Wind Energy

Practical Guide

Wind is a natural resource which we can harness and convert to electrical energy by wind turbines. This energy can help offset the use of fossil fuels, which release greenhouse gases (GHG) as they burn. Wind turbines have a much lower carbon footprint compared to generating electricity in a conventional power station. Lifecycle assessments for onshore wind predict roughly 15 g of carbon dioxide for every kilowatt-hour (kWh) of electricity.

For the lifespan of a turbine (around 20 years), power will be produced sustainably and in an environmentally benign way.

Parts can also be replaced and turbines refurbished and recycled to extend the operating life.

This Practical Guide looks at how to develop a medium scale wind turbine. Note: other scales of development may be appropriate at your site, however the basic principles still apply.

Key facts...

- **Wind energy is an important part of the fight against climate change and turbines have become a common sight in the landscape.**
- **Suitably windy sites provide the best development options. Payback can be made from offsetting onsite demand or selling the power to the grid or industry.**
- **Development comes with high risks and not all planned sites will go ahead.**
- **The risks can be taken by an external developer who may pay a rental for the use of the land.**

Is your site suitable?

- Is the site windy? Is the site exposed and, ideally, distant from trees/ buildings?
- Is there a high voltage grid connection nearby and if so is there capacity on the line for new generation? Do you have a high onsite demand?
- Could the large lorries carrying the turbine parts access the site?
- Are there any other constraints, e.g. is the site in proximity to an airport, radar station, communication mast? Is the site away from houses?
- Is the area of landscape significant? Are there rare birds or protected species nearby?

If the answers to the above questions are encouraging then the site may be worth evaluating more closely.

Farming for a Better Climate

Our Practical Guides cover five useful topics:

1. Use energy and fuels efficiently
2. **Renewable energy**
3. Lock carbon into soils and vegetation
4. Making the best use of nutrients
5. Optimise livestock management

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Riaghaltas na h-Alba
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Wind Energy

Wind Turbines

Wind energy is currently one of the more accessible and developed technological ways of generating renewable electricity for those with a suitable site. In the UK, the average wind speeds are generally high compared to mainland Europe and in exposed locations, especially further north, can be significantly above the 7 m/s (about 15 mph) wind speed at turbine hub height, which is normally the minimum speed required for economic development.

Modern turbines are highly complex machines that use computer control systems to keep the rotor facing into the wind. As wind speed is greater as distance from the ground increases, a higher tower and larger diameter rotor will improve output.

A medium sized commercial scale turbine for a farm in the UK may have a tower height of 50 m and a rotor diameter of 48 m, giving a tip height of 74 m and a rated power output of 800 kW. The wind industry is moving to larger turbines, for example: a turbine rated at 2.3 MW could be on a tower of around 60 m and have a rotor of 80 m in diameter. One unit, therefore produces almost as much as three smaller turbines, which may be a better fit with landscape characteristics.

Diversification

On-shore wind turbines are commonly installed on farmland or forestry because they must be far enough away from houses to avoid noise becoming an issue. In an area with a good wind speed, a turbine can generate a sizeable power output for the developer.

An 800 kW turbine working at rated output would generate 7 million kWh per year, if the wind blows continuously at the speed required to give the rated output. Obviously this will not always happen. The actual output would normally be of the order of 30% of the theoretical maximum depending on the actual site wind regime. This gives an output of around 2.1 million kWh for the 800 kW machine.

Smart Export Guarantee (SEG) ensures you are paid something for exporting to the grid. Payment opportunities include Power Purchase Agreements (PPA) where firms buy your electricity; the opening up of energy markets may provide other opportunities. Suitable metering and other conditions may be required to receive these payments.

Greater savings will be possible where power is used on-site to meet high demand and offset imported energy. This is particularly true at times of escalating energy prices. Battery storage and green hydrogen also offer opportunities to maximise onsite generation as these technologies develop.

Development Costs

The project costs involved for each 800 kW turbine are around £1.6M to £1.8M fully installed, though could be higher if a reasonably priced connection to the grid is not available.

Grid connection can itself cost in excess of a million pounds. A high grid connection charge usually means that more turbines have to be installed to spread the cost. Speak to the grid operator as they are developing new technologies and mechanisms to allow more renewable generation to join the network.

The cost of all the **preparatory work** can be high; for a single medium scale turbine this could be in the region of £30k. At any point in the process toward planning consent, extra expenditure may be required and if consent is not granted all costs incurred will be lost.

An alternative is to allow an **external developer** to take the risks in exchange for an annual land rental or payment. Income from this varies depending on the particular deal and it is worth looking for the best offering.

FAQs

Q. ***Can wind power ever be efficient if only 30% of the theoretical output is actually achieved?***

A. Annual output is the important measure of a wind turbine. Like most harvesting machines they only operate when there is a crop to harvest. Conventional power stations have a low capacity factor when the energy cost of extracting the fuel from the ground, converting it to electricity and removing the waste heat via cooling towers is considered.

Q. ***How will the National Grid cope if there is no wind across the country?***

A. Currently the system has to cope when a power station breaks down, so extra capacity already exists. If the proportion of wind energy production greatly increases then more power storage systems will be needed.

Q. ***My local wind farm often has some turbines not working even when the wind is blowing - why is this?***

A. Grid capacity and demand is often limiting so wind farms may install more turbines than the grid can cope with in times of strong wind, and only use all when the wind is relatively light. Maintenance might be another reason.