



General Certificate of Secondary Education
Specimen Paper

General Studies

XXXX/PM

Unit 1 (Case Study)

Case Study Source Material

To be opened and issued to candidates on XXXX.

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- A clean copy of the Source Material will be provided at the start of the Unit 1 examination.

- This Case Study consists of five sources (1 – 5) on the subject of ‘**Preparing to meet Britain’s future energy needs**’. These sources are being given to you in advance of the Unit 1 examination to enable you to study the content and approach of each source, and to consider issues which they raise in preparation for the questions based on this material.
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There is no Source Material printed on this page

Study **all** the information in this booklet.

Preparing to meet Britain's future energy needs

The information in this booklet comprises the following:

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SOURCE 1**Facts & figures**

1. The UK is currently responsible for 3% of global greenhouse gas emissions even though it only has 1% of the world's population.
2. Over a third of the carbon dioxide (54 million tonnes) produced by the UK is emitted from power stations. Currently around 80% of the UK's energy supply comes from finite sources: coal, oil and gas. 15.6 % comes from nuclear sources.
3. The Government has set targets for the percentages of the UK's electricity supply which it would like to see provided by renewable energy sources:
 - 10% by 2010
 - 20% by 2020 ('aspirational' target)
 - Potentially 60% carbon emissions cuts by 2050.
4. The Scottish Executive has set a target for Scotland to supply 18% of its power from renewable sources by 2010 and 40% from renewable sources by 2020.
5. Renewable energy comes from continuously available sources: wind, sun, water, or from renewable organic matter or 'biomass'.
6. Renewable energy sources in the UK now provide 3.86% of the total electricity supply.

Renewable Source	Percentage of UK power	Electricity produced in Megawatts (MW)
Bio-mass (renewable organic matter)	0.94	735
Wind (turbines on land and at sea)	0.83	649
Hydroelectric (rivers and dams)	2.03	1,579
Wave (turbines at sea)	0.006	0.5
Solar (solar panels convert sun's energy)	0.051	4

7. To meet the 10% target by 2010, approximately 10,000 megawatts of additional renewable power generation will be required. This equates to between 5,000 and 10,000 wind turbines, or 200 50-megawatt bio-mass power stations.
8. The British Wind Energy Association (BWEA) estimates that an additional 2,000 onshore turbines are required to meet the onshore wind element of the 2010 target. At present 1,043 wind turbines generate up to 649MW of power.

Source: adapted from *Department of Trade and Industry*, Crown copyright, 2004

SOURCE 2

UK 'needs varied energy sources'

Few of us would care to predict today how we shall be living in 2023.

We have to concentrate on renewables. That way we're in control of our own destiny.

But governments do not have that luxury: they have to try to think what may be happening 20 years from now. Keeping the lights on and the wheels turning in the UK two decades from now depends on decisions taken today.



Source: PA Photos

Middle East oil pipe line

So warnings about energy security are bound to be taken very seriously. The Institution of Civil Engineers (ICE) says the UK could face power cuts in 20 years' time, because it will depend so heavily on foreign energy sources to produce its electricity. The institution says 80% of the gas needed to fuel British power stations will come from distant and "politically unstable" countries by then.

In an ideal world, most countries would by 2023 be well on the way to reliance on clean and renewable energy sources, like wind, wave and solar power.

Nuclear Power Out of Favour

The potential wind energy available in the US is estimated at more than double the amount of electricity generated there today.



Source: JOHN GILES/PA Photos

Coal's day might come again

Solar Century, a UK company which provides solar PV (photovoltaic) installations, makes even more ambitious claims. It says: "Solar PV-generated power could provide 10,000 times more energy than the world currently uses. If we covered a small fraction of the Sahara desert with PV, we could generate all the world's electricity requirements."

The director-general of ICE, Tom Foulkes, says the UK is a long way from the big new gas fields being developed in central Asia and Africa. He says: "Can the security of the UK's gas supply be guaranteed, given that it will have to travel thousands of miles in a series of pipelines that are vulnerable to mechanical failure, sabotage and terrorist attack?"



