UK Environmental Challenges 1

The UK has a unique climate for its latitude which can create extreme weather conditions.

Term	Definition
weather	The day to day changes in temperature and precipitation.
climate	The long term average of the temperature and precipitation experienced at a location.
prevailing wind	The most frequent, or common, wind direction.
air mass	A large parcel of air that has similar temperature and moisture content at ground level.

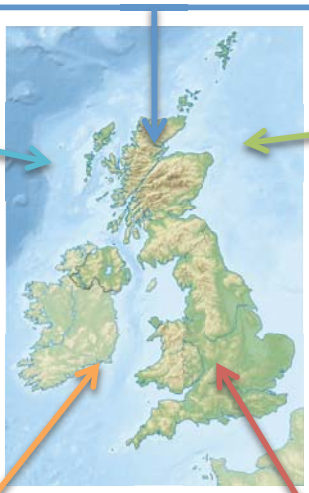
Factors affecting the UK's weather

Prevailing wind	Air masses	North Atlantic Drift	Continentality
- The dominant wind direction is from the SW. - This brings mild, moist air towards the UK keeping the UK warmer and wetter than we should be.	- Air masses have different characteristics and bring different types of weather based on where they have come from.	- This warm ocean current comes from the Caribbean. It brings warm ocean waters so the temperature in the UK is warmer, particularly in the winter.	- Large areas of land respond quickly to changes in temperature so the further you are from the ocean, the colder the winter and the hotter the summer will be. - The further inland you are, the drier it is too.

Air masses and the UK

Arctic Maritime: Heavy snow in 2009-2010
- Extremely cold, wet air mass from the North Pole.
- Most severe winter conditions in 20 years.
- Night time temperatures fell to below -10°C and 10-20cm of snow fell.
- Transport badly affected with blocked roads, cancelled trains and airports disrupted.
- Ice brought down power lines disrupting electricity to 25,000 homes.
- Farm animals in the UK severely affected.

Polar Maritime
- This brings cold, wet weather from the NW.



Polar Continental
- This brings cold, dry weather from the NE (Siberian winds).

Tropical Maritime: Strong winds in 2014
- Warm, wet air mass from the SW.
- In February 2014 storm winds came from the Atlantic creating huge waves that hit the south and west coasts.
- SW mainline railway damaged at Dawlish took many weeks to fix.
- Coastal flooding and damage to infrastructure, buildings and sea defences in Cornwall, Devon and Dorset.
- Power lines brought down in Wiltshire killing 1 person.

Tropical Continental: Heatwave in 2003
- Warm, dry air mass from the SE.
- Most extreme heatwave in 500 years to hit Europe.
- Over 20,000 people died across Europe.
- Wildfires broke out and rivers ran dry.
- Water reservoirs ran low, affecting water supplies and wildlife.
- Tourism in the UK increased as people stayed to enjoy the weather rather than go abroad.
- Some food princes rose as farm animals died and crops failed.
- Road surfaces in the UK melted and railway tracks buckled in the heat.

UK Environmental Challenges 2

Extreme flood hazard events are becoming more common place in the UK.

Key term	Definition
Extra tropical cyclone	Extreme low pressure system bringing huge amounts of rain and strong winds
Saturated	The ground holding as much water as possible, therefore it is impermeable
Flood	An overflow of a large amount of water beyond its normal limits, especially over what is normally dry land
Catchment area	An area of land drained by a river and river systems
Discharge	The amount of water carried within a river

Storm Desmond- Carlisle, Cumbria 5th – 6th Dec 2015

CAUSES: A tropical maritime air mass, driven by the jet stream, carried a lot of moisture across the Atlantic to the UK. As these warm, wet winds (atmospheric river) hit the Cumbrian Highlands, air was forced to rise. Air cooled and condensed to form clouds, releasing huge amounts of rain in one 24 hour period- **341.4mm** – a new record for the UK. This rain fell on already saturated soils and so water ran quickly into the river through surface runoff. Carlisle is at the confluence of the Rivers Caldew and Eden and the city is built on a floodplain, increasing the likelihood of homes and businesses being flooded. The intense low pressure also caused winds of over **100mph**

Glenridding village river channel blocked by boulders

Streets of Carlisle flooded

EFFECTS:

Social

- 5,200 homes were flooded in Cumbria and Lancashire.
- Many schools in Cumbria were closed because of flooding, power cuts and loss of water and heating.
- 61,000 homes in Lancaster lost power when the electrical substation was flooded.
- The NHS in Lancashire declared a major incident after flooding caused power cuts and stopped doctors and nurses reaching hospitals.

