Paper 2 Topic 6a Resource Management - Energy

Resource Management overview

Natural resources

Biotic - living

Abiotic – non-living

Renewable

Non-renewable

The Energy Mix

Renewable energy

Fossil fuels

Population growth

Wealth

Availability

Technology

Impacts on people

Impacts on the environment

Fracking

Case Study: China

Sustainable management

Case Study: Iceland

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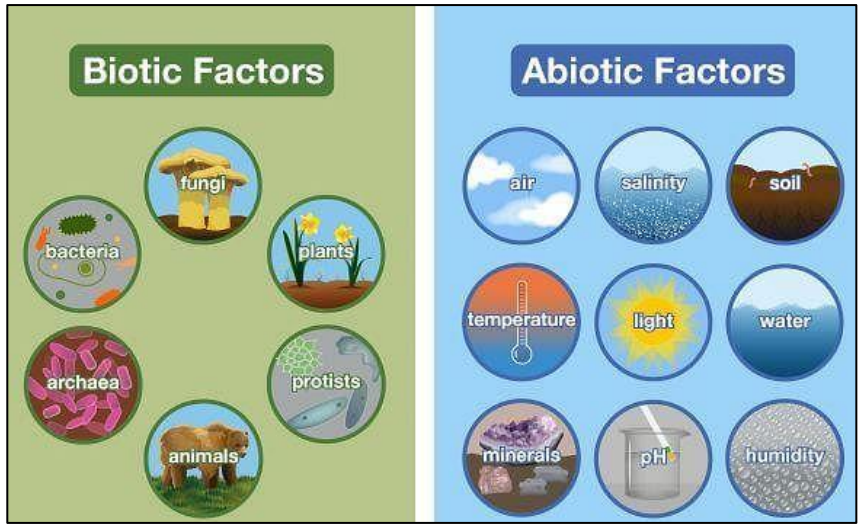
A **natural resource** is any feature or part of the environment that can be used to meet human needs.

Types of natural resource:

Biotic (living) – obtained from the biosphere – capable of reproduction (e.g. animals and plants).
Abiotic (non-living) – obtained from the lithosphere, atmosphere and hydrosphere (e.g. soil, sunlight and water).
Non-renewable – takes millions of years to form and cannot be 'remade' (e.g. coal, oil and gas).
Renewable resources – can be naturally replenished and last forever (e.g. wind, solar and hydro-electric power).



Exploitation of these resources can have long-lasting impacts on people and the environment

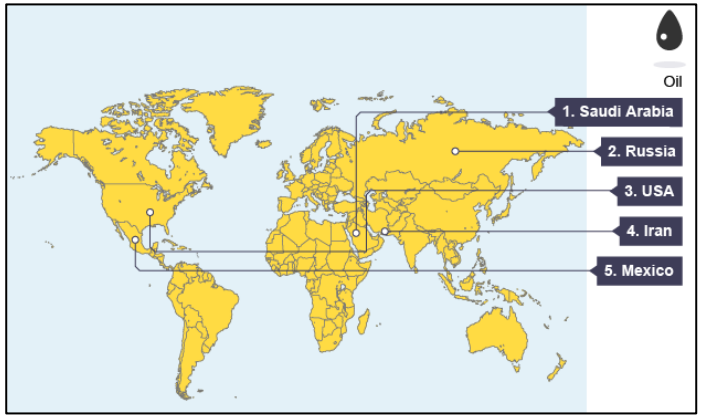
Deforestation – threatens biodiversity and causes soil erosion. Palm oil plantations destroy habitats such as those in the Amazon.
Overfishing – fishing provides a source of protein and jobs, but cod numbers have fallen in the North Sea.
Oil extraction – toxic water pollutes rivers that indigenous peoples rely on for washing, cooking and fishing.
Farming – intensive farming reduces biodiversity.