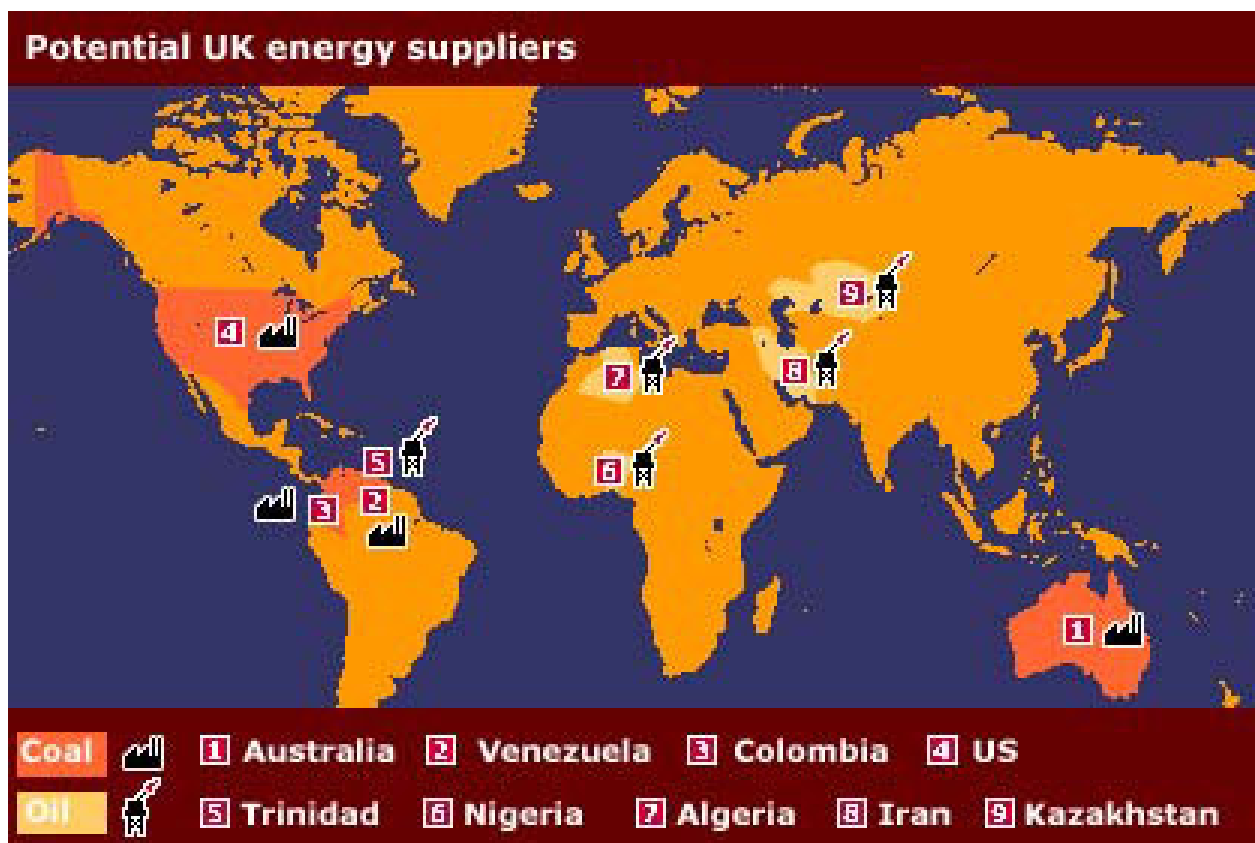
Source: VisionsofAmerica/Joe Sohm, Getty Images

Renewable energy has huge potential

But other analysts are not persuaded that future political instability in the countries supplying Britain's energy need be a devastating threat. John Mitchell is an associate fellow of the UK's Royal Institute of International Affairs (RIIA). He said, "The key to energy security is diversity of supply. I think it is far-fetched to say we face a threat of power shortages. In five years or so we'll have a much clearer idea whether renewables can deliver those very ambitious White Paper targets. If they can't, the only other possibilities will be nuclear power or imports of either natural gas or coal."

Self-reliant answer

Stewart Boyle, an energy analyst, told BBC News Online: "Any country that's over-dependent on a single fuel and a small number of suppliers could be in trouble. The ICE report is timely, and shows we have to concentrate on renewables. That way we're in control of our own destiny. Remember, electricity supplies less than a fifth of our energy needs in Britain. Most of the energy we use is for heating, and that's critical."



Source: adapted from ALEX KIRKBY, BBC News Online environment correspondent, July 2003

SOURCE 3

James Lovelock: Nuclear power is the only green solution**We have no time to experiment with visionary energy sources; civilisation is in imminent danger.**

Sir David King, the Government's chief scientist, was far-sighted to say that global warming is a more serious threat than terrorism. He may even have underestimated, because, since he spoke, new evidence of climate change suggests it could be the greatest danger that civilisation has faced so far.