Economic

- The A591 between Keswick and Windermere was washed away along with 3 bridges.
- £500 million of estimated flood damage.

Environmental

- Thousands of trees were ripped from river banks as well as millions of tons of sediment being transported by rivers and deposited on floodplains and in settlements.
- Large amounts of the fragile upland soils were washed into rivers and lakes, affecting water quality and wildlife.

Flood waters did overtop some flood defences, BUT they did save 1000 properties from flooding!

Local / Regional management	National Management
Local community responses e.g. sandbags and emergency shelters in sports centres / schools	National emergency response: 200 military personnel deployed
Planting trees in the River Eden catchment area	Environment Agency issue flood warnings
Restoring 350 hectares of peatbog	£72 million government funding to improve flood defences

Key question	Answer
What date did Strom Desmond hit?	5th and 6th December 2015
What two rivers flow through Carlisle?	River Eden and River Caldew
Four places badly affected by the flood?	Carlisle, Keswick, Cockermouth and Glenridding
What caused Storm Desmond?	An extratropical cyclone brought UK record for the most rain to fall in a single 24 hour period, 341.4mm fell on the Lake District. (Cyclone + relief rainfall) Ground already saturated so rain couldn't soak in. Carlisle is on flat land at a confluence.
How was the flood disaster managed?	Management can be local and linked to a specific catchment area or national and more strategic linked to planning, funding and preparation for future events.

UK Environmental Challenges 3

Humans use, modify and change ecosystems and environments to obtain food, energy and water.

Term	Definition
ecosystem	These are natural areas in which plants, animals and other organisms are linked to each other, and to the non-lining elements of the environment to form a natural system.
mechanisation	The process whereby machinery is introduced to complete work normally done by hand.
eutrophication	The process of excessive nutrients building up in water sources, usually because of leaching and surface run off.

How the UK Modifies Land to Provide Food

Mechanisation of Farming

- Large-scale farming uses tractors, combine harvesters, mechanical ploughs, vehicles and even aircraft and satellite technology.
- Farming is now a year-round process so fields no longer have time to recover between crops and become exhausted of nutrients (no 'fallowing' time).
- Increased used of chemical fertilisers and pesticides cost farmers money and can cause eutrophication.

Providing energy

- Wind farms can be found on land or out to sea. They are cheap and wind power has developed as a major source of electricity in the UK.
- Wind farms are often on open areas of high ground. People often complain they are unsightly and noisy.
- Making the turbines produces greenhouse gases but they are non-polluting once running.
- The UK is now exploring fracking as a way to use our natural shale reserves to give oil and gas.
- There are concerns groundwater will become toxic as it becomes contaminated with bromide, methane and lead. Some people also argue fracking could cause 'microquakes'.

Commercial Fishing

- This uses large trawlers rather than small boats, with thermal sensors and digital imagery to locate fish stocks.
- Has led to over-fishing of popular species like cod. Too many young fish have been caught to they cannot breed to produce more fish – now there are minimum sizes of fish before they can be caught to manage this.
- Consumers are being encouraged to eat other fish like pollack.
- Commercial fishing can lead to the accidental death of dolphins through being caught in tuna nets or the diesel fuel causing water pollution.

