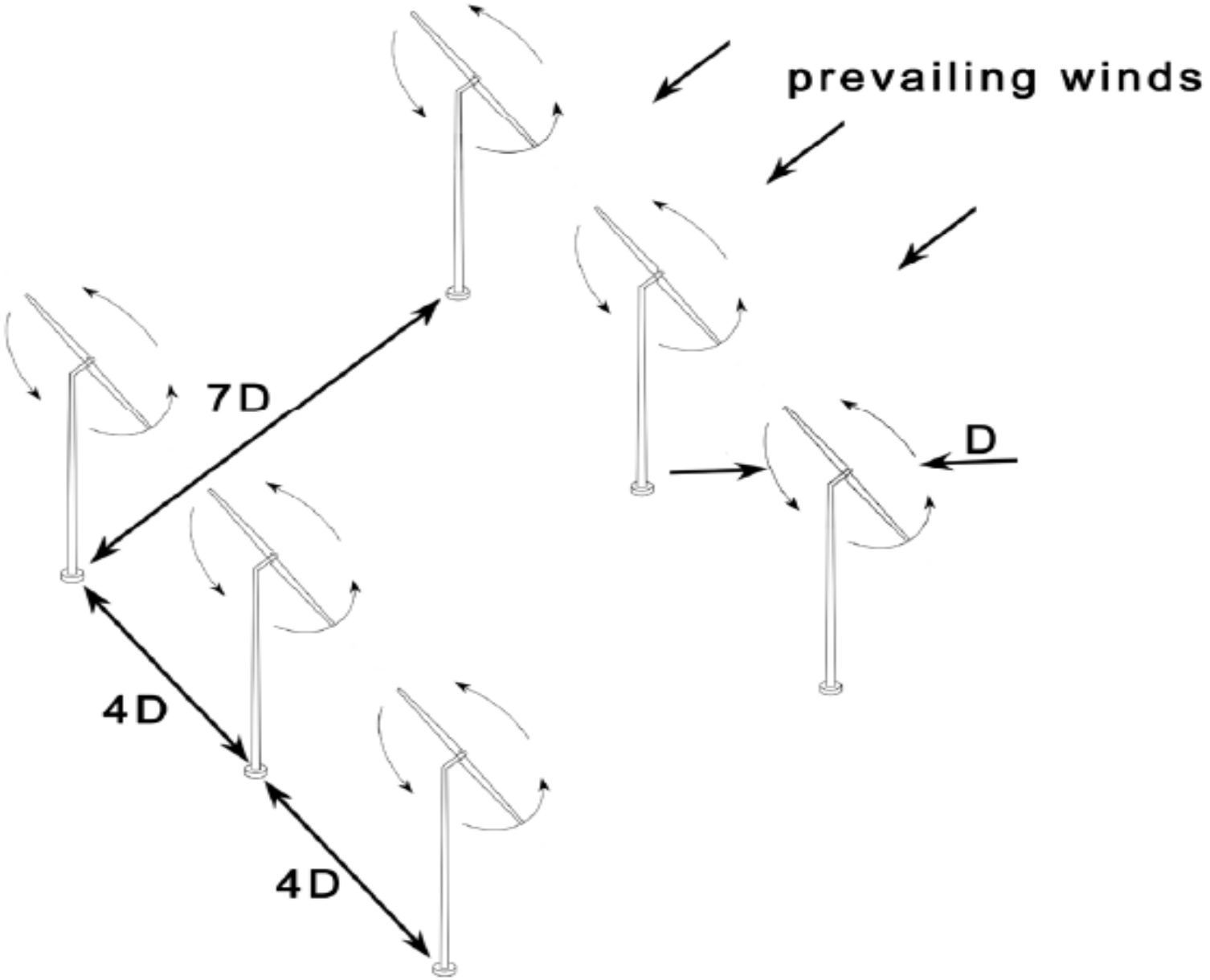
early in the process, developers, if not already the owners themselves usually approach landowners to negotiate “option” agreements to use their land. As the project progresses, the developer will seek to convert the options into firm land lease agreements.

- **Wind Assessment**

Another very important step is assessing the wind resource. Scientists and engineers use meteorological masts to measure wind speed and other climatic conditions for at least one year. This data is then used to estimate how much energy the wind farm will produce. It is often assumed that this has to be carried out before any serious consideration is planned.

- **Wind farm design**

this is important if the project is a wind farm, wind data is combined with topographical information to design the wind farm. Engineers use this data to model wind flow, turbine performance, sound levels and other parameters to optimize the location of the wind turbines. They also design the access roads, turbine foundations and local electric network, as well as the connection to the electricity grid.



Wind farm optimal placement

- **Environmental Impact Assessment**

Environmental assessments are conducted to identify any impacts on landscape, plants and wildlife, soil and water, land use or other activities such as aviation and telecommunications. If negative impacts are identified, the design is adjusted to avoid or mitigate them.