Most of us are aware of some degree of warming; winters are warmer and spring comes earlier. But in the Arctic, warming is more than twice as great as here in Europe and in summertime, torrents of melt water now plunge from Greenland's kilometre-high glaciers. The complete dissolution of Greenland's icy mountains will take time, but by then the sea will have risen seven metres, enough to make uninhabitable all of the low lying coastal cities of the world, including London, Venice, Calcutta, New York and Tokyo. Even a two metre rise is enough to put most of southern Florida under water.



Source: Greenland's melting glaciers, Alamy Stock Photography

The floating ice of the Arctic Ocean is even more vulnerable to warming; in 30 years, its white reflecting ice, the area of the US, may become dark sea that absorbs the warmth of summer sunlight, and further hastens the end of the Greenland ice. The North Pole, goal of so many explorers, will then be no more than a point on the ocean surface.

Not only the Arctic is changing; climatologists warn a four-degree rise in temperature is enough to eliminate the vast Amazon forests in a catastrophe for their people, their biodiversity, and for the world, which would lose one of its great natural air conditioners.

What makes global warming so serious and so urgent is that the great Earth system, Gaia, is trapped in a vicious circle of positive feedback. Extra heat from any source, whether from greenhouse gases, the disappearance of Arctic ice or the Amazon forest, is amplified, and its effects are more than additive. It is almost as if we had lit a fire to keep warm, and failed to notice, as we piled on fuel, that the fire was out of control and the

furniture had ignited. When that happens, little time is left to put out the fire before it consumes the house. Global warming, like a fire, is accelerating and almost no time is left to act.

So what should we do? We can just continue to enjoy a warmer 21st century while it lasts, and make cosmetic attempts, such as the Kyoto Treaty, to hide the political embarrassment of global warming, and this is what I fear will happen in much of the world.

When, in the 18th century, only one billion people lived on Earth, their impact was small enough for it not to matter what energy source they used. But with six billion, and growing, few options remain; we can not continue drawing energy from fossil fuels and there is no chance that the renewables, wind, tide and water power can provide enough energy and in time.

If we had 50 years or more we might make these our main sources. But we do not have 50 years; even if we stop all fossil fuel burning immediately, the consequences of what we have already done will last for 1,000 years. Every year that we continue burning carbon makes it worse for our descendants and for civilisation.

Worse still, if we burn crops grown for fuel this could hasten our decline. Agriculture already uses too much of the land needed by the Earth to regulate its climate and chemistry. A car consumes 10 to 30 times as much carbon as its driver; imagine the extra farmland required to feed the appetite of cars.

By all means, let us use the small input from renewables sensibly, but only one immediately available source does not cause global warming and that is nuclear energy. True, burning natural gas instead of coal or oil releases only half as much carbon dioxide, but unburnt gas is 25 times as potent a greenhouse agent as is carbon dioxide. Even a small leakage would neutralise the advantage of gas.



Source: Sellafield Nuclear Power Station, Alamy Stock Photography

Opposition to nuclear energy is based on irrational fears fed by Hollywood-style fiction, the Green lobbies and the media. These fears are unjustified, and nuclear energy from its start in 1952 has proved to be the safest of all energy sources. If we fail to concentrate our minds on the real danger, which is global warming, we may die even sooner, as did more than 20,000 unfortunates from overheating in Europe last summer.

I find it sad and ironic that the UK, which leads the world in the quality of its Earth and climate scientists, rejects their warnings and advice, and prefers to listen to the Greens. But I am a Green and I entreat my friends in the movement to drop their wrongheaded objection to nuclear energy.

Even if they were right about its dangers, and they are not, its worldwide use as our main source of energy would pose an insignificant threat compared with the dangers of intolerable and lethal heat waves and sea levels rising to drown every coastal city of the world. We have no time to experiment with visionary energy sources; civilisation is in imminent danger and has to use nuclear - the one safe, available, energy source - now or suffer the pain soon to be inflicted by our outraged planet.

The writer is an independent scientist and the creator of the Gaia hypothesis of the Earth as a self-regulating organism.

