



IRISH ENERGY CENTRE
RENEWABLE ENERGY INFORMATION OFFICE

SHINAGH HOUSE, BANDON, CO. CORK, IRELAND. TEL: (023) 42193 FAX: (023) 41304

Environmental (and Other) Impacts of Wind Turbines

Wind energy is an environmentally friendly method of producing electricity. Wind energy can be used to displace fossil fuels in generating electricity, and hence avoid pollution. No harmful gases are emitted when generating electricity with wind turbines - it is clean. And there will always be wind; it is inexhaustible and renewable. However, harnessing energy using wind turbines can have some environmental impacts, although in comparison to conventional power plants they are relatively minor and always restricted to the immediate locality.

Proper project design and site selection, appropriate planning conditions and consultation with local people and other interested parties should help reduce negative impacts. The turbines typically only use 3% of the Wind Farm land surface area (about 100 m²/MW), so that the land can usually retain its original use (livestock grazing, tillage or natural). At the end of their operating life, the wind turbines can be removed with almost no trace.



The main potential impacts are outlined here.

1. VISUAL IMPACT

Wind turbines are large structures that must be placed in areas free of obstructions, making them very conspicuous. Turbines will tend to be sited on hills, mountains and coastal areas, where the wind speeds are higher, and must be spread out so that they do not obstruct each other. Because of this, the visual impact of a wind farm is its most serious and obvious environmental impact.

Most forms of electricity generation have drawbacks. For example, the air pollution and greenhouse gases resulting from oil/coal/peat/gas generated electricity can't be seen, but is serious in terms of impact on human health and on the environment. With wind power, what you see is what you get. Wind farms are clean, and very visible.

There are measures that can be taken to reduce visual impact:

- areas of unique scenic beauty are not recommended as wind farm sites
- turbine layout should avoid turbines appearing one behind the other from main visibility points
- consider local screening (e.g. with tree plantings) from some local points of visibility within 1 – 2 km of wind farm
- turbines should be painted off-white or light gray with a matt finish
- blades should be left to spin when the turbines are off
- the number of machines should reflect the landscape of the site
- non-linear layouts may be more suitable where the topography is uneven
- all the turbines should be of similar size and design, with blades rotating in the same direction
- other structures (transformers) should be within the tower if sizing allows
- on site, cabling should be underground to avoid a cluttered look
- the site should not be fenced off (except normal livestock fencing)

2. NOISE

Virtually everything with moving parts makes noise, and wind turbines are no exception. Some older turbines had problems with mechanical noise from the nacelle and were far noisier than modern machines, and in some places have given wind energy a bad reputation for noise.

Nowadays most wind turbine noise comes primarily from the movement of the blades in the air. High winds tend to mask this sound, so it is more noticeable at lower wind speeds. Modern wind turbines have rotor blades aerodynamically designed specifically to reduce noise. Wind Turbines can be supplied at certified and tested sound power levels which allow accurate prediction of noise levels at given distances from the wind turbine.

- In the middle of a wind farm - the noisiest part - the sound from the turbines would be around 50 - 60 dB, about as loud as a busy office.
- At 200 m, the sound would be about 45-50 dB, quieter than a car at 100m.
- At 400 m, the sound would be as loud as leaves rustling in a gentle breeze.

Distance is the single biggest factor in determining the impact of a wind farm on nearby homes. There is unlikely to be any significant effects at distances over 400 m, although due to unusual topographical features, homes can sometimes be affected at greater distances. Noise can be accurately predicted in advance.

| Source/ Activity | Indicative noise level dB (A) |
|-----------------------------|-------------------------------|
| Threshold of hearing | 0 |
| Rural night-time background | 30-40 |
| Quiet bedroom | 35 |
| Wind farm at 350m | 35-45 |
| Car at 40mph at 100m | 55 |
| Busy general office | 60 |
| Truck at 30mph at 100m | 65 |
| Pneumatic drill at 7m | 95 |

3. ARCHAEOLOGY

There is a potential impact on the character of an archaeological site; this should be assessed as part of the visual impact assessment. There is a recommendation that a distance of at least three times the height of the turbine should be allowed between the two, so that the turbine will not physically dominate the archaeological site; however, a distance greater than this may be required for visual reasons. With a sufficient distance between the nearest wind turbine and an archaeological site (perhaps up to 1½ times the turbine height), there is no physical threat to the site.

Wind farms are most often constructed on greenfield sites, which could hold interesting finds for archaeologists. It is recommended that an archaeologist be present or notified during excavation work.

4. BIRDS

When wind farms and their impacts were less familiar, caution was urged in relation to bird life, because the potential impact on them was not clearly understood. Since that time, many detailed studies have been carried out, which on the whole conclude that wind farms have a very insignificant impact on birds nesting or breeding, or on bird mortality.

Studies in Germany, Denmark, the US and the UK have shown that wind turbines do not pose any substantial threat to birds, bats, or insects. At a near-shore Danish wind farm, which borders a sensitive, protected site for Eider Ducks, it was found that approximately 1% of bird deaths were due to collision with wind turbines. This was a three year study, followed by a further two year monitoring study, which confirmed its findings.