- **Economic and Financial evaluation**

to prove the economic viability of the project in order to raise the funds to build the wind farm. On one hand, there is a need to estimate the cost of turbines and their installation, as well as roads, electrical systems, operation and maintenance, etc. On the other hand, there is a need to estimate the income from the energy production of the wind farm over the lifetime of the project. If there is a net profit, the project has a chance to succeed.

- **Site preparation**

build access roads and clear the areas where turbines will be erected; then prepare the foundations; do the excavating, followed by installing the formworks and pouring concrete.

- **Construction**

The wind turbine parts are manufactured and pre-assembled into the main components at the factory then shipped to the wind farm site where the final assembly will take place. When all components have been received, the assembly can take place. A crane is used to erect the tower and install the nacelle and rotor with its hub and blades. On the ground, the electrical collection network is installed and connected to the grid through the substation.

- **Commissioning**

Finally, the wind turbine is tested, all components are calibrated on site and verified against the suppliers specifications, before becoming fully operational.

Wind energy and the Environment

In this section, both the positive and negative aspects of wind energy will be discussed

Positive environmental benefits of wind energy

It must be stressed that wind energy involves no combustion or nuclear reaction, so it is pollution free. It is renewable and plentiful and free, and what is more it is available everywhere, especially in remote areas and often it is windier in mountains and near costal areas. There are significant environmental benefits obtained from using a renewable energy device attributed to preventing the release of green house gases associated with fossil fuels. The general equation for estimating the reduction in emitted gas is:
Gas-emission reduction (in tonnes) = A x 0.8 x h xkG

Where

A	is the rated capacity of the development in kW
H	is the number of operational hours per year, = 8000h
kG	is the specific emitted gas constant.

Hence the following equations are used to predict environmental benefits from based on 1 kWe system:

CO2 emission reduction (in tonnes)	=1x0.8x8000x862/10^6 = 5.5
SO2 emission reduction (in tonnes)	=1x0.8x8000x9.9/10^6 = 0.063
NO2 emission reduction (in tonnes)	=1x0.8x8000x862/10^6 = 0.018

Negative Impacts of Wind energy

These issues are often raised, some are valid, some are opinion driven, and others could be due to personal preferences or biasness

a) Noise

wind turbines rely on the movement of rotor affected by wind to rotate the generator and make electricity. Virtually everything with moving parts will make some sound, and wind turbines are no exception. Turbines are an established and well developed technology, and well designed wind turbines are generally quite in operation, and compared to the noise of road traffic, train, aircraft and construction activities, the noise from wind turbines relatively low. Outside the nearest houses, which are at least half a mile away, and more often further, the sound of a wind turbine generating electricity is likely to be about the same level as noise of leaves rustling in a gentle breeze. This is similar to the sound level inside a typical living room with a gas fire switched on, or the reading room of a library or in an unoccupied, quiet, air- conditioned office.

Source/Activity	Indicate noise level db (A)
Threshold of hearing	0
Rural night-time background	20-40
Quiet bedroom	35
Wind farm at 350m	35-45
Car at40mph at 100m	55
Busy general office	60
Truck at 30mph at 100m	65
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

There are two potential sources of noise related to wind turbines : the turbines blades passing through the air as the hub rotates, and the gearbox and generator in the nacelle. Noise from the blades is minimized by careful attention to the design and manufacture of the blades. The noise from the gearbox and generator is contained within the nacelle by sound insulation and isolation materials.

Preliminary recommendations from the Wind Turbine Noise Working Group, established by the DTI in the UK, are that turbine noise level should be kept to within 5dB(A) of the average existing evening or night-time background noise level. A fixed low level of between 35 and 40 dB(A) may be specified when background noise is very low, ie. Less than 30dB(A).

b) Bird-kill

This is a very emotionally charged subject. Bird conservationists tend to view wind turbine as death machines and refer to bloody bird corpses lying at the foot of the turbine towers and entire species migrating from the areas surrounding wind farms.