Source: adapted from JAMES LOVELOCK © Independent Digital (UK) Ltd. All rights reserved, 24 May 2004

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SOURCE 4

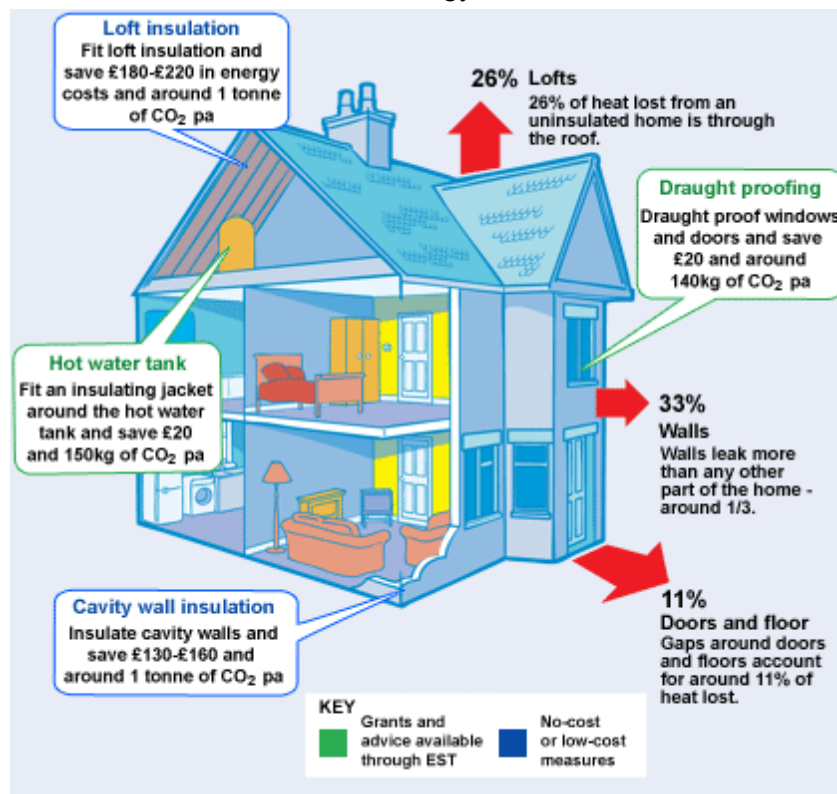
The balance of power

We can still have all the electricity we want in 2020 but we need to learn to love renewables and to conserve energy.

What will happen when the gas runs out, when the deepest oil well of the Arabian Peninsula finally runs dry, when the giant drills of the offshore platforms reach nothing but dry rock? Will we face a future of blackouts and electricity rationing, or will we find a way to continue living lives in which energy consumption is crucial to everything we do.

Think of the electricity you use in a day. You are woken by the clock radio buzzing into life, and you turn the bathroom light on as you climb into your power shower. After dressing you head downstairs, where you turn on another radio, put some bread into the toaster and turn on the kettle, getting the milk from your fridge to put in your tea. After breakfast you head to work, where the lights are burning - and on go the computer and desktop fan.

How to save energy in the home.



Source: © Energy Saving Trust, data from 2006.

Those are just the most obvious of personal uses and the day has barely even begun. How can we possibly sustain such a level of usage? In short: stop wasting the energy we create and use renewable energy sources.

There is no longer any doubt that renewable energies will play a large part in the future of mankind. With these we should be able to maintain our electricity supply and, as a beneficial side-effect, avert the disaster of rapid global warming.

Oil and natural gas will run out. Continuing to use coal is not a solution because it will add to the excessive quantities of carbon dioxide in the atmosphere. Those factors make both renewables and nuclear more and more competitive.

Hydropower is already one of the largest and most established forms of renewable energy, providing 19% of the world's electricity. Of the others, geothermal is a long established and growing energy resource, and wind power is already a mainstream technology. And there are others that are, as yet, underexploited but with great potential: solar is growing fast, and tidal, ocean currents and wave power are also undergoing rapid development.

In Europe, money is being poured into wave and tidal power. Undersea turbines, working on much the same principle as wind turbines, are already in operation in the UK and Norway. Their potential is huge, particularly because all along the Atlantic coast with its large tides, and many inlets and islands, there are countless sites for exploiting the power of the sea. And unlike the winds, tides are completely predictable.