Providing Water

- About 40% of all blue water abstracted in the UK is for domestic use, 40% for energy and 20% for industry (including about 1% for agriculture).
- Most of the rain falls in the NW but the demand for water is highest in the SE.
- Reservoirs can store water behind dams but these are expensive, flood farming land and can fill up with sediment affecting wildlife.
- Water transfer schemes can move water to where it is needed.
- In Norfolk water is moved from the reservoir on the River Ely Ouse to the River Stour in Essex by tunnels and pipes; 400 million litres of water per day.
- Water from Graig Goch dam in Wales provides 160 million litres of water per day to Birmingham.
- But transferring water can affect nutrient balances in the water affecting wildlife and this relies on hard engineering which is expensive and can alter natural river flows.

UK Environmental Challenges 4

There are a range of energy sources available to the UK.

Term	Definition
renewable energy	Energy harvested from resources which are naturally replenished on a short timescale.
non-renewable energy	Energy sources formed millions of years ago and have to be extracted from the ground. These resources are finite and will eventually run out.
energy mix	A measure of different sources of energy in a given reason.

Renewable Energy

Energy Source	How It Produces Energy	Importance in the UK
Biomass	From organic matter by burning dung or plant matter. The UK grows sugar cane and maize as 'biofuel' to burn.	5% of electricity. 3% of road transport fuel.
Wind	Turbines are turned by wind to generate electricity.	10% of electricity and more potential in the future.
Hydro (HEP)	Dams trap water that is used to spin turbines to generate electricity.	1.4% of electricity. Large dams are expensive but micro-dams are increasing in number.
Geotherm al	Water heated underground when in contact wit hot rocks creates steam to turn turbines to generate electricity.	Some small projects eg in Southampton.
Tidal	Barrages constructed across river estuaries which turn turbines as the tide rises and falls.	None in the UK today. Future sites could generate up to 10% electricity.
Wave	Forcing waves into a chamber to turn turbines to generate electricity.	Some experimenting in the UK but costs are very high.
Solar	Photovoltaic cells mounted on solar panels which convert light from the sun into electricity.	Increasing number of solar farms and many homes have solar panels on their roofs.

Non-Renewable Energy (Fossil Fuels)

Energy Source	How It Produces Energy	Importance in the UK
Coal	Burning coal to heat water and create steam to turn turbines.	Used to be our main source of energy and coal mining was a major industry. Today only a few open cast mines are still working and we import coal from other countries. 36% of electricity today from coal.
Oil and Natural Gas	Burning oil to heat water and create steam to turn turbines.	From 2015 oil is no longer used to create electricity and the last oil-fired power station closed. Gas is used to give 27% of electricity today. Most of our gas has come from the North Sea but by 2019 the UK will import 69% of the gas it needs.
Nuclear	Uranium is radioactive and as it decays if produces heat that is used to generate electricity.	19.7% of electricity. There are 16 reactors in the UK, all on the coast as they need huge quantities of water for cooling and the uranium is imported by ship.

UK Environmental Challenges 5

Energy in the UK is affected by a number of factors.

Term	Definition
energy supply	The amount of energy sources available.
primary fuels	Fuels used to directly provide energy or to indirectly produce electricity.

Energy Supply Changes since 1950

1961
- Coal contributes 80% of UK energy supply.

1974
- OPEC quadrupled the price of oil so the UK starts to develop its own North Sea oil and gas in 1975.

1984-85
- The coal miners went on strike so there was no coal energy.
- After the strike it became cheaper to import coal or change to oil and gas for energy.
- Coal's contribution to energy eventually fell to 30%.

1990s
- The EU's Gas Burn rules ended which had limited use of gas.
- The use of natural gas increased rapidly.

2000s
- Increasing EU and UN limits on carbon emissions led to decrease in use of fossil fuels to generate electricity.
- Solar and wind power increased.

2007
- The Government published a long term plan to provide energy.
- This included plans to build new nuclear power reactors.

Energy Demand Changes since 1950

1950s-2000
- Growing population and increasing demand for energy in the home (eg washing machines/tvs) as well as expanding industry and transport gives increasing demand for energy.

2000s
- Energy consumption started to decrease in 2003 as energy costs rise sharply.
- The Government brought in a scheme to help people better insulate their homes to reduce energy use.
- Since 2005 boilers and since 2007 buildings have had to meet new standards to reduce energy use.
- Rising environmental awareness means people are encouraged to use less energy.

