WIND ENERGY EXPLAINED

Frequently Asked Questions

Common Myths

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Who we are

At E.ON UK, the company that runs Powergen, we are committed to playing a leading role in how we shape and deliver energy in a way that will protect our environment and the needs of our customers. As part of our commitment, we plan to invest £1 billion in renewable technology over the next five years.

We are sourcing an increasing proportion of our electricity from renewable sources and operate 20 onshore and offshore wind farms, producing enough clean renewable energy to supply the homes of a city the size of Manchester.

We own the largest hydro power station in England and Wales on the river Rheidol in mid-Wales and we also burn carbon neutral biomass fuel alongside coal at Kingsnorth and Ironbridge power stations.

In 2004, we completed one of the country's first large-scale offshore wind farms, situated off the coast of Great Yarmouth in Norfolk, generating power for over 41,000 homes.

In addition to this, we're building the UK's largest dedicated biomass power station at Steven's Croft near Lockerbie which will generate enough electricity for around 70,000 homes and prevent the emission of 140,000 tonnes of greenhouse gases every year.

Last year, we announced the launch of our new marine team which will look at new technology to harness the power of the tides and waves.

Our reference sources

This pack is designed to give simple answers to frequently asked questions and common myths regarding wind power. To support our position we have used facts and figures from the following independent and highly respected bodies.

Sustainable Development Commission (SDC), www.sd-commission.org.uk

The Sustainable Development Commission is the Government's independent advisory body on sustainable development, reporting to the Prime Minister and to the First Ministers of Scotland and Wales. Through advocacy, advice and appraisal, SDC help put sustainable development at the core of Government policy.

British Wind Energy Association (BWEA), www.bwea.org

The BWEA is at the heart of the wind energy industry in the UK. Established in 1978, BWEA is now the largest renewable energy body in the UK, representing more than 310 companies active in the sector. BWEA takes an active interest in all issues affecting the industry from financing, planning and electrical infrastructure to winning 'hearts and minds' and undertakes political lobbying and stakeholder engagement on behalf of its members. BWEA represents industry at home and abroad, to Government, regional bodies and local authorities throughout the UK, to the business community, the media and the public.

European Wind Energy Association (EWEA), www.ewea.org

EWEA is the voice of the wind industry - promoting the best interest of the sector in Europe and worldwide. EWEA members include manufacturers covering 98% of the global wind power market, as well as component suppliers, research institutes, national wind and renewables associations, developers, electricity providers, finance and insurance companies and consultants. The combined strength of more than 250 members from over 40 countries makes EWEA the world's largest renewable energy association.

Friends of Earth (FoE), www.foe.co.uk

Friends of Earth is one of the UK's most influential national environmental campaigning organisation. A unique network of campaigning local groups, working in over 200 communities throughout England, Wales and Northern Ireland and the most effective environmental network in the world, with almost one million supporters across five continents and over 60 national organisations worldwide.

Frequently asked questions

GENERAL

Why is the UK setting targets for increasing the use of renewables?

Renewable Energy is clean, free, indigenous and will never run out. The Government recognises the many benefits of green energy and is actively supporting the growth of renewable generation to tackle climate change and encourage a more sustainable approach to energy use. It has set a target for 15.4% of electricity supplied in the UK to come from renewable energy sources by 2015/2016. In the Energy review that was released on 11 July 2006, the Government is considering increasing the target to 20% by 2020.

This is a demanding target and, at E.ON, we are committed to making a significant contribution. We have invested millions in developing new renewable generation including building the UK's largest dedicated biomass power station in Scotland and developing onshore and offshore wind farms with a capacity of more than 1,300MW.