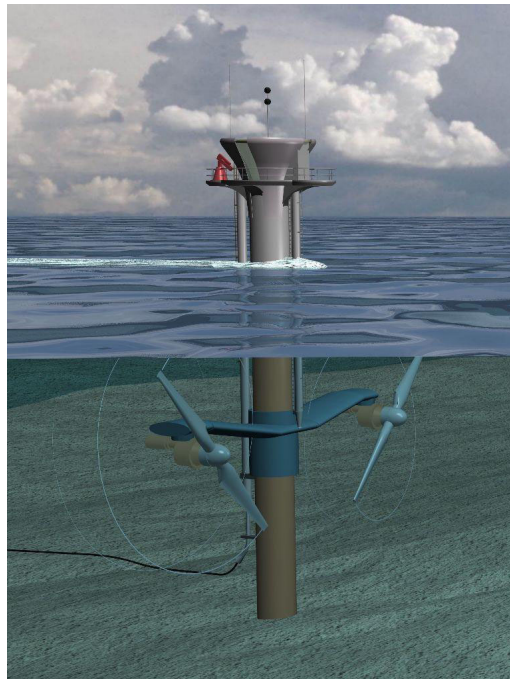
Geothermal technology is increasing in regional importance, particularly in countries that do not have a wind, tidal or wave resource. This heat is as inexhaustible and renewable as solar energy and comes from hot rocks near the earth's surface. Water is pumped into the hot ground and used on its return to the surface to create electricity and for district heating.

And then there is the nuclear question. The nuclear industry rightly claims it provides a reliable source of energy that does not produce the carbon dioxide that fossil fuels do. But nuclear power is still dogged by the old, familiar problems: it takes a long time to take a nuclear power station from the drawing board to production; nor has anyone yet come up with a satisfactory method of disposing of nuclear waste.

Currently there are 444 nuclear reactors worldwide, producing 16% of the world's electricity. Most of the countries that have a lot of reactors - particularly in North America and Europe, with Japan also on the list - have stopped building new ones. As a result the closure programme is exceeding the rate of new building.

The new generation of energy, then, is likely to lie with forces as old as the earth itself: the elemental powers of the wind, waves and sun. The very things that have shaped so much of our past will also help shape our future.

Source: article adapted from PAUL BROWN, Environment correspondent for *The Guardian*, September 2004
Image: courtesy of Marine Current Turbines Ltd.



Marine current turbine

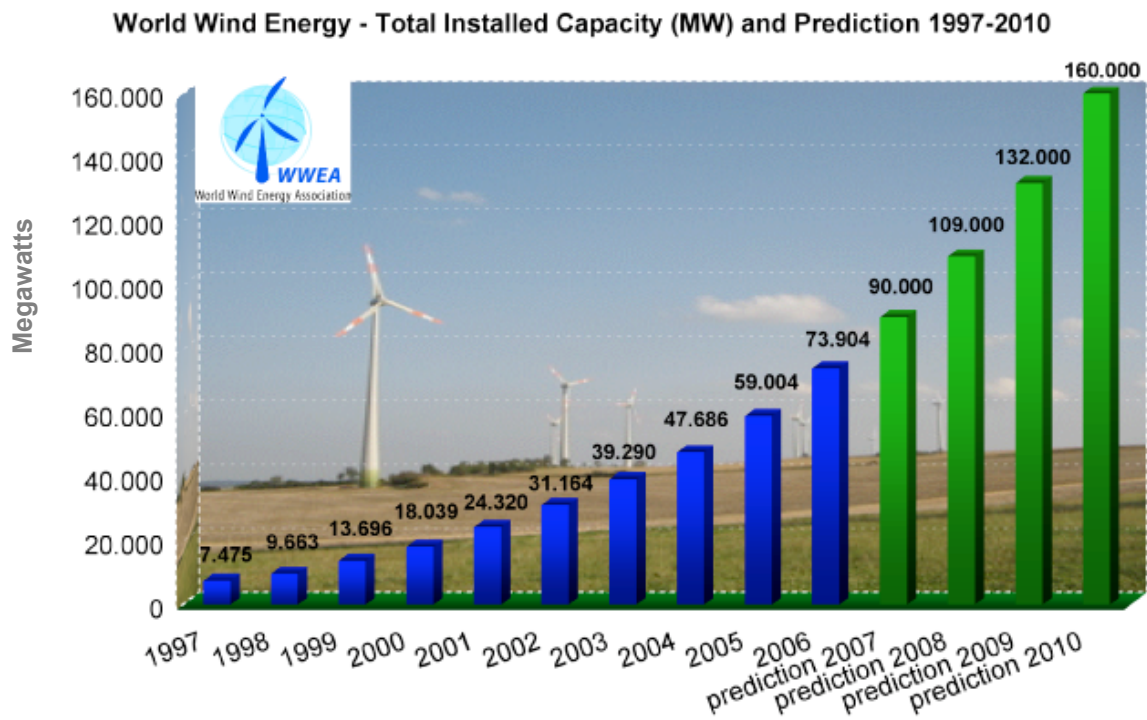
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SOURCE 5

