Rewarding Learning

GCE LEVEL

# FACT FILE

## Environmental Technology

For first teaching from September 2013

For first award in Summer 2014

# Counting the Costs on the Reliance on Fossil Fuels


environmental technology

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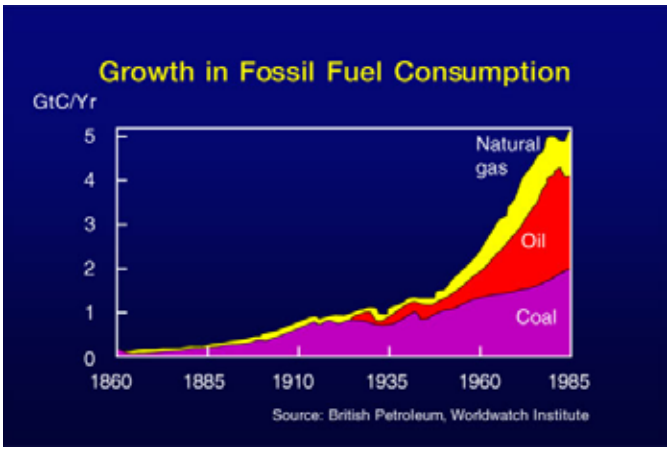
# Counting the Cost of Reliance on Fossil Fuels

## Specification Content

**Students should be able to:**

- recognise the trends in fossil fuel (coal, oil, gas) use in industrialised western countries;
- discuss the global economic impact of key emerging economies (for example Brazil, India, China and Russia) in relation to demand for fossil fuel supplies;
- explain the concept of fuel security and understand how the global demand for finite fossil fuel supplies influences geopolitics across the world; assess the environmental impact resulting from the global use of fossil fuels, with reference to:
  - habitat degradation;
  - impact on biodiversity;
  - air quality reduction; and
  - land and water contamination;

## Course Content




The chart above gives some idea of the growth in the use of fossil fuels on a worldwide basis. It is easy to conclude that the trend has been steadily upwards but contained within this are a number of different factors to consider.

### How much fossil fuel do we actually use?

Consider the information below which is intended as a guide to the type of thing we should consider when attempting to contextualise the extent to which modern society uses fossil fuels. By no means is it intended to be an exhaustive study, simply some examples.

The data is not expected to be completely accurate, but should put our own fossil fuel demand in perspective.

***Activity:*** Use the internet or any personal data you can acquire e.g. the amount of oil used in your home each year, to research and obtain the necessary data e.g.

- Individual household use of fossil fuels,
- The number of households in your town, Northern Ireland as a whole and the UK.

First the relatively easy to quantify costs to the individual household of:

| Fuel Item | Household annual use | |
|---|---|---|
| Petrol / Diesel / LPG vehicle fuel | | litres |
| Home Heating Oil or Gas | | litres |
| Electricity provided through grid | | KWh |
| Coal | | Kg |
| Gas for cooking | | Litres |

Now scale these figures up to the number of households in:

**Your town (Eg Greater Belfast approximately 250000 households)**

| Fuel Item | Household annual use | |
|---|---|---|
| Petrol / Diesel / LPG vehicle fuel | | litres |
| Home Heating Oil or Gas | | litres |
| Electricity provided through grid | | KWh |
| Coal | | Kg |
| Gas for cooking | | Litres |

**Then, the whole of Northern Ireland (Eg Northern Ireland approximately 700000 households)**

| Fuel Item | Household annual use | |
|---|---|---|
| Petrol / Diesel / LPG vehicle fuel | | litres |
| Home Heating Oil or Gas | | litres |
| Electricity provided through grid | | KWh |
| Coal | | Kg |
| Gas for cooking | | Litres |

**And finally, the UK**

| Fuel Item | Household annual use | |
|---|---|---|
| Petrol / Diesel / LPG vehicle fuel | | litres |
| Home Heating Oil or Gas | | litres |
| Electricity provided through grid | | KWh |
| Coal | | Kg |
| Gas for cooking | | Litres |

There are also the not so easy to quantify costs of fossil fuel use for the manufacture of plastic, coatings, paints, man-made textiles. We can use some data from 2006 from the US as a guide [1]

- 329 million barrels of oil was used as fuel in the chemical industry. (4.6% of total usage)
- 2 million barrels were used as fuel in the manufacture of plastics.
- 310 billion litres of LPG was as fuel (only 1.5% of total used).
- 9 trillion litres of LPG used as fuel in chemical industry.
- 19.2 billion KWh of electricity used in manufacture of oil based chemicals (only 1% of US electricity usage).

Consideration should also be given that even goods branded as 'Organic' or 'Eco-Friendly' or otherwise less harmful to the environment may also need fossil fuel use to manufacture, package and transport. It would be extremely difficult to locate goods that had not used fossil fuels somewhere along their supply chain.

## Energy Cost of Public Transport

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Based on data from US urban public transport [2] we can do a rough calculation based on an urban bus doing 10mpg (which is probably very generous) and find that;

- 4.1 billion gallons of diesel alone was used in urban bus transport in 2009 in US cities.

If we add in rail links using diesel or heavy oil, electric trains, buses, trams, ferries we can see the volumes of fuel needed as being astronomically large. We have not even mentioned jets!

- A Boeing 747 will use about 45,000 gallons of fuel for a range of around 7000 miles. If you can research how many 747 miles are flown annually then you can add to the already astronomical fuel use globally.

