
WJEC Geography A-level

Energy Challenges and Dilemmas

PMT Education

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Resources

Resource Classifications

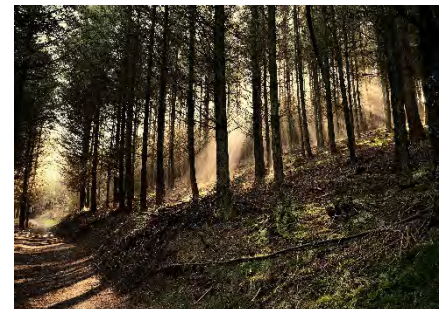
- Resources can be classified into stock sources, being non-renewable such as fossil fuels, or flow resources, which are generally renewable.
- Flow resources do not need regeneration, such as wind power, unlike biomass resources which, albeit being renewable, require vegetation growth.
- Stock reserves develop overtime and go through a cycle of exploration, exploitation and development for human activities.
- Stock resources follow a bell shaped curve of production and have a peak. Once this peak is reached, supply will begin to decrease which hinders growth and development as demand remains high.
- To control supply, there is a growing awareness of sustainable development and all projects above a certain size require an Environmental Impact Assessment so environmental damage is limited.
- Globally, emerging countries, such as India and China, have the largest growing demand for resources with China being the largest consumer in the world of natural resources such as timber and earth metals.

Human Activity Impacts on Resources

- As population growth has been exponential, there has been growing demand for food, fuel and other resources globally. This has led to contrasting regional trends in land use cover as deforestation, afforestation and conversion of grassland to farmland has affected terrestrial carbon stores. This effects the water cycle and soil health.



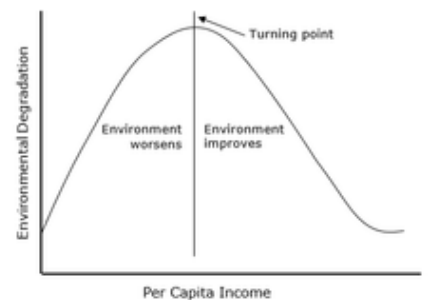
- Ocean acidification refers to the reduction in the pH of the ocean due to the uptake of carbon dioxide from the atmosphere. The ocean's role as a carbon sink



- is increasing due to surges in fossil fuel combustion which has caused a decline in the health of coral reefs and other marine ecosystems whilst polluting freshwater available for drinking.
- Climate change, due to the enhanced greenhouse effect (which is largely anthropogenic), may increase the frequency of extreme weather events such as droughts and floods because shifts to the climate belts. This is likely to impact the health of forests as carbon stores.

Resource Insecurity Implications for Human Wellbeing

- Forest loss has implications on human wellbeing. Forests provide shelter, forestry, food, medicinal plants and stabilise the earth and atmosphere. They also hold rich resources such as woods, minerals and energy sources.
- Though deforestation is a growing problem in developing countries, there is evidence to suggest that forest stores are being more consciously protected and expanded.
- This is especially the case for more developed countries, such as the UK, where conservation is a governmental priority. Additionally, schemes such as 'debt for nature swaps', help to conserve forest stores in developing countries.
- These trends support Kuznets' curve model which concludes that, as a country's GDP and development improves, they will take more actions to conserve and protect the environment.
- Resource insecurity may therefore encourage nations, most likely to be developed, to take a greater role in protecting the environment and favouring sustainable projects.



- Increases in temperature affect evaporation rates and the quantity of water vapour in the atmosphere. This has implications on precipitation patterns, river regimes and water stores which can affect the amount of water available for human consumption.
- Rising temperatures will mean that less water is stored in the cryosphere. Melting of glaciers will lead to flooding and a loss of freshwater. This will be detrimental for locals who rely on freshwater from glaciers, such as the Himalayan tribes. It must however be remembered that great uncertainty lies in future predictions and impacts.
- Threats to ocean health can impact the fishing industry, tourist industry and spoil coastal protection defences.



Energy Security

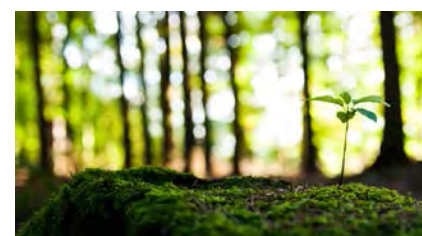
Energy Security



- Primary energy sources are the natural sources found in the earth, such as coal, oil and gas. Secondary energy converts these sources into other forms, such as electricity for convenience.
- A rich energy mix is made up of domestic and foreign sources; a country will have its own energy sources as well as importing from other nations, having a diverse mix of renewable and non-renewable sources.
- Energy consumption is greater for newly industrialised countries, such as India and China, whilst countries in the later stages of The Demographic Transition Model (being more developed) will be more sustainable and conscious of their consumption.

