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RECOGNISING ACHIEVEMENT

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**Advanced GCE**

**CRITICAL THINKING**

Unit F503: Ethical Reasoning and Decision-Making

**Resource Booklet**

**F503**

**INSTRUCTIONS TO CANDIDATES**

- Use Documents 1, 2, 3, 4 and 5 to answer the questions.

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This document consists of **8** printed pages.

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**Document 1**

**Wind Power Generating Capacity**

From 1990–2002, wind has been the fastest growing power source worldwide on a percentage basis, with an annual average growth rate exceeding 30%. In 2003, world wind power capacity passed the 39,000 MW (megawatt) mark and reached 39,294 MW. Wind power plants are heavily concentrated in Europe and the United States, with the exception of India. The 'top 10' nations listed below accounted for over 95% of the total wind energy produced in 2003.

**World Leaders in Wind Capacity (December 2003)**

| Country | Capacity (MW*) |
|---|---|
| Germany | 14,609 |
| United States | 6,374 |
| Spain | 6,202 |
| Denmark | 3,110 |
| India | 2,110 |
| Netherlands | 912 |
| Italy | 904 |
| Japan | 686 |
| United Kingdom | 649 |
| China | 568 |

Source: adapted from: www.awea.org

* 1 megawatt (MW) represents the amount of electricity needed to power 10,000 light bulbs.

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**Document 2**

**A turn for the better**

Steve Rose
*Guardian Weekly* (18.08.05)

Think of wind power and the first image to spring to mind is most likely a giant, three-bladed propeller spinning atop a slim tower, probably in a rural area. Chances are that's actually the only image that springs to mind – and that's a problem. To renewable-energy supporters, the wind turbine symbolises the hope of a green, clean future, but to opponents, they might as well be Martian tripods from "War of the Worlds", advancing inexorably across the precious British countryside.

With Britain's plans for wind farms proceeding apace in an effort to meet the target of 10% renewable-sourced energy by 2010, the debate has reached critical levels. Anti-wind farm groups have been springing up wherever wind farms are proposed; some opponents say they would rather have a nuclear power station in their backyard than see Britain's rural landscape covered in propellers on sticks. And as long as propellers on sticks are the only option, pro- and anti-wind farm camps are unlikely to agree.

The debate is clearly as much about the aesthetics of wind power as the politics and practicalities but, at present, wind turbines barely rank above electricity pylons in terms of aesthetic consideration. Members of the design community are beginning to rise to the challenge, however, either by finding better places to put wind turbines or by making them better looking.

Beyond making better-looking wind farms, there is also potential for integrating turbines directly into buildings. After all, if nobody wants wind turbines in the countryside, why not put them in the cities? Cities already have high-rise structures in which to incorporate turbines, and they would be far more in tune with a man-made environment than a natural one. Added to which there would be less need to transport the electricity large distances to its users.

From *A turn for the better*, © Steve Rose, Guardian Weekly, 18 August 2005

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**Document 3**

**Offshore Wind Farms**

**Pros:**

1 Make an important contribution to meeting the UK's renewable energy targets.
2 Help increase the security of the UK's energy supply.
3 On similar farms in Denmark, the bases of the towers have proved excellent sites for shellfish and have provided a food supply to both fish and ducks. They provide conditions that resemble those of a reef, which provide shelter for young fish.
4 Establish Britain as a world leader in offshore wind technology.
5 Create up to 20,000 new jobs.
6 It is hoped that the new wind farms will provide electricity to one in six homes.

**Cons:**

1 Possible impact on fishing and navigation in the surrounding seas.
2 The Ministry of Defence is concerned that they may cause problems for low level radar.
3 The Royal Society for the Protection of Birds is concerned that migrating birds may be killed by flying into the rotating blades.
4 Building offshore wind farms can be complicated and expensive.
5 As predicted in the Energy White Paper, the cost of electricity bills is likely to increase.
6 During the less windy summer, supply is likely to be unreliable.

(Adapted from: Offshore Winds Round 2, www.bbc.co.uk/climate)

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## Document 4

### Energy Balance of Power

The polling company Populus interviewed approximately 1000 adults in July 2005. Below are the responses to two of the questions they were asked.