> *"Several factors are driving the shift towards renewable energy sourcing, and the setting of targets for increasing our use of them. Firstly, we have climate change and emissions reductions targets. Secondly, supplies of traditional fuels such oil and gas are becoming more expensive, and the UK's reserves are in decline. We need to strengthen our energy security. Finally, the advent of the EU Emissions Trading Scheme will make the use of fossil fuels – especially carbon-intensive coal – less attractive in future. This is because a price is being placed on carbon emissions providing financial incentives to minimise these in all industrial processes, including electricity generation."* ***(SDC, 2005c, p.6)***

Why wind enegy?

Onshore wind is the most commercially viable renewable energy technology in the world today. The offshore industry is constantly developing and huge advances have been made. In the UK, we have the best wind resource in Europe and theoretically we have enough to generate three times our annual electricity usage.

> *"Wind power is clean, natural and will never run out. There is more than enough onshore and offshore practical wind resource to meet current renewable energy targets from wind alone. The technology to extract energy from the wind is a tried and tested method and is available to help combat climate change now."* ***(SDC, 2005b, Q.4)***

Can wind turbines alone tackle climate change?

The UK faces major challenges of securing reliable energy supplies and reducing its climate changing carbon emissions. Renewable power will play an important role in meeting these challenges, alongside increased energy efficiency in our homes and investing in cleaner power generation.

At E.ON we recognise the extent of the challenge we face and the role we have to play. We're standing up to that challenge by investing in the next generation of renewable energy sources alongside low carbon technologies and energy efficiency.

> *"Increasing our use of clean energy sources will make a vital contribution to reducing the impact of climate change. But other strategies must also be pursued, primarily boosting our energy efficiency."* ***(SDC, 2005c, p.6)***.

Why not build smaller wind turbines?

Technology has developed and advances now mean that we can install fewer but more powerful turbines to generate the same amount of clean electricity.

The first turbines we installed in 1992 are 0.225MW and have a total height of 45 metres to blade tip. The latest ones we have installed are 2.75MW, have a total height of 120 metres to blade tip and can generate 10 times more electricity.

> *"At a given site, a single modern wind turbine annually produces 180 times more electricity than its equivalent twenty years ago."* ***(EWEA, 2006, p.8)***

Why not site all wind turbines offshore?

It's important that we secure a mix of renewable sources of energy which includes both on and offshore wind farms.

The economics and technology for building and installing onshore wind farms is proven while the technology and know-how to build offshore wind farms is still growing. Construction of wind farms offshore is more complicated than on land due to the variable nature of the seabed and the range of different sea conditions.

At E.ON we remain fully committed to developing more onshore and offshore wind farms in the UK.

> *"At present, onshore wind is more economical than development offshore. Furthermore, offshore wind farms will take longer to develop, as the sea is inherently a more hostile*

*environment. To expect offshore to be the only form of wind generation allowed would therefore be to condemn us to missing our renewable energy targets and commitment to tackle climate change". **(BWEA, 2004)***

Why not build more nuclear power stations and/or increase energy efficiency measures instead?

To combat climate change and secure a reliable energy supply we will need to use every tool in the box. That means that we will need to produce energy from a range of renewable sources that are already available, increase our commitment to energy efficiency and develop a new generation of lower carbon power stations. At E.ON, we are committed to playing a leading role in how we shape and deliver energy in a way that will protect our planet and meet the needs of our customers.

*"Reducing the nation's demand on the National Grid – through energy saving, and changing our everyday behaviour – is not an optional extra in the drive to tackle climate change effectively. Energy saving and renewable energy production must work in tandem if we are to achieve targets for reducing greenhouse gas emissions – in the UK and elsewhere." **(SDC, 2005c, p.6).***

*"Even if we decided to build new nuclear plants now, it would take at least 15 years by most estimates for them to start operating. We need emissions reductions now, and wind projects can be constructed much more quickly. Regardless of what happens with nuclear power, we still need all the renewables we can get, with wind power as a major contributor." **(SDC, 2005b, Q.7)***

STATISTICS

How many wind turbines are there in the UK?