About BWEA

Introducing Wind Power

Man has harnessed the power of the wind since the earliest times. Today, modern wind turbines harness this power in the production of clean and green electricity, with no waste products or harmful emissions, from a fuel that will never run out.

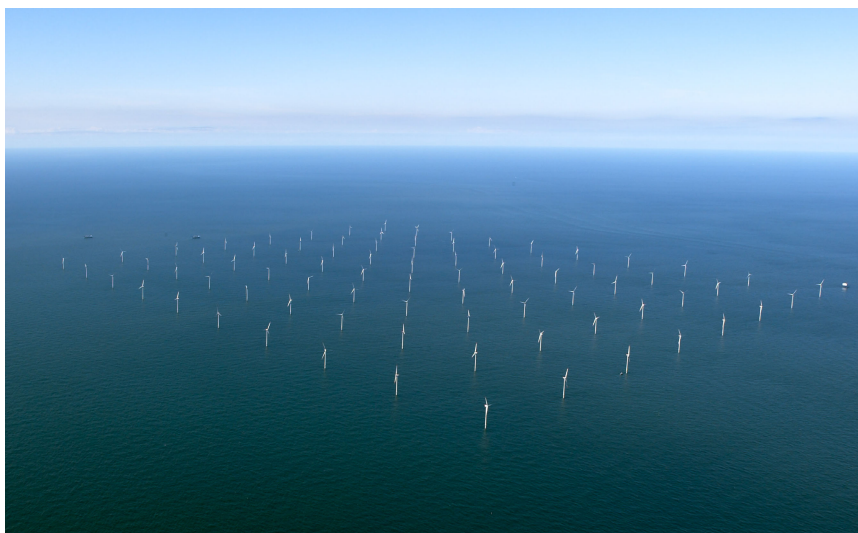


Wind power in the UK generates electricity at some of the lowest prices in Europe, bringing with it many benefits, both environmental and economic. Every unit produced by a wind turbine displaces one that would otherwise be generated from fossil fuels, preventing the emission of several greenhouse gases. Wind turbines in the UK currently prevent the emission of over a million tonnes of carbon dioxide while providing sufficient electricity to meet the needs of well over a third of a million households each year.

The most advanced of the renewable technologies, the role of wind power has been recognised in the UK Government's new energy policy. Targets have been set for 10% of the UK's electricity supply in 2010 to be met by renewably-generated electricity with an aspiration to broadly double this by 2020. Wind energy from both on and off shore sites has been identified as the most important contributor to the 2020 target.



Source: Npower Renewables



Source: © Elsam A/S

Source: © Npower Renewables
ANTHONY UPTON, 2003

A key component of Government's strategy in the move to a low carbon economy, wind power offers the opportunity to create a new industry for the UK. The fastest growing energy source worldwide for seven consecutive years, the power of the wind and the benefits this dynamic industry brings are coming home to the UK, the windiest country in Europe.

Wind Farms of the UK - at a glance						
Projects	Turbines	Megawatts	Homes equivalent	CO ₂ reductions	SO ₂ reductions	NO _x reductions
89	1123	767.4	440,000	1,730,000 tonnes	20,200 tonnes	6,050 tonnes

Renewable energy sources in the UK currently generate almost 3% of the total electricity supply, 15% of which comes from wind energy. New legislation has set targets on the generation of electricity from renewables to 10% by 2010. The UK Government recently announced its intention to increase this to 15% by 2015. Wind energy is one of the best placed technologies to help meet these targets; the UK is the windiest country in Europe with over 40% of the available resource - enough to meet the country's electricity needs several times over.

Notes:

- BWEA is the professional Association for the UK wind industry, representing over 300 companies active in the sector and with a dedicated staff of 12, making this the largest renewables body in the UK.

Source: adapted from *British Wind Energy Association (BWEA)*, 2007
and *World Wind Energy Association (WWEA)*, 2007

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