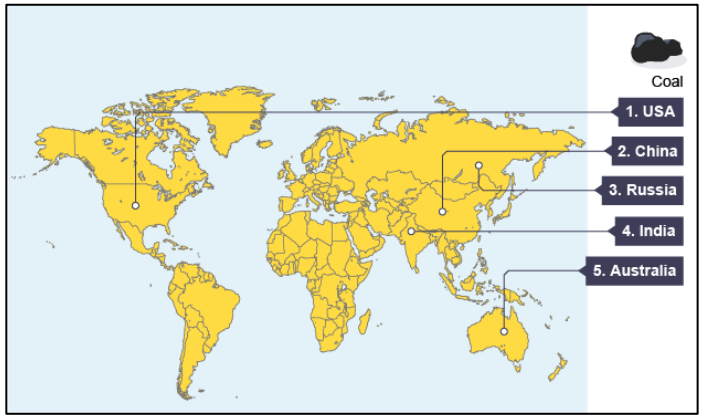
Distribution of natural resources varies around the world, depending on **geology** and **climate.**
Fossil fuels like **coal** are found in **sedimentary rock** regions such as the USA and Canada. Gold is often found in past tectonically active areas such as Australia. South America has huge reserves of copper along with South Africa.

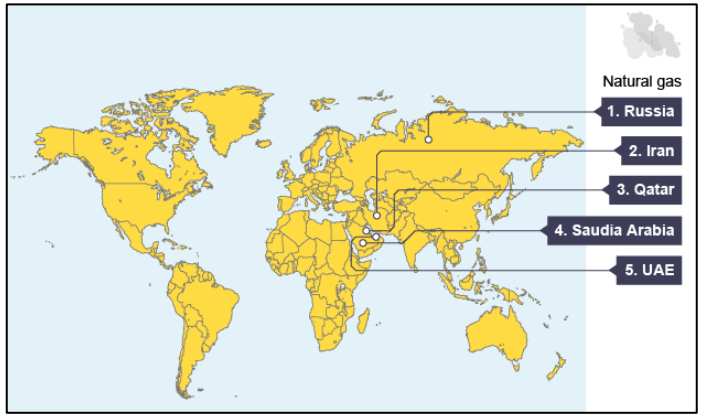
In the UK, high **precipitation** in the north and west along with upland areas mean that hill sheep farming is common. Warm summers and flatter land, along with **fertile soils**, make East Anglia perfect for arable farming. **Oil** and **gas** are extracted from the North Sea.

Usage and **consumption** are *not* evenly distributed around the world.

Energy usage is higher in more developed countries, is rising in China and India, and is low in less developed countries.
Food consumption is higher in wealthy countries like the USA and low in many African countries.
Water usage – water consumption is greater in more developed countries and lower in less developed countries.