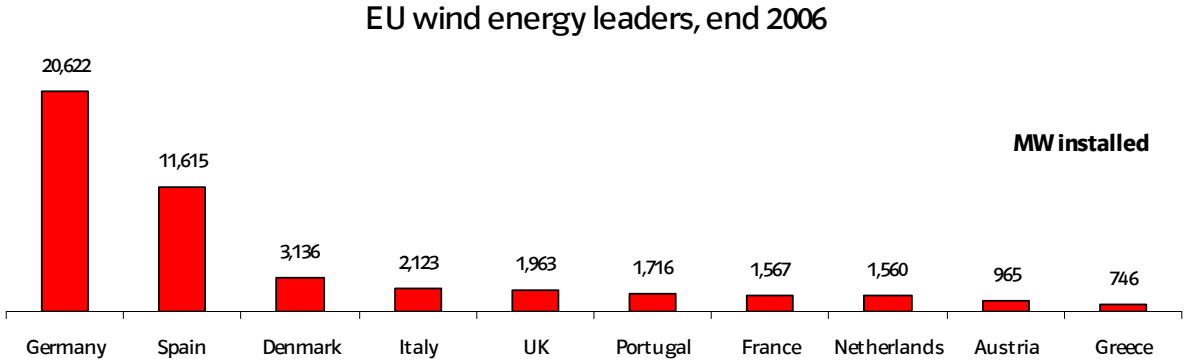
In the UK we get about 4% of our power from renewable energy sources. This includes about 1.3% from wind power **(DTI, 2005c)**. There are 137 operational onshore and offshore wind farms in the UK. In total there are 1769 wind turbines generating electricity. They have an overall capacity of 2034.85MW and produce enough electricity for 1,137,784 homes **(BWEA, 2007)**[*].

E.ON own and operate 20 onshore and offshore wind farms. We have a total of 219 wind turbines generating enough electricity to supply over 139,000 homes.

[*] correct as of March 2007

What is the progress of wind energy in other EU countries?

Europe is the world's leading wind energy market with a total installed capacity of 48,027 MW. European companies are world leaders in the manufacture of wind turbines and their components. The following graph shows the 10most successful EU counties **(EWEA, 2007)**:



In Germany wind power accounts for about 5.7% of national electricity demand. Spain gets around 8% of its electricity from wind power and in Denmark wind power already satisfies 20% of electricity consumption **(EWEA, 2006, p.19)**.

> *"Germany has been the world leader in wind energy deployment since the mid-1990s. In Spain the installed wind capacity already exceeds nuclear and combined cycle gas, and will this decade overtake coal and large hydro."* ***(EWEA, 2006, p.19)***

How many wind turbines are required to reach 2010 targets?

The UK has the best wind resource in Europe. This means that wind energy, alongside other renewable power such as biomass and marine technology, can play a vital role in meeting the Government's target to generate 15.4% of the UK's power from renewable sources by 2015/2016.

Assuming that the additional capacity will come from 2MW onshore wind turbines, that equates to 2,983* additional wind turbines needed to achieve the 2010 target **(BWEA, 2007)**. In total, about 4,770 onshore wind turbines could supply three-quarters of the 10% by 2010 target.

> *"Wind energy's key role in delivering the UK's renewables policy means that the sector is expected to supply three-quarters of the 10% by 2010 target, equivalent to some 8,000 MW of capacity."* **(BWEA, 2005)**

* correct as of March 2007

How many households electricity demand does a wind turbine meet?

On average a 2 MW wind turbine could generate enough electricity in a year for up to 1,000 homes.* As technology develops, the amount of energy one turbine can produce will grow.

*Assumptions: Capacity factor: 27%, annual generation: 2MW * 27% * 8760h = 4,730MWh. Typical household electricity consumption: 4.7 MWh/year **(Digest of UK Energy Statistics, 2004)**

How much CO_2 emissions per year is offset by a wind turbine?

A 2MW wind turbine could save up to 2,000 tonnes of CO_2* in a year, that's the same as about 7,000 return trips from London to Edinburgh in a petrol car**. And the bigger the turbine, the more CO_2 it will offset.