→ Access and consumption of energy resources depends on:

- **Physical Availability:** Fossil fuels, solar, wind, tidal and geothermal power depend upon location. Large power stations require flat and stable land to function correctly. There is a mismatch between locations that are abundant in fossil fuels and places which have high demand.
- **Cost:** As supply decreases, costs increase. Prices are consistently fluctuating. Onshore oil deposits tend to be cheaper than offshore whilst HEP sites situated near transport routes will be more economical.
- **Technology:** New technological developments have allowed oil to be extracted from deeper and more technically difficult environments. There are plans to extract oil from tar sands in Canada and Venezuela.
- **Public Perception:** There are cultural preferences around the world, some may be reluctant to adapt to new technology, such as the Amish tribe. Others have doubts over nuclear power after Chernobyl.
- **Level of Economic Development:** France can afford 78% of its energy to come from nuclear sources whilst poorer regions, such as Ethiopia, use sources like dung and crops for energy. It may be free but combustion of these sources can cause serious health effects.
- **Environmental Priority:** Costa Rica obtained 99% of its energy from renewable sources in 2015 as they are conscious of their environmental footprint.



Energy Players



→ Energy players have different roles in securing pathways and energy supplies. Energy TNCs, such as Shell, are incredibly profitable but are challenged by the recent rise of OPEC and other environmental groups.

→ OPEC consists of 12 oil producing countries founded in 1960. They aim to stabilise oil prices whilst limiting environmental damage. Though they help compensate the poor, significant energy producers (such as Russia) refuse to be part of the bloc.

→ Governments can influence conservation through movements such as increasing taxes for large emitting companies. Consumers have a role in voicing their needs through protests, such as the UK riots over mining in the 20th century.

Reliance on Fossil Fuels

→ Energy pathways, which can be pipelines, transmission lines or shipping routes, are vital in transporting energy sources from producers to consumers. These pathways are high-risk areas, prone to piracy, theft, disruption and damage.

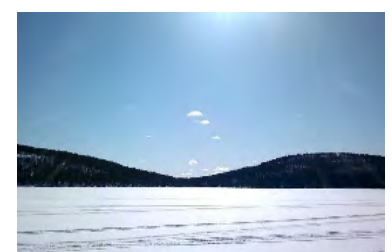
→ One high-risk pathway is the pipeline connecting Europe to Russia. In 2006, Russia increased the price of gas for Ukraine and then in 2009, Russia completely stopped supplying gas, claiming that Ukraine failed to pay in time. This caused a two week dispute and led to a 16% increase in gas prices for the UK as gas passes through Ukraine to reach the UK. Russia's energy company, Gazprom, is a state owned company and one of the country's best assets.

→ In 2007, Belarus cut off Russia's oil pipeline because of the high prices Russia demanded. This affected Germany and Poland, the latter being 96% dependent on imports.

→ Accidents can also cause disruption, such as the Buncefield Oil Depot fires. It is likely that as supply decreases, more conflicts and tensions will arise, slowing the flow of energy between producers and consumers.

→ The development of unconventional fossil fuel energy resources, such as tar sands, oil shale, shale gas and deep water oil, have a myriad of costs and benefits:

- **Tar Sands in Alberta:** There are rich tar deposits within Canada which could reduce the nation's dependency on imports whilst providing 33000 jobs. However, the extraction method for one barrel of tar sand oil is 3 times more energy extensive than producing one barrel of conventional oil. There is also a lot of water required; each barrel of oil needs 4 barrels of water which then becomes polluted and cannot be reused. Environmental impacts involve the removal of The Boreal Forest which is home to 45 unique species.
- **The Arctic Circle:** Estimated that 25% of the world's undiscovered oil and gas are present under this *PRISTINE* environment. There are territorial claims involving Russia so future exploration could cause serious competition over who gets what. There are also high risks of oil spills and environmental degradation.
- **The Falkland Islands:** Hostile environment where oilrigs and drilling occurs. There are territorial claims from Argentina but the British Geological Survey estimates that there is a one in five chance of commercial oil being found in the north, improving energy security of owner.
- **UK's Atlantic Frontier:** Oil fields are 150km west of the Shetland Islands in deeper water than the North Sea.