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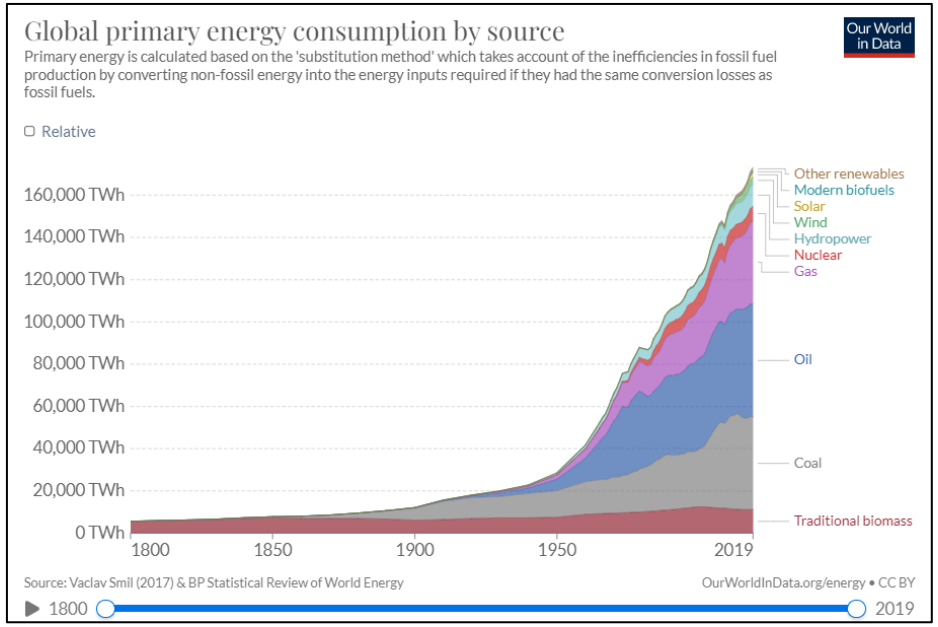
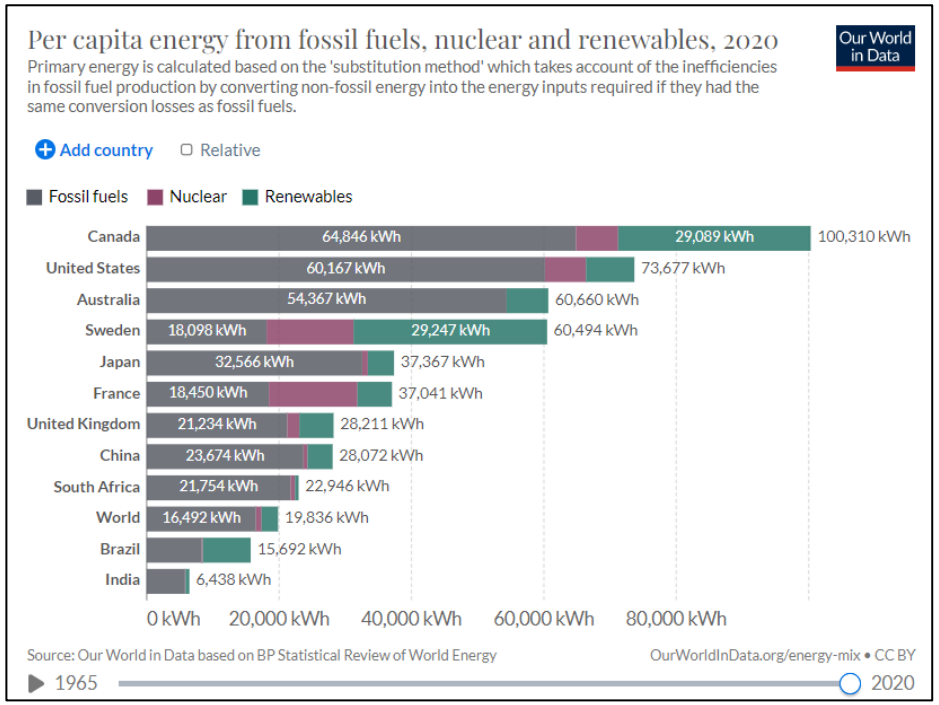


Reasons for increasing energy consumption
Global energy consumption is rising. There are four main reasons for this:
1.Affluence - **emerging countries** like China are seeing the biggest growth in energy consumption. This is because the **standard of living** in these countries is improving and so more people are buying things like technology for the home and cars. Energy use in **developed country** is high, but stable as populations are steady and new technologies help to conserve energy.
2.Population - global population is increasing. It reached 7 billion people in 2011 and it is estimated to reach 9.5 billion around 2050. Everyone uses energy and so this leads to a greater consumption of energy.
3.Technology - the development of new technologies means that more people are using energy. The use of mobile devices and computers has increased and these all require energy to power them.
4.Economic reasons - factories and offices are run using energy. As countries develop economically, they build more factories and offices for people to work in.



The **energy mix** refers to the different types of energy production used to supply energy to a country.

