Wind Energy

Practical Guide

Farming for a Better Climate

Wind energy is a natural resource generated from temperature differences caused by the sun and converted to electrical energy by turbines. The energy produced replaces energy generated from fossil fuels, which release greenhouse gases (GHG) as they burn. A 'medium scale' wind turbine of 800 kW supplying electricity to the grid can save in the region of 1000 tonnes of CO_2 per year compared to generating the electricity in a conventional power station.

Energy is needed to create and install the turbines, however, this is typically replaced within the first three months of use. For the rest of the life of the turbine (around 20 years), power will be produced sustainably and in an

Key facts...

- **Wind energy is an important part of the fight against climate change and turbines have become a common sight in the landscape.**
- **In windy sites developments can be very economically attractive.**
- **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.**

This Practical Guide concentrates on how to develop a medium scale wind turbine and help reduce GHG emissions.

Note: other scales of development may be appropriate at your site. The basic principles still apply.

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?
- Is the site away from houses?
- Could the large lorries carrying the turbine parts access the site?
- Are there any other constraints, e.g. site in proximity to an airport, radar station, communication mast, etc.?
- Is the area of landscape significant? Are there rare birds or protected mammals nearby?

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

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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www.ipcc.ch

www.carbontrust.co.uk

www.energysavingstrust.org.uk

www.renewableuk.com

https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy

www.microgenerationcertification.org

www.snh.gov.uk/docs/A301202.pdf

www.renewableenergyonfarms.co.uk

www.agrecalc.com

The European Agricultural Fund for Rural Development: Europe investing in rural areas
Scottish Government Riaghaltas na h-Alba gov.scot
SAC CONSULTING
SRDP Farm Advisory Service

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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.

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. Income from this varies depending on the particular deal but is likely to be less than 10% of the revenue generated by the turbine.

Wind Turbines

Wind energy is currently one of the more accessible ways of generating renewable electricity for those with a suitable land holding. In the UK the average wind speeds are generally high compared to mainland Europe and in exposed locations, especially further north, wind speed 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. The power available from the wind increases greatly as its speed increases and because wind speed increases 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. This may suit the landscape better.

Diversification

On-shore wind turbines are commonly installed on farmland or forestry areas because they have to 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 income for the developer.

Typical income from wind turbine

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.

Assuming the energy generated can be sold to the National Grid for around 4.91 p/kWh, and the income from Feed In Tariffs (FITs) is about 3.88p/unit (April 2017), the total income will be around £184k per turbine per year. Greater savings will be possible where power is used on-site to offset imported energy. Tariffs are subject to change and are designed to encourage renewable developments.

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 hard - why is this?*

A. Grid capacity 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.