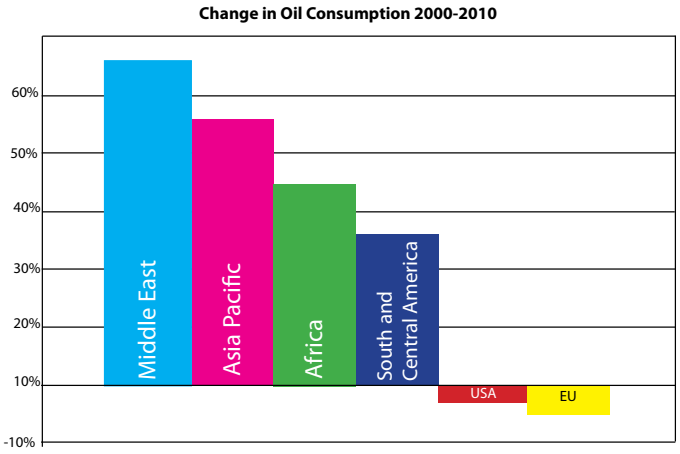
The expected increase from US data [2] showing a 25% increase in public transport will only indicate that the fuel usage for public transport will continue to rise in developed countries. Even if bus companies and governments

encourage renewable fuel public transport, we will still be using fossil fuels at alarming rates for many years to come.

## Activity

Use the link http://data.worldbank.org/indicator/EG.USE.COMM.FO.ZS/countries/1W?display=default to gain an understanding of fossil fuel energy consumption in a number of countries. Using the tabs in the link you can see data covering a range of years which can be presented as a table, graph or map. Use this information to make a presentation which shows the trend in fossil fuel use in industrialised western countries.

### The global economic impact of key emerging economies on demand for fossil fuels




The bar chart to the above shows how demand for oil has changed over the first decade of this century in a range of countries. The developing countries, as they are sometimes called, will continue to have an insatiable thirst for oil well into the future. The link provided with the chart provides some recent data to show just how much oil these developing nations use.

Over the last 10 years there has been a rise of approximately 400% in the cost of crude oil. However, the graph shows that during this period of rising prices that oil consumption in emerging economies such as Brazil, India, China and Russia has increased while in Europe and the United States it has fallen slightly. One explanation is that the per capita oil consumption in emerging economies is much less than in the United States and Europe so as the oil prices rose people from these countries simply made small lifestyle changes such as driving more economical cars, car sharing, use of alternative fuels, technological advances etc. leading to a reduction in the amounts of oil used. In emerging economies as wages increase then more of the population has the opportunity to buy cars etc. and their oil consumption per person has risen.

The demand for oil in emerging economies will continue to grow and this demand will encourage further rises in the price of oil.

## Activity 1

Using the link below the chart and http://www.guardian.co.uk/news/datablog/2010/jun/09/bp-energy-statistics-consumption-reserves-energy compare the oil consumption per person in China and the United States in 2000 and 2010.

### Fuel Security

Fuel security refers to any nation's fossil fuel dependence and the fact that, to ensure an adequate supply, it may be forced to protect foreign sources of oil. The economic performance of a country can depend upon its ability to produce energy using fossil fuels.

If the country in question depends on imports of fossil fuels then it is said to be vulnerable in terms of fuel supply. This can have a major political effect and can lead to military intervention and conflict e.g. the Gulf war. Reliance on imported oil also creates a danger of fuel price changes or shortages if supply is disrupted.

## Activity 2

Using the two links shown below, make a list of the major industrialised countries whose need for oil outstrips their available resources and the countries whose resources are greater than their likely need for oil. Identify the main ways in which those countries dependent on the import of oil are considered to be economically vulnerable in terms of fuel security.
http://www.edfenergy.com/energyfuture/the-energy-gap-security-of-supply
http://www.agmrc.org/renewable_energy/energy/world-and-u-s-fossil-fuel-supplies

### The environmental impact resulting from the global use of fossil fuels

Coal oil and natural gas are made up mainly of carbon and hydrogen. When they are burned the carbon and hydrogen combine with oxygen forming carbon dioxide and water. The carbon dioxide released has been linked with the "green house effect" and its associated change in the earth's climate.

The other major environmental issue associated with the use of fossil fuels is acid rain. Coal and oil also contain small amounts of sulphur. In the combustion process the sulphur combines with oxygen to form sulphur dioxide, which is the largest contributor to acid rain. At high combustion temperatures small amounts of the nitrogen in the air also combine with oxygen to form nitrogen oxides. The sulphur dioxide and nitrogen oxides then react in the atmosphere to form sulphuric and nitric acid which dissolves in water droplets and falls as acid rain.

Climate change has already been linked with habitat changes in many parts of the world e.g. polar regions, with the melting of the icecaps. One of the greatest potential problems that could lead to habitat degradation would be the rise of sea levels if global warming was to continue as some research has predicted. Acid rain not only causes damage to forests but soaks into soil and washes into rivers and lakes causing damage to vegetation, insects and marine life.

These changes in habitat have an impact on biodiversity. Animals such as polar bears are now an endangered species mainly due to global warming and the impact it is having on their habitat and the arctic ecosystem.

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The link below provides information of how fossil fuel use has an environmental impact in a variety of different ways. It was published by the Union of Concerned Scientists.

## Activity

Using the link, or others of your choice, provide a summary of the impact of the use of fossil fuels. Your summary should include details of the following specific impacts of the use of fossil fuels;

- habitat degradation – the effect on plant and animal life;
- impact on biodiversity – the effect on the amount of variation found in species or ecosystems;
- air quality reduction; and
- land and water contamination;

http://www.ucsusa.org/clean_energy/our-energy-choices/coal-and-other-fossil-fuels/the-hidden-cost-of-fossil.html

## References


1. www.eia.gov/tools/faqs/faq.cfm?id=34&t=6
2. www.apta.com/resources/reportsandpublications/Documents/apta_public_transportation_fuel_savings_final_010807.pdf





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