The **energy mix in the UK** reflects the fact that it has a strong economy and so needs a variety of energy sources for industrial production, electrical production, transport, and domestic use.
The UK uses a mixture of **fossil fuels** (oil, gas and coal), nuclear energy and renewable energy (eg solar, wind and hydroelectric power). Most of the oil and coal the UK uses has to be **imported** from other countries, however the UK secures some of its gas supply from the North Sea. Nuclear power requires uranium which the UK does not have, so this also has to be imported. However, as the UK invests in renewable energy it will be able to be more self-sufficient in its energy supply.

Access to energy is affected by many factors.
Technology – some countries are not able to **exploit** their energy resources as the technology required is **unavailable** or **too expensive**
Geology – **fossil fuels** are found in sedimentary rocks, where impermeable rocks have trapped the oil and gas in the permeable rocks below. Countries on plate boundaries may be able to access **geothermal** energy
Climate – **solar power** requires large amounts of **sunlight** to generate energy. Some countries are able to exploit this resource more easily than others
Landscape – **wind turbines** are most efficient on **higher ground** or on the **coast,** whereas **HEP** requires rivers with steep-sided valleys to use as **reservoirs**

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Renewable and **non-renewable** energy resources can be developed.

Non-renewable – takes millions of years to form and cannot be 'remade' (e.g. coal, oil and gas).
Renewable resources – can be naturally replenished and last forever (e.g. wind, solar and hydro-electric power).

The main nuclear fuels are **uranium** and **plutonium**. These are housed in a nuclear reactor.
The nuclear fuel undergoes nuclear fission in the reactor, producing heat - **nuclear to heat energy**. Heat is used to change water into steam in the heat exchanger. The steam drives the turbine - **heat to kinetic energy.** This drives the generator to produce electricity - **kinetic to electrical energy**

Crude oil originates from fossilized sea creatures buried for thousands of years beneath sedimentary deposits. It is pumped from below ground and taken to a r**efinery** where it is refined into **diesel, gasoline**, (petrol), **jet fuel** and **petrochemicals** used as detergents, fertilizers and plastics

Coal is a sedimentary rock formed when dead plant matter decays into **peat** and is converted into coal by the heat and pressure of deep burial over millions of years. Coal is extracted through both deep and surface mining and is often used through burning to heat water to spin a **turbine** to generate electricity

Natural **gas** is formed through the decomposing of plants and animals. Deposits of sediment compress the organic matter and, along with higher temperatures in the Earth's crust, gas is formed. Gas deposits are often found near oil deposits with the gas trapped in impermeable rock. **Hydraulic fracturing**, or **fracking**, is a process that splits open rock formations with high-pressure streams of water, chemicals, and sand. The sand props open the rocks, which allows gas to escape and be stored or transported.

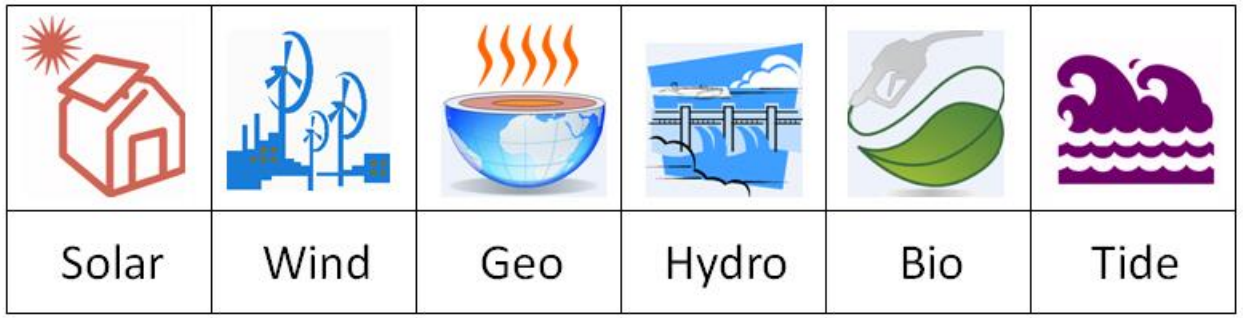
Wind power - wind turbines convert air movements into electricity. In the UK wind speeds are consistent and so this is a good way to generate electricity. The UK generates more wind energy using turbines on the land (onshore). As an island nation, the UK could build more turbines in the sea (offshore) though these are more expensive than onshore turbines.