Future Demand
- Demand is expected to continue to fall as we become more efficient in our energy usage.
- The EU has a target of reducing carbon emissions by 40% by 2030. Energy labels are now attached to new electrical appliances to show how efficient they are and industry is being encouraged to produce more energy-efficient products.

Factors Affecting the UK's Future Energy Supply

Economic	Political	Environmental
- High cost of building new nuclear and gas-fired power stations. - Electricity from new power stations could be expensive to buy. - North Sea oil and gas is becoming expensive to extract as it runs out. - High cost of constructing wind farms, tidal barrages and HEP. - For local communities, small-scale renewable projects will need grants or loans.	- Political parties disagree on fracking. - Importing natural gas means we need to find stable nations to trade with. - Disagreement on if other countries should operate UK energy. - The Government needs to decide if it will still subsidise renewable energy.	- UK has committed to reducing carbon emissions. - Fracking might damage the environment. - Many people worry about nuclear power and radioactive leaks. - Some people argue wind farms and solar farms will also harm the environment.

UK Environmental Challenges 6

Energy in the UK requires careful management and consideration of future supplies.

Term	Definition
sustainable	Improving current quality of life but still maintaining resources for the future.

UK National Energy Strategy

The UK Government wants to create a low-carbon, sustainable future energy supply by:

1. Increasing contribution of renewable sources – 15% contribution by 2020.
2. Encouraging energy saving and conservation – Government insulation schemes and labeling electrical appliances.
3. Developing nuclear energy – will fill any gap from renewable sources as it is reliable but it is controversial because it produces radioactive waste that needs to be disposed of safely.
4. Developing carbon capture and storage – to capture carbon dioxide from power stations to store it underground to reduce atmospheric carbon dioxide levels.

Recent developments:

- Between 2010 and 2013 £31 billion was invested in renewable electricity generation supporting 35,000 jobs.
- In 2015 the Government announced it was going to cut subsidies for solar and wind power – this could make them too expensive to build.

UK Local Energy Strategy

In the UK there are many local sustainable energy projects:

Anaerobic Digestion, Silloth, Cumbria

- Farm slurry and silage is used to generate electricity for 4000 homes.
- The project cost £4 million.
- The left over liquid can be used as fertiliser and the heat generated is also used by local homes.

Hoathly Hill district heating, West Sussex

- A small community of 27 homes that has one district heating system to supply hot water to all the houses.
- Water is heated using a woodchip boiler which has created local jobs at the sawmill and gives off low carbon emissions.
- Cost of project was £400,000.
- Project has led to increased community cohesion has the community works together.

So what does the UK's Energy Future look like?.

Renewable Energy – what are the impacts on people and the environment?

Wind farms:

- Kirby Moor wind farm, Cumbria: In 2015 local councilors objected to new bigger turbines as they were concerned about the impact on the landscape and tourism. Many people were concerned tourists would stop visiting if views were spoiled.
- Navitus Bay offshore wind farm: In 2015 the Government rejected a plan for 190 wind turbines near the Isle of Wight as it would harm the view from the Dorset coast and tourism would suffer.

Solar farms:

- Hacheston solar park: In 2014 a proposal for a solar park in Suffolk the size of 75 football pitches was rejected because it would have a negative impact on the environment and would be a waste of farmland.

Non- Renewable Energy – is there still a place for non-renewable energy sources in the future?

Natural gas:

- Natural gas is a relatively secure and reliable energy source as we have our own North Sea supplies and can import it too.
- There are options for fracking in the UK to extract oil and gas from shales but this is controversial and is not yet providing the UK with energy,

Nuclear energy:

- Many of the UK's nuclear reactors are coming to the end of their usability.
- Nuclear reactors are extremely expensive to build but they do give reliable and efficient power.
- Hinkley Point C power station, Somerset: In 2015 China agreed to fund 1/3 of the construction costs of a new reactor with total construction costs of £18 billion. The plant will be run by EDF and is expected to start generating electricity in 2025. The plant will power 5 million homes and create 25,000 jobs.