*Assumptions: Capacity factor: 27%, annual generation: 2MW * 27% * 8760h = 4,730MWh, grid electricity converting factor: 430 kg CO_2/ MWh**. (DEFRA, 2005)**

** National Energy Foundation, CO2 calculator

How long does an onshore wind farm take to develop and build ?

The length of time depends on a number of factors including the location and the scale of the wind farm but it usually takes about four to five years to develop and build an onshore wind farm.

The consultation process with the local community, planners and statutory consultees can take around two years, including the preparation of an Environmental Impact Assessment and a planning application.

Planning decisions typically take six months for local applications (schemes below 50MW) but sometimes well in excess of a year for Section 36 applications (schemes generating more than 50MW), where applications are made to the DTI, the Scottish Executive or the National Assembly for Wales.

Once a developer has gained consent, it typically takes about 12 months to carry out procurement, satisfy pre-construction planning conditions and gain investment approval for a scheme. Construction and commissioning typically take a year for an onshore wind farm.

At E.ON, we're committed to best practice and closely consult with the local community, planners and stakeholders when we put forward a proposal.

Common myths

ENVIRONMENT

Wind farms are forced through with no regards to environmental concerns

At E.ON we take every step to ensure our wind farm proposals are developed with the greatest care for the local environment and the community. Early consultations are carried out to make sure that our schemes have a minimal impact on the local environment and are designed in a way that is sympathetic to the landscape.

We ensure that we follow best practice and produce an independent Environmental Impact Assessment which looks at the potential effects on the local environment. The results are published in an Environmental Statement which is made publicly available through the planning process.

> *"For larger wind farms (usually those over 5MW), developers are required to produce an independent Environmental Impact Assessment. This investigates specific concerns such as potential effects on landscape, noise and wildlife that the Council and other appropriate bodies have identified. The results of the EIA are published in an Environmental Statement (ES), a publicly available document that is used by the Council to assess the proposals when reaching a decision on relevant planning applications."* ***(SDC, 2005, p.44)***

Wind turbines spoil the landscape

At E.ON, we always carry out detailed landscape impact studies and avoid sensitive areas. Ourd evelopers undertake significant assessments of the visual effect on the landscape when preparing planning applications as part of the Environmental Impact Assessment process. This allows for a full and independent assessment of the turbines' potential effects by the Planning Authority and other appropriate bodies.

> *"Our willingness to save energy and reduce our dependence on traditional means of power generation will help to safeguard the landscape for the use and enjoyment of future generations."* ***(SDC, 2005c, p.9)***

> *"If we don't switch to cleaner forms of energy, climate change will severely and irrevocably alter much of our landscape and the animal and plant life it contains."* ***(FoE, 2005, p.13)***

Wind turbines kill birds and harm wildlife

At E.ON, we always work closely English Nature, Scottish Natural Heritage, the Countryside Council of Wales and the RSPB to ensure that wind farm design and layout does not interfere with sensitive species or wildlife designated sites.

> *"Available evidence suggests that appropriately positioned wind farms do not pose a significant hazard for birds. The RSPB insists that all wind farm proposals are subject to rigorous environmental assessment before development is permitted and that the effects of any approved developments are monitored before and after construction."* ***(RSPB, 2005)***

Wind farms harm agricultural livestock

Experience shows that farm animals fully adjust to the wind turbines and no change in their behaviour has been observed.

> *"Wind farming is popular with farmers, because they can continue to use their land for growing crops or even grazing livestock, as sheep, cows and horses are not disturbed by the turbines."* ***(DTI, 2007)***

Wind farms take up huge land areas

Wind farms take up less space than people think and the area around the turbines can be used for farming.