Geothermal power - this uses heat within the Earth to generate electricity. This is easier where geothermal heat is more accessible, eg Iceland. There are few suitable locations so geothermal energy is rare in many countries.
Ground source heat pumps are a similar idea, but they use the heat from the Sun that is stored within the surface of the Earth.

Hydroelectric power (HEP) - HEP is generated when river water is trapped behind a **dam** and used to turn **turbines**. The UK generates 1.5% of its electricity this way. Most suitable locations for dam building have already been used.

Biomass - this is recently-formed material derived from living things, eg chicken droppings. **'Energy from waste' plants** burn biomass and non-recyclable rubbish to generate electricity. The UK has many 'energy from waste' plants, eg Allington Quarry in Maidstone, Kent.

Solar power - the UK government wants to increase the use of solar power by 2020. **Solar panels** can be fitted onto buildings or within fields. They turn sunlight into electricity. New technology is making solar panels able to generate electricity on cloudy days, which would be good for the UK.



Wave power and **tidal power** - the UK is an island nation, yet it generates very little energy using the sea. Wave energy harnesses the power of small movements on the surface of the sea. The technology is new and currently expensive. Tidal energy harnesses larger movements of the tides. There are plans for **tidal lagoons** to be built in the UK.

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All types of energy generation have both advantages and disadvantages and positive and negative impacts on people and the environment

Coal

Advantages	Disadvantages
There are still large quantities of coal available in 70 countries worldwide. World coal supplies should last for at least another 200 years.	Burning coal releases harmful greenhouse gases into the atmosphere, causing air pollution.
Mining coal is technically relatively easy and cheap.	Mining of coal is dangerous and has caused many deaths.
Coal is used in power stations in many countries around the world. It is an efficient resource for generating large amounts of electricity.	**Open-cast** mining of coal can have significant impacts on the surrounding environment and wildlife habitats.

Wind

Advantages	Disadvantages
It is a clean fuel and does not pollute or emit greenhouse gases.	Many people feel that wind turbines spoil their view of the landscape.
It is one of the lowest priced renewable energy sources for the consumer.	Energy is only produced when it is sufficiently windy to turn the turbine blades.
Wind farms can be built on agricultural land, providing a source of income for the people who own the land.	It is not possible to store the power produced for use on calm days.
New technology means turbines are more efficient and make less noise.	Offshore wind farms are far from where the resource is needed, requiring expensive transmission lines.

Hydroelectric power (HEP) - impacts

People	Environment
Families were forced to leave their homes and relocate to make way for the new dam.	The construction of the dam has destroyed a large area of forest on the Paraguayan side of the river.
The production of HEP means people from the two countries are less reliant on non-renewable energy resources.	HEP is a reliable, clean source of energy which contributes to the energy needs of Brazil's heavy industries, reducing carbon emissions.

Nuclear - impacts

People	Environment
Nuclear power plants are expensive to build, but once they are operational they produce relatively cheap, reliable and plentiful electricity. They can produce energy when it is needed, day and night, all year round.	Nuclear power generation produces much less CO_2 than burning fossil fuels. This means it has a much lower contribution to global warming than energy produced from oil, gas or coal.
Nuclear power plants are very dangerous if they become damaged because of the potential for leaks of radioactive material into the atmosphere. Damage is rare but can happen as a result of human error, natural disasters or, potentially, terrorist attack.	The waste products of nuclear energy are highly radioactive and very difficult and expensive to manage safely. The risk of environmental pollution from stored waste products remains high for centuries.