Alternatives to Fossil Fuels: Managing Supply

→ Renewable and recyclable energy, including nuclear (as uranium is reused), wind and solar power, could reduce reliance on fossil fuels but come with their own costs and benefits. Ideally, a diverse mix of sources is needed for energy security.



- **Nuclear Power:** Zero greenhouse emissions and reduced reliance on fossil fuels but toxic waste and disasters such as Chernobyl cause a dislike amongst the public. New fast breeder technology will increase production but has a key ingredient used in nuclear weapons.
- **Solar Power:** This is location dependent, suitable for deserts. Solar power heats and provides air conditioning in the Mediterranean. It is expensive but a long-term option.
- **Wind Power:** Costs 10% of what it did 20 years ago. Prices will decrease further as new technology is created. There are issues of NIMBYISM but this is now controlled due to new developments, such as the mega-watt turbine, which is more efficient, less noisy and more visually pleasing. Wind turbines do impact property levels, affect TV reception and work better offshore albeit this being expensive and disruptive to radar signals.

→ Biofuels are increasing globally but have implications over food security as land is used to grow biofuels instead of food crops, having led to previous riots in Mexico and India as food prices have consequently increased.

→ There are also debates over the carbon neutrality of biofuels as carbon is emitted in the transportation and production of biofuels.

→ Radical technologies include carbon capture and storage and alternative energy sources such as hydrogen fuel cells and electric vehicles. These could reduce carbon emissions but great uncertainty exists over their effectiveness and ability to work.



Future Risks, Players and Scales

→ Future emissions, atmospheric conditions and climate warming are uncertain due to natural factors, such as the role of sinks, and human factors such as the rate of economic growth, population and energy sources.

→ The role of feedback mechanisms and tipping points which can amplify change are also unknown. Some predicted impacts include acid rain, the enhanced greenhouse effect, a rise in nuclear waste and a push for energy conservation.

→ Adaptation strategies for a changed climate involve water conservation, resilient agriculture schemes, land use planning and solar radiation management. Yet these vary in effectiveness, cost and have secondary impacts, such as a reduction in food production and water availability.

→ The carbon cycle could be rebalanced through mitigation techniques such as carbon taxation, renewable switching, energy efficient and CCS but these require global management and player integration.



Mineral Security

Iron Ore Reserves

- Minerals are also finite resources as they will eventually run out one day. They remain a key ingredient for numerous activities within industries so, as demand increases and supply declines, there will be greater competition over these resources.
- Obtaining minerals requires quarrying which is an energy intensive process, especially if it disrupts natural settlements.
- There are 60 countries in the world which produce iron ore, the main being China, Brazil, India, Russia, Ukraine, USA, South Africa, Sweden and Canada.
- By emerging countries having an abundant supply of iron ore, they can potentially gain power by trading and using the resource to their advantage, as they are currently mineral secure.
- Iron ore is one of the most abundant rock elements, making up 5% of the Earth's crust. It is the 4th most common element in the world and abundant in Australia however Australia is not one of the largest producing countries of iron ore.



Uses of Iron Ore

- 98% of the world's iron is used to make steel which is a fundamental material in infrastructure. Steel is used to make:

- Automobiles
- Locomotives
- Ships
- Beams in Buildings
- Furniture
- Paper Clips
- Tools
- Reinforcing Rods for Concrete



- Bicycles
- Cars
- Engines
- Pipes
- Roofs
- Nails and Bolts
- Machinery
- Food Cans



- The iron industry is huge but the business has a low margin because iron is of low value, due to its abundance.
- The world's largest single producer of iron ore is the Brazilian company Vale which produces over 350 million tons of iron ore annually.

Environmental Impacts of Extraction

- The environmental damage done is huge. Extraction causes:
 1. Pollution: Surface water, atmosphere and ground water become contaminated by minerals and volumes of dust.
 2. Land Destruction: Due to chemical contamination and scarring.
 3. Noise: Disturbance to locals and wildlife.
 4. Energy: Intensive process, adding to acid rain and global warming.
 5. Destruction of Biological Environment: Death of plants, biomass and species diversity.
- Recycling extends supply of iron, reduces waste disposal and protects biodiversity and the land.