> *"A typical wind farm of 20 turbines might extend over an area of 1 square kilometre, but only 1% of the land area would be taken out of use, the remainder can be used for other purposes, such as farming or as natural habitat."* ***(BWEA, 2004)***

It takes years to pay back the energy used for the production/installation of wind turbines

Depending on factors such as the local wind resource of the wind farm site and the turbine model, the payback time varies between 3-10 months of operation.

> *"The 'energy pay-back' or the time that wind turbines take to produce the electricity consumed during their life cycle -from production and installation through to maintenance and finally decommissioning- has been estimated at 3-10 months."* ***(SCD, 2005, p.18)***

There are environmental impacts from new power lines and access roads

The impact from new roads is assessed as part of the Environmental Impact Assessment that we carry out at the early stages of development. Access roads are built only when there are no existing roads that can be used.

How we connect the wind farm to the electricity network is dealt with as a separate planning procedure and will be subject to the usual consultation processes.

Wind farms affect the traffic levels to and from the site

During the construction of a wind farm increased traffic is to be expected as components and workers travel to site. After the work is complete there will be no significant increase in the amount of traffic going to the site. At E.ON, we do everything we can to ensure local disruption is kept to a minimum.

SOCIETY

Wind farms are unpopular

The results of surveys into public attitudes to wind farms are remarkably consistent. They typically suggest that 70-80% of the UK public support wind farm development. Those who live near operational wind farms tend to be even more positive, with support levels of up to 94% being recorded.*

> *"More than eight out of ten people are in favour of wind energy and less than one in ten against it. However, this 5% often have the most to say and certainly say it the loudest, which often gives rise to the misconception that wind energy, is unpopular and unwelcome."* ***(BWEA, 2004)***

*TNS/DTI UK Attitudes to Renewable Energy Distributors

Wind farms harm tourism

Despite the construction of wind farms across the UK, there is no convincing evidence to suggest any adverse impacts on tourist numbers.

Ourown experience suggests that wind farms can be good for tourism. Our information centre for Scroby Sands Wind Farm attracts around 35,000 visitors a year.

*"91% of tourists questioned said presence of wind farms would not effect whether they would return to an area. 55% of those who had actually seen wind farms felt their impact was generally or completely positive. Only 8% felt their impact was negative." **(MORI/BWEA/SRF, 2002)***

Wind farms harm house prices

There is no evidence to suggest that wind farms have a long term impact on house prices.

*"Any price fall diminishes with time, and prices generally recover after the wind farm has been up and running for two years. **(RICS, 2004, p.3)***

Wind farms do not create jobs

Where possible, E.ON uses local contractors thereby creating jobs for local people. Specialist contractors will also need to stay close to the site, bringing in trade to local shops and hotels, guest houses and B&Bs.

*"Work undertaken by the DTI as part of its 'Renewables Supply Chain Gap Analysis' indicates that around 8,000 people are currently employed in the renewables industry, with the potential for this to rise to around 35,000 over the longer term." **(DTI, 2005c)***

Wind farms bring no benefits to the local community

E.ON is committed to working with local communities. Apart from offering an annual community fund for the lifetime of the wind farm, E.ON engages the local community from the very early stages of every project so that local people can discuss their needs and have a clear idea of how they will benefit.

*"Wind power developments have the potential to increase rural incomes through rents on land leased to wind developers. Wind projects can also bring economic benefits to a community through community benefit payments." **(SDC, 2005, p.92)***

Wind developers are simply making profits for their shareholders

E.ON is a business like any other and seeks to make a profit from its activities. If wind farm developments were not profitable, developers would not build them and the nation's renewable energy generation would not be met.

We balance our responsibility to our shareholders with the responsbility we have for our local communities and the environment. Through the development process we ensure that we meet and consult with local stakeholders and their views and concerns are considered and addressed through the wind farm's life.

> *"Carefully developed wind power schemes can have many benefits, not just to the developer and owners, but to local communities, national energy security and global environmental protection. While the majority of wind farms are not community owned, local communities will benefit from the job opportunities they create, and landowners will receive an income."* ***(FoE, 2005, p.16)***

Wind farms are forced through with no regards to local concerns

E.ON follows best practice in public consultation, involving the local community at an early stage through public exhibitions and consultation. We take time to listen and we are happy to address any issues the community has about our schemes.