Solar - impacts

People	Environment
Large solar farms can take up land that could be used for growing crops – although it is possible for farmers to grow crops alongside solar panels.	Manufacturing **photovoltaic cells** can be harmful to the environment because the panels are made of silicon and other toxic metals such as mercury, lead and cadmium.
Solar energy is a growing industry, creating many hundreds of thousands of jobs around the world.	Deserts are excellent locations for solar farms because of their clear skies and strong sunlight. However, desert habitats are fragile and easily damaged during farm construction.

Wind - impacts

People	Environment
The turbulence created by turbines can lead to temperature changes in the air around them – warming at night and cooling during the daytime.	Although the electricity generated by wind turbines does not produce any CO_2, the construction of the blades and pillars does.
Turbines produce noise – older designs typically produced 40–50 decibels. However, modern designs produce less and 40 decibels is only equivalent to the noise of a 15 km/h wind.	Turbine blades cause on average about four bird deaths per turbine per year. However, this is far fewer than the numbers killed by other energy sources.
The London Array will have a generating capacity of 630 MW of electricity, enough to power 470,000 homes.	It is predicted that the London Array wind farm will save 925,000 tonnes of CO_2 a year.

Fracking- impacts

People	Environment
Fracking has made fuel prices in the USA much cheaper for consumers because the USA has large shale deposits and so the country does not need to import energy from other countries.	Producing and using natural gas releases approximately half the carbon emissions of coal, so it is better for the environment to replace coal-fired power stations with gas-fired ones.
There is evidence that fracking can be linked with subsidence of homes, as rocks are disturbed deep underground. Fracking has also resulted in gas entering people's homes – flammable gas coming through taps, for example!	The chemicals used to release the shale gas may leak into and contaminate **groundwater** supplies. This could damage ecosystems that rely on the groundwater (and could affect humans who use the water, too).

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Meeting the demands for energy resources can involve interventions by different interest groups.

Different attitudes:

- An example is fracking in the UK. Individuals protest against the exploitation of shale gas due to the impacts on the environment.
- However, the UK government and businesses see fracking as a financial benefit, generating money for industry and services.
- Environmental pressure groups such as Greenpeace are against the burning of fossil fuels, fracking and nuclear energy, preferring the use of renewables.

Sustainable management is ensuring present needs are met without compromising resources in the future.

According to scientists, **dependency** on fossils fuels could have permanent impacts from **climate change.** Growing populations and rapid economic development must encourage governments to increase the use of renewable energy sources.
There are different views on meeting energy demands:

Individuals – more people are using energy efficient products and solar panels, but many people believe they are still too expensive and look ugly.

Organisations – businesses see using renewables are good for public relations, but they are expensive for smaller companies. McDonald's reuse cooking oil for their lorries and use LED bulbs in their restaurants.

Governments – shared targets by world leaders' and pledges to reduce global warming (UN Climate Change Summit), such as adoption of sustainable transport, bicycle schemes and congestion charges.

