Information on the following potential energy sources will be provided:

Coal – a fossil fuel
Coal is a combustible rock composed mainly of carbon and hydrocarbons. Coal is a non-renewable energy source because it takes millions of years to develop. It was typically formed in non-marine settings from the remains of land vegetation that grew millions of years ago. A coal-fired power plant uses steam or other gas-streams to drive turbines, connected to an electric generator. Coal is a carbon-intensive fuel but is cheap and worldwide reserves are large.

Oil and gas – fossil fuels
Oil and gas are also fossil fuels. Oil and gas are formed from the organic remains of marine organisms which become trapped in sea-floor sediments. Reserves are finite and non-renewable. Oil and gas-fired power plants operate in a similar way to coal-fired power plants. Hydrocarbons are carbon-intensive fuels but have lower CO_2 emissions than coal but resources are more limited.

Nuclear
Nuclear energy is produced by a controlled nuclear chain reaction and generates heat which is used to boil water, produce steam, and drive a steam turbine. The safe storage and disposal of nuclear waste is a significant social challenge. It is considered a sustainable energy source that reduces carbon emissions.

Wind – a renewable energy
Wind turbines use the wind to turn aerodynamic blades that drive a rotor which creates electricity. The electricity generated at any one time by a wind turbine is highly dependent on the speed and direction of the wind. The wind speed itself is dependent on a number of factors, such as location, height of the turbine above ground level and nearby obstructions.

Solar – a renewable energy
There are three main ways that we can use the energy that reaches the Earth from the Sun. Firstly, solar cells convert light directly into electricity. Secondly, solar energy can directly heat water in glass panels. Lastly, huge solar furnaces can generate very high temperatures, which can be used to generate electricity. Solar energy production is relatively expensive but has low CO_2 emissions. However, it doesn't produce energy at night; it can have large setting-up costs, and can be unreliable unless you're in a very sunny climate.

Hydroelectric – a renewable energy
A hydroelectric plant uses falling water to turn a turbine, which then turns a shaft in an electric generator. The advantages of hydroelectric power are: there is minimal pollution; it's renewable–rainfall renews the water in the reservoir; it produces little CO_2. The main disadvantage is the huge amount of water required and a large amount of land is needed to build a dam and a reservoir. The setting up costs for a station is therefore high.

Geothermal – an almost renewable energy
Geothermal energy is energy obtained by tapping the heat of the Earth itself, either from kilometers deep into the Earth's crust or through shallow ground-source heat pumps. It is a natural resource which can be used in conjunction with heat pumps to provide energy for heating and hot water. It is more expensive to build a geothermal power station, but operating costs are low. CO_2 emissions are much lower than gas fired boilers or electric heating systems.

Biomass
Biomass is biological material derived from living, or recently living, organisms. In the context of biomass for energy it usually means plant-based material. Biomass is a renewable, low carbon fuel that is already widely used. When managed correctly, biomass is a sustainable fuel that can deliver a significant reduction in net carbon emissions when compared with fossil fuels.

worldskills uk

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

An environmental science challenge

Natural energy resources and land use conflict

- Inside we set out the key issues surrounding an exciting new Environmental Science Challenge that, through vocational competitions and demonstrations, will raise the level of awareness of environmental issues for young people.
- The aim for 2008/09 is to encourage employers and educational institutions to consider the challenging issues facing our environment, particularly those of climate change and the influence this could have for global energy resources and land use conflict.
- We are working on this project with UK Government Research Councils, and UK Sector Skills Councils and Trades Unions.
- The plan is then to develop the activity to the level required for a Demonstration Skill in EuroSkills 2010 and encourage the participation of other member states to EuroSkills.

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An environmental science challenge in natural energy resources and land use conflict

The world is consuming an ever-increasing amount of resources, but these resources will not last forever. The use of carbon-based fossil fuels also adds significantly to the amount of carbon dioxide (CO_2) emitted to the atmosphere. The problem could be mitigated by the use of low-carbon energy production. Countries' approaches to achieving this decoupling of CO_2 emissions from economic growth are varied with emphasis ranging from the development of renewable energy, such as wind, solar, hydroelectric and tidal systems to increased biomass co-firing and nuclear energy. In addition, ways of reducing overall energy demand are being sought, such as energy saving initiatives and carbon offsetting, and emerging technologies such as geological CO_2 storage and clean coal technologies should be assessed.

The challenge

Who

The environmental science challenge is aimed at young people who have an interest in sustainable natural resource exploitation, sustainable energy production, environmental protection and climate change, and want to gain skills and experience to progress in these areas of scientific research. Potential job roles in the team are: GIS expert, process operator, project manager, project engineer, research scientist, computer programmer and economist.

It is aimed at an **advanced level** of knowledge, equivalent to a level 3 qualification and is planned to be a **live** competition.