1. People were asked: "How much importance do you think that the Government should attach to each of the following factors as they consider how to ensure Britain's future energy needs are met?"

| Clean Air | Total | Male | Female |
|---|---|---|---|
| Very important | 73% | 66% | 80% |
| Fairly important | 21% | 28% | 15% |
| Fairly unimportant | 1% | 1% | 1% |
| Very unimportant | 2% | 2% | 3% |
| Don't know | 3% | 3% | 2% |

| Minimising pollution | Total | Male | Female |
|---|---|---|---|
| Very important | 70% | 62% | 78% |
| Fairly important | 23% | 31% | 16% |
| Fairly unimportant | 1% | 1% | 0% |
| Very unimportant | 3% | 3% | 3% |
| Don't know | 3% | 4% | 3% |

2. The people surveyed were given this statement: "Though wind farms don't emit pollution, they would wreck Britain's countryside because we would need many thousands of huge wind turbines, which can be very noisy."

   They were then asked whether they thought the above statement was persuasive against wind farms or outweighed by other arguments in favour of them.

| | Total | Male | Female |
|---|---|---|---|
| Persuasive | 27% | 29% | 25% |
| Outweighed | 72% | 71% | 73% |
| Don't know | 1% | 0% | 2% |

(Source: adapted from figures collected by Populus Ltd, taken from www.populusltmted.com)

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**Document 5**

American Wind Energy Association

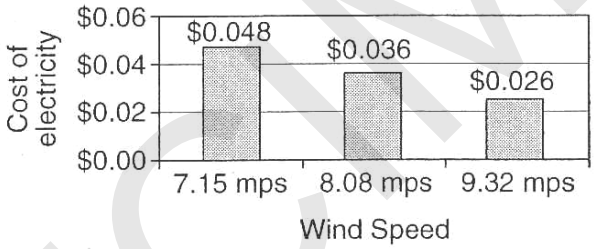
www.awea.org

## The Economics of Wind Energy

A number of factors determine the economics of wind energy and its competitiveness in the energy marketplace.

**The cost of wind energy varies widely depending upon the wind speed at a given project site.** The energy that can be tapped from the wind is proportional to the cube of the wind speed, so a slight increase in wind speed results in a large increase in electricity generation. Consider two sites, one with an average wind speed of 14 miles per hour (mph) and the other with average winds of 16 mph. All other things being equal, a wind turbine at the second site will generate **nearly 50% more electricity** than it would at the first location.

**Cost of Energy and Wind Speed**

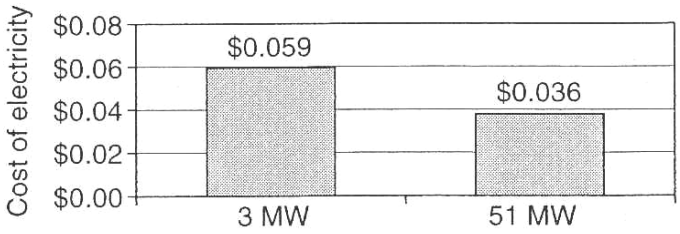



*The three examples above are for costs per kilowatt-hour for a 51 MW wind farm at three different average wind speeds expressed in metres per second (mps).*

**Improvements in turbine design bring down costs.** The taller the turbine tower and the larger the area swept by the blades, the more powerful and productive the turbine. The swept area of a turbine rotor (a circle) is a function of the square of the blade length (the circle's radius).

**A large wind farm is more economical than a small one.** Assuming the same average wind speed of 18 mph and identical wind turbine sizes, a 3 MW wind project delivers electricity at a cost of $0.059 per kWh and a 51 MW project delivers electricity at $0.036 per kWh – **a drop in costs of $0.023, or nearly 40%**. A larger project has lower O&M (operations and maintenance) costs per kilowatt-hour because of the efficiencies of managing a larger wind farm.

**Cost of Energy – Large Windfarm v. Small**

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**Document 2:** Adapted from Guardian Weekly, © Steve Rose, 18 August 2005

**Document 3:** Adapted from Offshore Winds Round 2, BBC website. www.bbc.co.uk/climate

**Document 4:** Adapted from Populus Ltd website, www.populuslimited.com

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