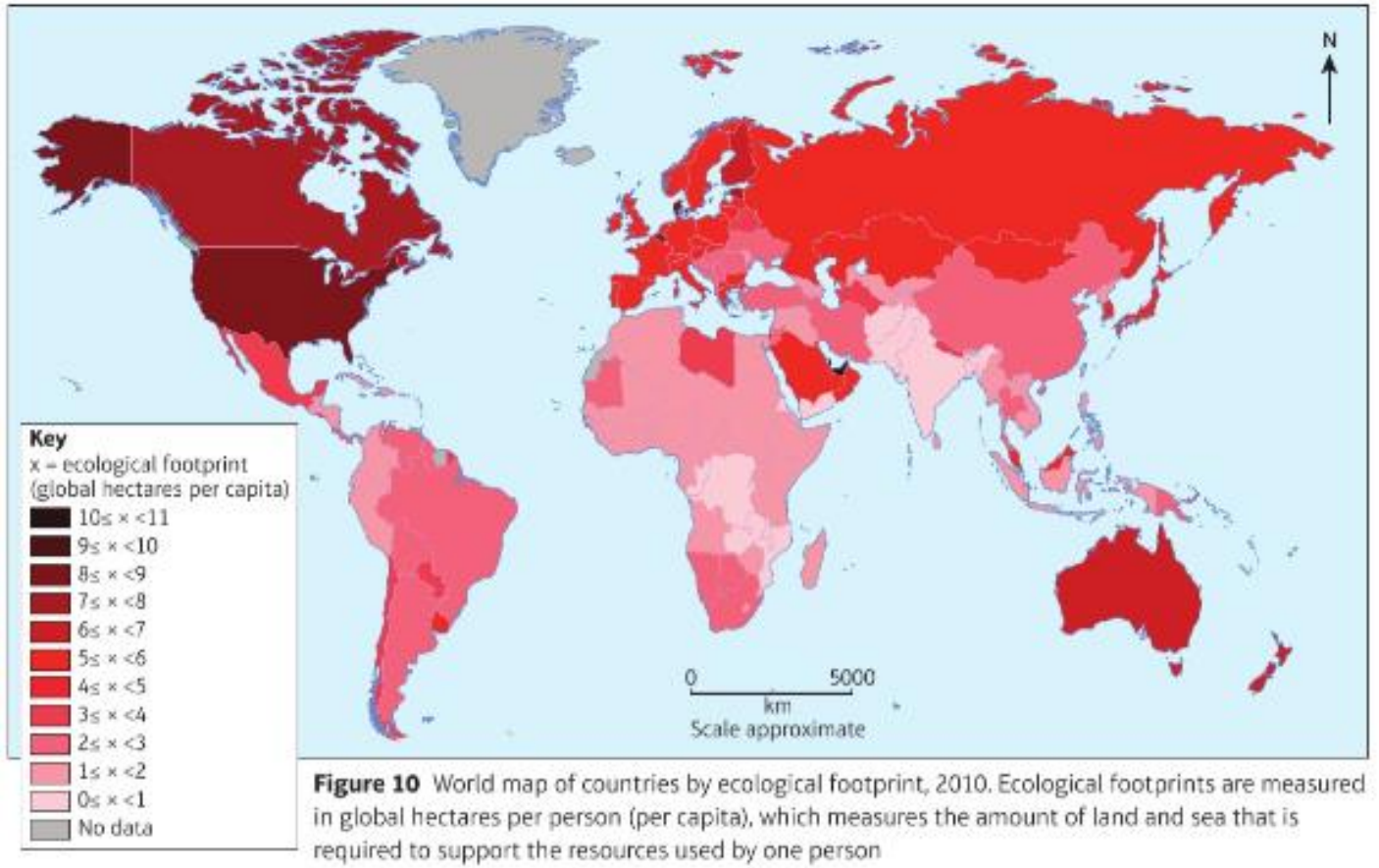


Figure 10 World map of countries by ecological footprint, 2010. Ecological footprints are measured in global hectares per person (per capita), which measures the amount of land and sea that is required to support the resources used by one person

A **carbon footprint** is a measure of the amount of greenhouse gases generated by the activities of an individual or organisation, or by a product over its lifetime
An **ecological footprint** is a measure of how much land is needed to support an individual's, city's, country's or world population's lifestyle
Both are calculated from key areas : **Food** – the amount of meat eaten, **Home** – the size of your house and how many people live in it and how much energy is consumed, **Travel** – types of quantities of transport and travel, **Lifestyle** – how much is spent on clothes and electrical devices in a year and how much recycling is carried out

Paper 2 Topic 6a Resource Management – Energy – Case Studies

Sustainable Iceland

About 85% of the total primary energy supply in Iceland is derived from domestically produced renewable energy sources. This is the highest share of renewable energy in any national total energy budget.