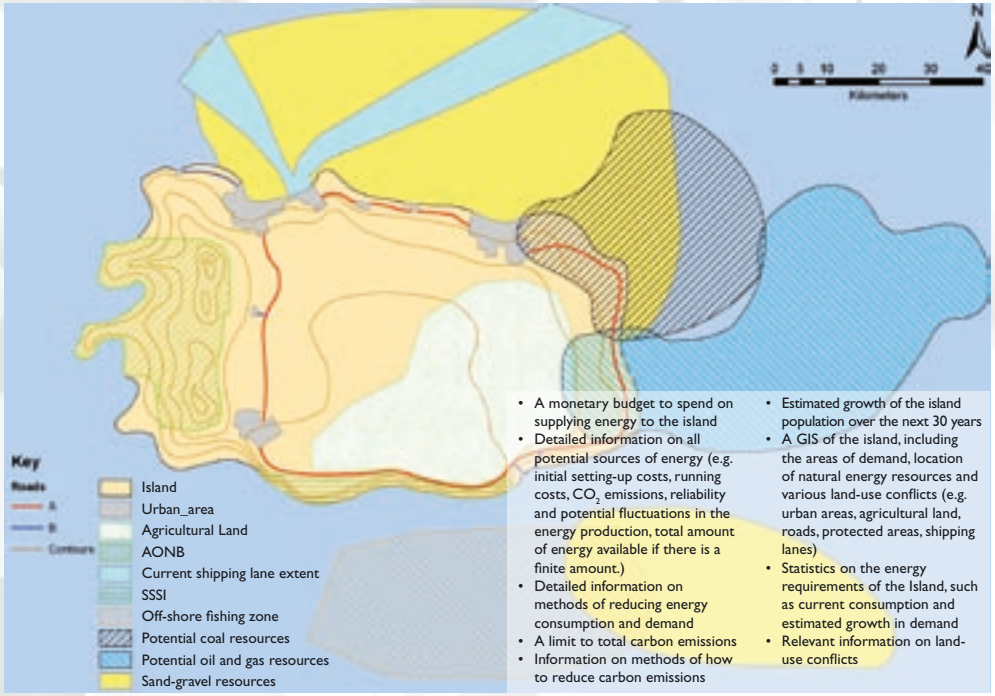
What

The participants will be tasked with devising the 'best' combination of energy supply for a purpose-designed, generic island, for the next 30 years, considering all the information provided. They will have to produce a written 'Island Energy Plan' detailing energy supply to meet the populations demand over this period.

How

The teams will be expected to produce a written report detailing their decision-making process and how they will meet the energy demands of the island. It should include information such as a breakdown of which energy resources will be utilised for each year, including how much of each type, the land-use conflicts they encountered and resolved, and total carbon emissions and costs for each year. There will also be a practical element to the competition.

The competitors will be supplied with the following information:



- A monetary budget to spend on supplying energy to the island
- Detailed information on all potential sources of energy (e.g. initial setting-up costs, running costs, CO_2 emissions, reliability and potential fluctuations in the energy production, total amount of energy available if there is a finite amount.)
- Detailed information on methods of reducing energy consumption and demand
- A limit to total carbon emissions
- Information on methods of how to reduce carbon emissions
- Estimated growth of the island population over the next 30 years
- A GIS of the island, including the areas of demand, location of natural energy resources and various land-use conflicts (e.g. urban areas, agricultural land, roads, protected areas, shipping lanes)
- Statistics on the energy requirements of the Island, such as current consumption and estimated growth in demand
- Relevant information on land-use conflicts

Figure 1 Example Island GIS

Reducing energy consumption

Information will be provided on the following methods of reducing energy consumption on the island:

- Cavity wall insulation
- Low energy light bulbs
- Double glazed windows
- Unplugging/turning off unused appliances e.g. lights
- Lower thermostat temperatures
- Carbon offsetting to reduce overall carbon emissions

Potential conflicts

As well as the conflicts between energy resources, there will be other conflicting issues to be considered by the team, including:

- An underground CO_2 storage site
- On and offshore resources e.g. minerals, aggregates, hydrocarbons, coal, etc
- Environmental designations on the island
- Agricultural land/food supply
- Offshore conflicts such as shipping routes and fisheries
- Location of urban areas (greatest demand) on the island
- Potential sites for energy production

Marking

The competition will last for one-two full days. The competitors will work in teams of three to five. The skills being assessed require subjective marking, involving a panel of judges. Each skill will be given a weighting, demonstrating the importance of this skill in the work place.

- GIS/IT skills
- Analysis of scientific data and identifying relevant information
- Report writing
- Presentation skills
- Team skills

The competitors will be assessed using the following methods:

- Observed whilst completing the challenge
- Based on their written 'Island Energy Plan'
- Based on a final presentation of their plan
- Based on answers to questions following the final presentation

Skills gained

The proposal covers fundamental skills required for many job roles within the science sector. These include:

- Analysis and interpretation of scientific data and maps
- Using a geographical information system (GIS)
- Report writing
- Presentation skills
- Team skills
- Increased understanding of energy resources
- Increased understanding of climate change, fossil fuels and mitigation of, or reduction in, carbon emissions
- Understanding of budgets and economics

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