In conclusion, each wind farm site must be carefully evaluated before construction, but overall, the risk to birds from wind turbines is very small.

5. FLORA & FAUNA

Wind turbines and their associated infrastructure, e.g., site tracks, typically use between 2% and 3% of the land area covered by a wind farm. It is very unlikely that operational wind farms will have any significant impact on flora and fauna. However, this should be thoroughly assessed by a qualified ecologist beforehand, with particular attention being paid to the construction phase and to birdlife. The access tracks to the site are likely to have a far greater impact on the ecology than the wind turbines.

6. CONSTRUCTION

Most of the impacts of construction are temporary for the duration of the work. There need be no permanent effects if proper mitigation and remedial measures are implemented.

The main impacts on the environment due to construction are:

- a) damage to vegetation and turf due to construction vehicles
- b) extra local traffic due to construction vehicles
- c) damage to the local road network due to traffic of heavy vehicles
- d) difficulty in re-establishment of vegetation after excavation
- e) noise from construction machinery

All these impacts can be mitigated by careful planning and management, including the following measures:

- a) the movement of construction vehicles across the site can, if required, be confined to pre-defined areas necessary for construction; once site roads are completed, vehicles could be required to use them at all times, with other aspects of the construction being timed so that roads are structurally viable before other works are carried out.
- b) traffic generated during the course of construction is temporary in nature, and will not have a permanent effect on the local traffic levels; however the transport of mud and dust from the site on to the surrounding public road network should be addressed. The paving of the site road on the approach to the public road can assist this problem.
- c) the local authority can and regularly does require the developer to pay a bond in advance of construction, as a condition of the planning permission, in order to ensure the proper re-instatement of the approach roads. Prior work may also be necessary, and is paid for by the developer.
- d) where excavation is required, the over-lying turf can be preserved if this is considered necessary, and re-laid on banks afterwards. Excavated material can often be used for the construction of banks, for the re-instatement of the site, and for landscaping.
- f) because the site will have been chosen so that no dwelling-houses are near enough for turbine noise to be an issue, this distance will assist in mitigating the effects of construction noise. Such noise is most likely to occur during daytime hours only.

7. DECOMMISSIONING

The life span of a wind turbine is about 20 years, and occasionally up to 30 years. At this stage, the turbines can either be replaced or removed.

Thus, wind farms will not have a permanent impact on the environment. Turbines can be removed as quickly as they are erected (about one per day). The foundations, site tracks, and underground cabling can be removed and the site reinstated, but it is generally recommended that foundations are simply covered over, and that tracks and cabling be allowed to remain.

The scrap value of the turbines will generally cover a proportion of the cost of decommissioning. Sometimes a bond is requested by the local authority at the time of the grant of planning permission.

8. ELECTRICITY NETWORK

A wind farm could have a positive effect on the local electricity network. Where the grid is weak, it can have the effect of strengthening it. A wind farm can provide an electricity supply for industry that otherwise could not site itself in a particular location; or it can allow for the expansion of an existing industry that could not otherwise have gone ahead.

Having a local power station can assist in preventing power cuts. Where there is partial failure on the high voltage network, and demand on the substation is greater than remaining available electrical capacity, an operating wind farm can prevent local consumers from being affected.

If there are severe problems with meeting electrical demand in an area, some areas may have to be switched off temporarily. This is most unlikely to happen in an area with an embedded generator, because of its valuable electricity contribution.

Wind farms in Ireland range in size from 2.64 MW to 25 MW - enough electricity for 1700 to 16000 households, respectively.

For wind farms now at various stages of planning, the turbine sizes proposed are generally 1 MW and above, serving approximately 650 households each.

9. ELECTRO-MAGNETIC RADIATION

Wind farms may have a minor impact on electro-magnetic radiation, but in a different way to that which is generally perceived.

Wind turbines emit a negligible amount of electro-magnetic radiation. The turbine is a generator, which generates electricity at low voltage, just as a diesel generator does. It emits no more electro-magnetic radiation than a diesel generator; in fact, very considerably less, because the metal housing acts as a protective shield; also the generator is usually quite a distance overhead.

All European electrical equipment must conform to strict standards for electro-magnetic radiation (EN 5011 and EN 61000). The vast majority of wind turbines are of Danish or of German origin.

The impact that is of more concern is the effect wind turbines could have on electro-magnetic signals emitted elsewhere.

a) the blades could physically block some signals

b) the blades could act as an unwanted relay transmitter, meaning that a TV could get an extra "ghost" signal

However, it should be emphasised that this is a very rare occurrence indeed, and has not been found at any of Ireland's existing 22 wind farms, as far as the REIO is aware.

These rare effects would be generally limited to an area a couple of hundred yards wide by one to two kilometres long. More importantly, they can generally be easily predicted and avoided by careful siting, or easily and cheaply remedied. They should be assessed prior to construction.