Through the planning process, the local Planning Authority will assess any local issues raised by the public before it takes any decision and democratically elected Councillors will have the final say.

> *"Pre-planning public consultation can yield benefits for both the developer and the public. The developer will gain a valuable insight into the issues of local concern and can plan the development of the scheme to mitigate any possible negative impacts at an early stage. The public benefits as they learn about the scheme early in the process, have more opportunity to influence the detail of the scheme and have much more time to prepare a response to the proposal.* ***(SDC, 2005, p.92)***

Saying yes to one wind farm opens the door to massive wind developments in the area

This is not the case. The planning system is designed to evaluateand consider the 'cumulative impact' from wind farm developments in an area. There are strictly applied criteria for establishing the capacity of a landscape and every development is judged on its merits.

Wind turbines can cause car accidents as a result of drivers distraction

Evidence from existing wind farms in Britain close to busy roads indicates that turbines do not distract drivers. Wind turbines are almost always sited over a minimum distance which is the same as the total wind turbine height plus 10%from public roads.

Wind turbine components are dangerous for the Health & Safety of local people

Wind farms generate clean, renewable electricity and pose no harm to the local community.

> *"Wind energy has no associated emissions, harmful pollutants or waste products. In over 25 years and with more than 68,000 machines installed around the world, no member of the public has ever been harmed by the normal operation of wind turbines."* ***(BWEA, 2005b)***

ECONOMICS

Wind power is heavily subsidised

Wind power, along with other sources of renewable power, receives support from the government through the Renewables Obligation (RO). This places an obligation on suppliers to source an increasing percentage of their electricity from renewable sources. The cost of the RO is paid by consumers through their bills.

The support schemes for renewable power aim to restore a level playing field in the electricity market. Historically, all new forms of electricity generation have received initial support.

> *"The subsidies being given to renewables now must be contrasted against the huge subsidies (explicit and hidden) given to fossil fuels and nuclear power over the years."* ***(SDC, 2005b, Q.12)***

> *"No electricity generating technology in history has been developed, introduced and become competitive without initial support. The EU recognises that wind power and other renewable sources remain at a competitive disadvantage to fossil and nuclear sources. The support mechanisms for renewable energy in the EU Member States exist to overcome the many current distortions in national electricity markets and between national and regional electricity markets."* ***(EWEA, 2004, p.12)***

Wind power is expensive

The costs of developing onshore wind farms have declined as the technology and the industry has grown and developed. Power from onshore wind is now the most competitive of the renewable energy technologies. Developing offshore wind is now challenging but the industry is growing rapidly.

*"Wind power's competitiveness will improve further still as fossil fuel prices rise due to the decline in reserves and policies that take into account the environmental and social costs of using fossil fuels, which are not currently reflected in their price (e.g. Climate Change Levy, EU Emissions Trading Scheme). If the social cost of carbon is included, the net additional cost of wind power, if it were to fully meet the 2020 targets, is reduced, and could be zero. (**DTI, 2005c; SDC, 2005, p.27**)*

The costs to build back up plants is huge

Wind power does not require dedicated back-up plant or storage. In high levels of wind penetration additional costs mainly derive from maintaining the balance between demand and supply and reinforcing the grid. If the environmental benefits of this cost are included then this is substantially reduced.

*"This is because wind plant is treated as part of the total portfolio of generating plant, and 'balancing services' (services that help maintain the balance between demand and supply) are scheduled according to the overall level of risk, not for individual plants or technologies. A high level of wind penetration will require an increase in balancing services, but this is a cost rather than a constraint – and this cost is a small part of the additional costs of incorporating wind power." **(SDC, 2004b, Q.15)***

TECHNICAL ISSUES

Wind turbines are noisy

E.ON carries out noise assessments in accordance with industry standards to ensure that there will be no noise impact on nearby properties. We will also be subject to a planning condition to ensure that we do not exceed noise levels.