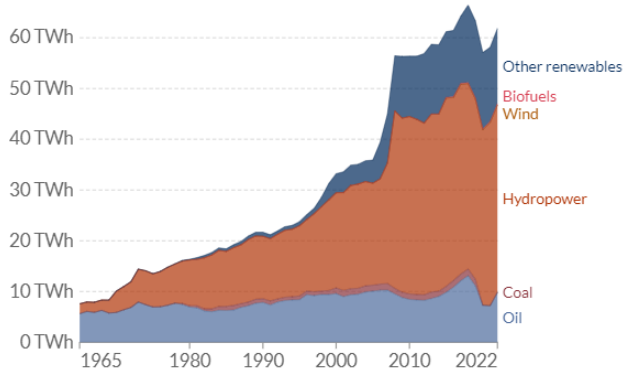
Geothermal energy

In 2016 geothermal energy provided about 65% of primary energy, the share of hydropower was 20%, and the share of fossil fuels (mainly oil products for the transport sector) was 15%. In 2013 Iceland also became a producer of wind energy. The main use of geothermal energy is for space heating, with the heat being distributed to buildings through extensive district-heating systems. About 85% of all houses in Iceland are heated with geothermal energy.

Electricity

In 2015, the total electricity consumption in Iceland was 18,798 GWh. Renewable energy provided almost 100% of electricity production, with about 73% coming from hydropower and 27% from geothermal power. Most of the hydropower plants are owned by Landsvirkjun (the National Power Company) which is the main supplier of electricity in Iceland. Iceland is the world's largest green energy producer per capita and largest electricity producer per capita, with approximately 55,000 kWh per person per year. In comparison, the EU average is less than 6,000 kWh.

Iceland's energy consumption by source

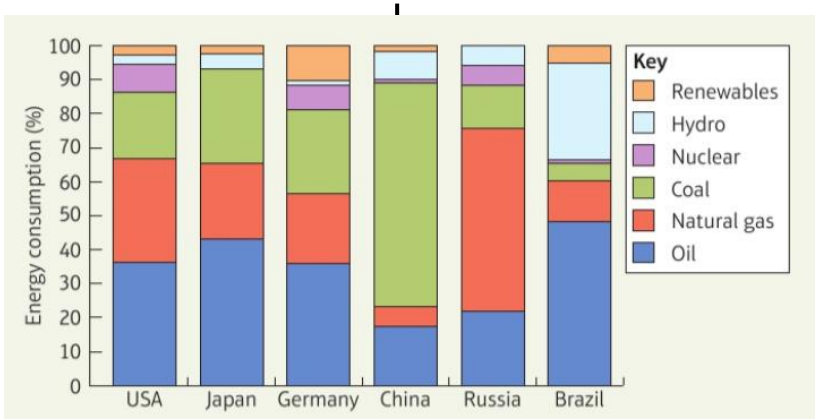


Sustainable China

China burns more **coal** than the USA, Europe and Japan combined, producing 29% of global carbon emissions. Strategies to manage energy resources include:

- HEP – the Three Gorges Dam.
- Solar power – the leading solar power producer.
- Coal restrictions – laws restricting the use of coal.

Selected country's energy mix



Hydro-electric power (HEP) – The Three Gorges Dam

The Three Gorges Dam became the worlds' biggest HEP producer in 2012, generating 98.9 billion (kWh) of electricity, equivalent to burning 49 million tonnes of coal, preventing 100 million tonnes of CO_2 emissions.

However, negatives include:

- **Economic** costs of US$30 billion
- **Relocation** of 1.4 million people from their homes, with some still living in temporary accommodation
- F**looding** of 632 km² of habitat and the extinction of the Yangtze River dolphin
- **Landslides**, build of silt and sewerage and damaging pollution has affected **biodiversity** in the area and **crop yields** for farmers downstream

China has also become one of the world leaders in generating solar energy through a giant solar power station in the Gobi Desert, which could potentially produce enough energy to supply on million homes