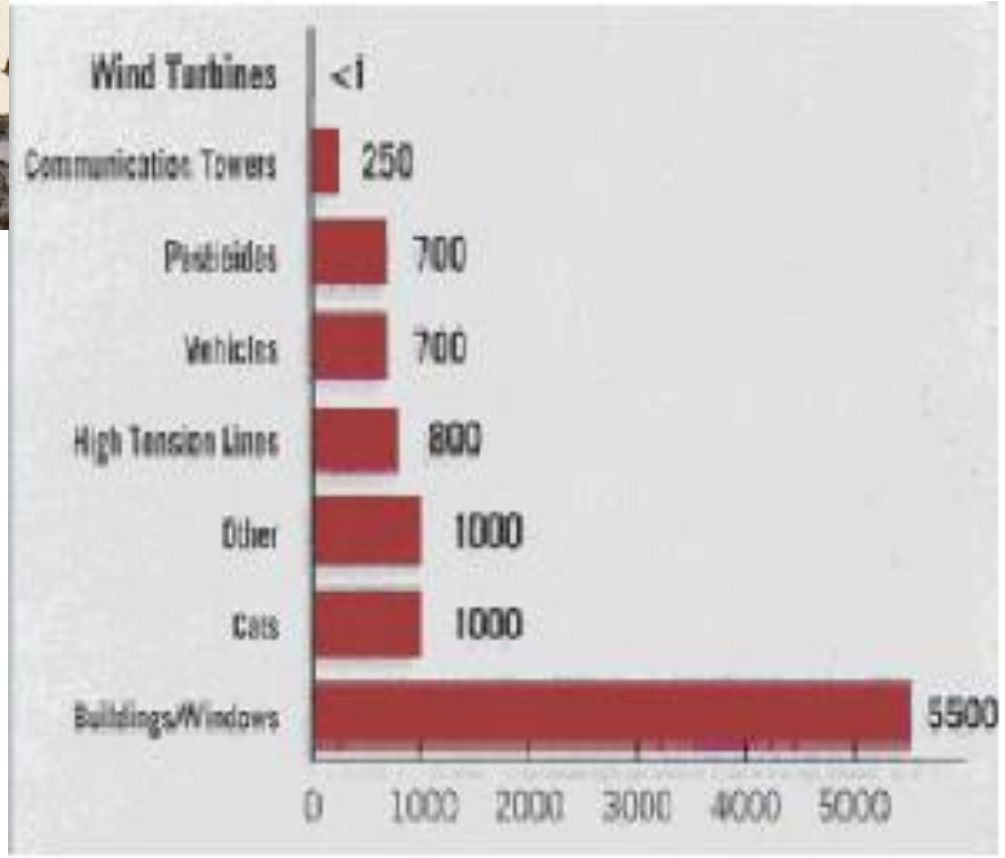
Birds occasionally collide with wind turbines, as they do with other tall structures such as buildings. Detailed studies and monitoring following construction, at wind development areas indicate that this is a site-specific issue that will not be a problem at most potential wind sites. Also, wind's overall impact on birds is low compared with other human-related sources of avain mortality.

c) Visual impacts

wind turbines are just normal structures to look at, just like trees, better looking than boiler chimneys.

in comparison to other energy developments, such as nuclear, coal and gas power stations or open cast coal mining, wind farms have relatively little visual impact. Wind farm developers recognize that visual impact can be a concern for neighboring communities. Considerable effect is therefore committed to the planning stages in order to reduce the impact and gain their consent

Causes of bird-kill



A number of national wind energy associations have established detailed best practice guide lines for the development of wind farms, including their visual impact.

Surveys of public opinion show that mot people who live near wind developments find them less intrusive once they are operating than they might have feared beforehand. Other surveys, for instance in Scotland, have shown that there is no evidence that tourism is seriously affected by the presence wind farms. The authors experience is the opposite to that, I found myself going to places never thought I would, for the simple reason to see how the wind turbines work and enjoy the view of clean energy machine.

Although a wind energy project can spread across a large total area, it does not occupy all that space. Farming or leisure activities can still continue around the turbines. The European Wind Energy Association has estimated that the number of wind farms required to contribute 20% of Europe's electricity supply would take up only a few hundred square kilometers

d) Shadow Flicker

is occasionally raised as an issue by some people. A wind turbine's moving blades can cast a moving shadow on a nearby residence, depending on the time of the year (which determines how low the sun is in the sky) and time of day. It is possible to calculate very precisely whether a flickering shadow will in fact on a given location near a wind farm, and how many hours in a year it will do so. Therefore, it should be easy to determine whether this is a potential problem.

e) Communication interference

wind turbines, like all structures, can interface with communication or radar signals when these signals are interrupted by the turbine structure or the rotor plane. Wind turbines can sometimes cause electromagnetic interference affecting TV and radio reception. Electromagnetic interference can be caused by near-field effects, diffraction, or reflection and scattering. Such interference can typically be mitigated by using satellite TV or wireless cable TV. Although instances of TV or radio interference are infrequent and typically straightforward to mitigate, the interaction of wind turbines and navigational or defense radar signals is the subject of considerable recent attention.

A number of tools and practices are available to manage or mitigate the potential impact of wind turbine interference:

- Farm layout optimization, terrain masking, or reduction of the radar cross-section area may be sufficient to address identified interference problems.
- Coating equipment with absorbent or reflective materials to minimize the turbine's radar signature.
- Often the easiest and least costly approaches involve software optimization. Other options include installing post-processors or adding hardware (such as processors, transmitters, or receivers). When such changes alone are insufficient, more involved approaches can sometimes be implemented. These include deploying extra radars to cover the shadow spots, relocating radar installations to accommodate the new wind farms, or altering air traffic routes around new wind farms.

Even with these mitigation methods, there will be some proposed locations where wind turbines will cause disruptive radar interference. In such cases, wind projects would likely be unable to proceed at the proposed site.

“Not” a perfect place to site a windfarm