*"The evolution of wind farm technology over the past decade has rendered mechanical noise from turbines almost undetectable with the main sound being the aerodynamic swoosh of the blades passing the tower. There are strict guidelines on wind turbines and noise emissions to ensure the protection of residential amenity. It is possible to stand underneath a turbine and hold a conversation without having to raise your voice. As wind speed rises, the noise of the wind masks the noise made by wind turbines." **(BWEA, 2004)***

Wind turbines create shadow flicker

The possibility of shadow flicker is investigated as part of the environmental assessments carried out as part of the planning process. At E.ON, we ensure that we keep the required distances from properties to avoid any possible negative affect.

> *"Shadow Flicker happens when the sun is low in the sky and shines on a building from behind a turbine rotor. This can cause the shadow of the turbine blades to be cast onto the building, which appears to flick on and off as the turbine rotates. When this flicking shadow is viewed through a narrow opening it is known as shadow flicker. Developers can calculate the extent of this effect using the geometry of the machine and the latitude of the potential site. Shadow flicker only occurs in relative proximity to sites and has only been recorded occasionally at one site in the UK."* ***(DTI, 2005b)***

Wind turbines interfere with aviation and radar systems

At E.ON, we consult with the Ministry of Defence, the Civil Aviation Authority, the National Air Traffic Services and individual airports and aerodromes from the outset to make sure any issues with aviation safety and radar reception are quickly addressed.

> *"Wind turbines can present a hazard to low flying aircraft and may also affect radar and radio navigation systems. However early consultation with all statutory authorities can help successful siting and mitigation decisions to be made. International experience suggests that the UK has some of the strictest policies in place on radar and aviation – these must be justified."* ***(SDC, 2005, p.99)***

Wind turbines interfere with telecommunication systems and TV reception

As with the aviation authorities, we consult with radio communication companies from an early stage to ensure that any issues with telecommunication systems and TV reception are resolved.

TV reception problems are usually very easily and quickly rectified by a developer of a wind farm and there are usually no technical obstacles to sorting things out. A planning condition, should this be deemed necessary by the planning authority, will also ensure that any problems with TV reception are promptly and effectively rectified.

> *"Wind turbines can sometimes cause electromagnetic interference, potentially leading to problems such as 'ghosting' on television screens. Developers putting up signal booster equipment on or around the wind farm site can generally correct this easily."* ***(DTI, 2005c)***

GRID ISSUES

Wind turbines are not efficient

People often confuse efficiency with intermittency. Wind turbines generate electricity from a free fuel that will never run out, but it's not available all the time. This is called 'intermittent generation'. It's t herefore misleading to compare the efficiency of wind energy with conventional power plants which can run when needed if supplied with fuel.

> *"A modern wind turbine produces electricity 70-85% of the time, but it generates different outputs depending on the wind speed. Over the course of the year, it will generate about 30% of the theoretical maximum output. This is known as its load factor. Coal and nuclear plants have a load factor of 65-85%* ***(BWEA, 2004)***

Wind turbines are not reliable

As wind farms rely on the natural resource of the wind, they will not run all the time. However all forms of generation require back up and no energy technology can be relied upon 100%.

> *"No generating plant is 100% reliable. Therefore, reserves are required to cover for unexpected outages on all plants. The rated capacity of the total installed wind plant is of minor interest to system operators, who make supply security assessments based on estimates of overall statistical probabilities for the complete generating mix."* ***(SDC, 2005, p.22)***
>
> *"The total output of all wind capacity will be less variable, as it will be made up of a large number of wind farms spread throughout the country. It therefore follows that greater geographic diversity in wind farm locations is beneficial to the combined output profile of wind power. "(****SDC, 2005, p.24****)*

In Germany they are no longer building wind farms due to grid instability problems

Germany has been the world leader in developing wind farms and has ambitious targets to provide 30% of the nation's electricity from wind energy by 2030*. The UK has the best wind resource in Europe and an electricity grid with wide geographical distribution which means that problems faced in Germany do not apply in the UK.