The kinds of signals affected can include:

- *microwave (e.g., T.V.) signals*: these are generally quite narrow signals, travelling in a straight line, and a turbine could simply be moved a little to one side to avoid a problem
- *mobile phone signals*: are generally quite robust, and not affected, as they are designed to operate in an urban environment, where interference is more the rule than the exception.
- *Radar, and airport traffic control signals*: these can be affected by wind turbines, so wind farms will generally not be allowed on a site where this might occur.
- *UHF and VHF television signals*: as described above, wind farms can occasionally affect these signals. This has been found to be infrequent, and is cheaply remedied, by, for example, using a more directional kind of aerial. The developer will generally cover these costs.

10. SAFETY

There is a remote chance of a damaged rotor blade being thrown from a wind turbine, or of ice flying from the blade in extremely cold conditions. The wind farm should be designed and sited such that no occupied lie within the possible trajectory range of the blade.

- No member of the public has ever been injured or killed by a wind turbine.
- Any injuries or deaths that have occurred have been to construction or operation & maintenance staff who failed to observe manufacturers' and operators' instructions.
- The risk of being hit by turbines, turbines parts, or ice fragments, within a distance of 210 m, is 1:10,000,000, comparable to the chance of being hit by lightning.
- The minimum desirable distance between wind turbines and occupied buildings, calculated on the basis of visual impact and expected noise levels, will always be greater than that necessary to meet safety requirements.

11. WATER AND AIR

a) HYDROLOGY

The potential impact is on the 1 - 2% of land developed, particularly the access tracks. The impact is likely to be minimal, but care should be taken in constructing interceptor drains on the uphill side of access tracks. The drains should then be culverted to the downhill side to avoid erosion. It is recommended that, where the site drainage pipes connect to existing streams, silt traps should be used. Ideally, the traps should be constructed from natural stone.

b) AIR AND CLIMATE

There are no emissions from a wind farm, and so it does not affect the local air quality. This is in contrast to the quantities of pollutants emitted by burning fossil fuels such as coal, oil, peat, and gas.

No carbon dioxide is released into the air during the operation of a wind farm. Again, this contrasts with the carbon dioxide released by the burning of fossil fuels, which is responsible for global warming.

Since the primary means of generating electricity in Ireland is by the burning of fossil fuels, and the demand for electricity is increasing steadily with economic growth, the construction of a wind farm means avoiding the negative effects of generating electricity from conventional means.

12. MATERIAL ASSETS

a) TRAFFIC

There is likely to be little or no effect on local traffic, with one to two trips a day being likely to be generated by staff performing day-to-day caretaking duties.

b) AGRICULTURE

Apart from the 1 - 2% of the land taken up by the development, the wind farm will have no effect on grazing, turf-cutting, or any other farming activities, which can all proceed as before. Livestock is in no way affected. In Europe, farmers plant crops right up to the base of the turbines; in Ireland, sheep and cattle graze right around the wind farms.

c) WASTE

Minimal waste is generated on site. Oil in the machines is changed annually; this should be disposed of carefully. It is important for developers to keep a wind farm well maintained and litter-free, as this could otherwise create a poor impression.

13. OTHER IMPACTS

a) TOURISM

There is no evidence to suggest that wind farms detract tourists and indeed many wind farms have become tourist attractions in themselves. While insufficient study has been made in this area in Ireland, international studies show no overall impact of wind farms on tourism.

In The Netherlands, wind farm cycling holidays are popular and in the UK walking and hillwalking around wind farms is promoted. Due to demand, some wind farms have had to build tourist centres.

In Ireland, all the wind farms regularly have visits (which should generally be arranged beforehand). In Northern Ireland, the wind farms have had 15,000 visitors, mostly schoolchildren, with up to 700 children per wind farm per day on special Open Days.

b) MOVING SHADOWS

When the sun shines, the rotating rotor blades make moving shadows. Normally this effect is only visible very close to the turbine. However at some sites with a flat, even landscape, shadows may be cast over some distance for a limited period on sunny winter days, when the sun is low in the sky. This may be inconvenient if the shadow is cast onto a house window. Correct positioning of wind turbines, and a minimum distance from dwellings should be sufficient to avoid this problem. Alternatively, if shadows cause inconvenience for only a small number of hours a year, the wind turbine can be deactivated at those times without too much loss of production. A building would have to be in the radius of approximately 400 m - 750 m, to have any possibility of being affected.

Summary

The local impact of wind farms must be given proper consideration, but that should always be balanced against the global benefits of avoiding greenhouse gas emissions and air pollution. A 1 MW Wind Turbine can provide enough electricity for 650 homes and will avoid 175 tonnes of slag and ash and the emission of **2,500 tonnes** of the greenhouse gas CO², 30 tonnes of Sulphur Dioxide and 10 tonnes of Nitrous Oxide per year, helping us to meet our Kyoto Protocol targets and to preserve our environment.

Please support the harnessing of the energy in the wind, and from other renewable sources.

Further reading

The Renewable Energy Information Office has a range of publication covering all renewable energy technologies, including a fact sheet on wind energy:



Irish Energy Centre
Renewable Energy Information Office
Shinagh House, Bandon, Co. Cork
Tel: 023 42193; Fax: 023 41304
Email: renewables@reio.ie
Web: www.irish-energy.ie/reio.htm