At E.ON, we are committed to expanding our renewable generation portfolio in support of the Government's targets. It's important that we look at ways of using experiences in other

countries, such as Germany, to tackle the issue of embedded generation, including wind farms and micro CHP systems, as we rewire Britain for the 21st-century.

> *"Germany plans to massively increase its wind energy output from almost 17 GW today to 36 GW in 2015 and 48 GW in 2020 and a recent report confirms that this is technically feasible from a grid perspective and economically very effective. This expansion should deliver 14% of the country's electricity consumption by 2015.* ***(DENA, 2005)***

* (EWEA, 2006, p.18)

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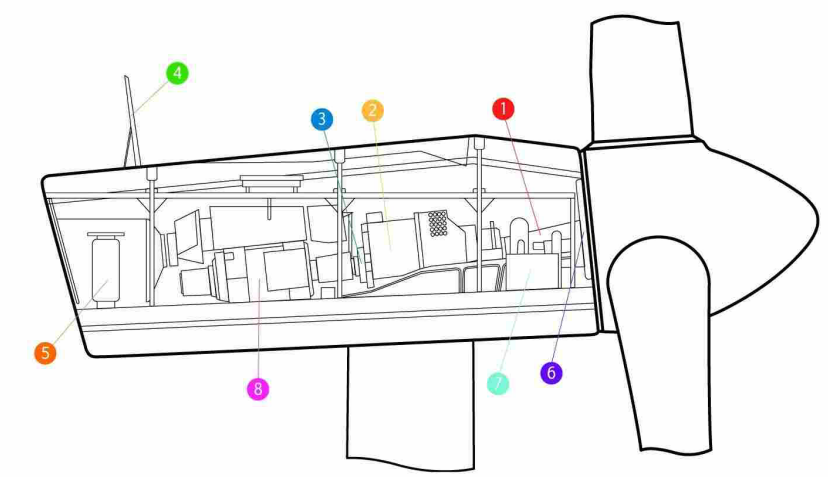
How does a wind turbine work?

As wind blows past the blades, sensors detect the direction of the wind and turn the blades to face it. The blades rotate around a hub which connects to a shaft inside the head, known as the nacelle

The rotating shaft powers a generator to covert the energy into electricity. It's then fed into the cables connected to the electrical grid network for use in homes, schools and industry.



1. Main shaft
2. Gearbox
3. Parking brake
4. Wind sensors
5. Transformer
6. Rotor lock system
7. Hydraulic unit
8. Generator

1. Main shaft:

The main shaft is used to support the rotor and transfer the rotating energy from the rotor to the gearbox.

2. Gearbox:

The blades turn at about 22 revolutions per minute, but the generator needs to spin much faster to create electricity. That's where the gearbox comes in, it really speeds things up

3. Parking brake:

The brake is used to bring the rotor to a stop and hold it there after the blades have pitched to slow the rotor down.

4. Wind sensors:

Wind vane - this measures the direction of the wind to ensure that the turbine is always pointing in the right direction.

Anemometer - this measures the wind speed. This is used by the turbine to control the angle of the blades to ensure the most efficient setting.

If it senses that the wind speed is too strong, the computer inside the turbine automatically shuts the turbine down.

5. Transformer:

This converts the lower voltage (690V) from the generator, to a higher voltage (33,000V) for more efficient transition to the National Grid.

6. Rotor lock system:

This is a safety feature and is used to lock the rotor into position when maintenance activities are taking place within the nacelle and hub.

7. Hydraulic unit:

This is used to generate hydraulic power for use in the blade pitch system and the parking brake.

8. Generator:

The generator converts energy from the rotating blades into electricity.