

Unit 3: Topic 9 Consuming Energy Resources

Why is access to energy resources uneven around the world?

Classifying energy resources

We classify energy resources as non-renewable, renewable and recyclable. 86% of the world's energy is from finite stock (fossil fuels) and will run out. Renewable energy makes up 9.3%, also known as flow resources, which will not run out e.g. HEP, solar, wind and wave. Recyclable energy sources account for 4.4% and can be reused e.g. biofuels and nuclear power.

What affects the distribution of energy resources?

Access to energy is not even around the world, some countries have become very rich because of their large reserves of fossil fuels. It is uneven for a number of factors:

1. Geology

Fossil fuels are found in sedimentary rocks, countries in the Middle East such as Saudi Arabia have 48% of the world's oil reserves and 43% of the gas. Coal is widely distributed around the world with large reserves in the USA, Russia and China. Countries on plate boundaries like Iceland have access to vast amounts of geothermal energy.

2. Relief and Climate

Regions with high rainfall and relief are suitable for HEP as large volumes of water are needed and steep sided valleys for dam construction and reservoirs. Climate is also important in using wind energy or solar power. Exposed areas have high winds e.g. the London Array North sea offshore wind farm. Places with exposure to extended hours of sunlight are ideal for generating solar energy e.g. the Gobi desert, China providing 1 million homes with energy.

3. Accessibility and development

The economic development of a region can influence its ability to invest in and use technology and explore for and develop energy resources. For example large parts of Sub-Saharan Africa have vast reserves of oil and gas but these are largely exported. The region has huge potential to develop renewable energy but they lack funding for investment leaving 620million without access to electricity, many of whom rely on biomass as a source of energy.

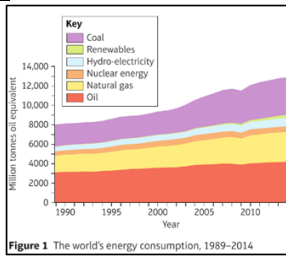
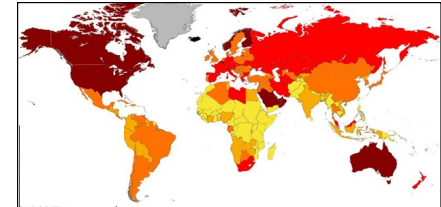


Figure 1 The world's energy consumption, 1989-2014



What are global patterns of energy use?

Over the past 100 years, population growth and rising income per person have driven the increased demands for energy. By 2035 an extra 1.6 billion people will require energy and as incomes improve in emerging countries like China demand will increase.



What causes these variations in energy use?

Economic Development: Energy is vital to growing economies, powering industry, transport and information as well as heating and cooling buildings. Developed countries have high demands for energy and are able to invest in technology (electronic goods) so increase energy consumption. Technology can also help develop renewable industries for example solar as well as for fossil fuels e.g. fracking. However many developing countries have limited access to energy resources and so are unable to develop further their economies.

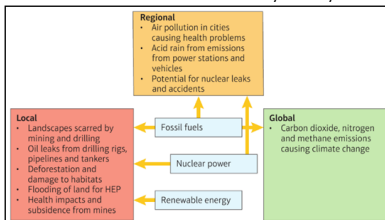
Energy use	UK (%)	India (%)
Transport	38	14
Industry	21	35
Homes	27	41
Services	13	
Farming/other	1	5/6

Economic Sectors – Energy changes with economy and technology. In 1970, industry in the UK used 40% of energy and homes 24%. By 2013 industry had declined to 21% as homes rose to 27%, with growing populations, better heating and more technology. However in emerging countries, like India, industry often use most energy.

Traditional Fuel Sources – in rural areas in many developing countries traditional biomass fuels for domestic use are the main energy use. In Sub-Saharan Africa there is no direct electricity in many rural areas and urban supply is inconsistent. So although Africa is rich in energy resources 700m people continue to cook over fires.

What impact does extracting energy have on the environment?

Extracting and using energy is humans' most significant impact. There can be local impacts such as pollution or the global impacts of climate change.



Can we cope with the rising demand for oil?

What is the distribution of oil reserves and production?

The production of oil is the world's largest business and like other fossil fuels the distribution of oil is uneven. The middle east has the largest reserve with 804bn barrels left enough for 200years. Saudi Arabia, USA and Russia are the world's biggest producers (over 10m barrels per day). New reserves are often found in more hostile locations such as the Arctic, the tropical rainforests of Ecuador and Venezuela and under seas for example the North Sea.

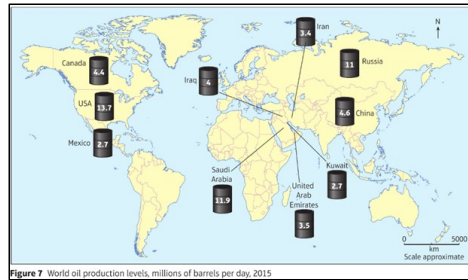
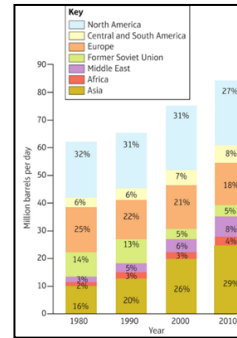


Figure 7 World oil production levels, millions of barrels per day, 2015

How has the global consumption of oil changed?

Consumption has been rising since 1990's due to increasing demands for energy and wealthier populations mainly through development and industrialisation in emerging countries such as China. It's consumption has trebled during this time making it the second highest global consumer of oil behind the USA 12% and 20% respectively. The graph opposite shows per capita consumption is largely related to wealth and car ownership. 70% of oil consumed is used to transport people and goods around the world and is used at a rate of 1000 barrels per second.



How are oil supplies and prices affected by geopolitics?

What are the factors affecting energy supply and prices?

Since 1983, the price of oil per barrel has seen big fluctuations in price due to changes in supply and demand as well as significant global events. Up to 2008, increasing global economic growth has led to increases in demand and so price of oil. China's growth was so rapid their own oil fields could not keep up so they had to import vast amounts. During periods of recession, such as after 2008, economies slowed down so fewer goods were bought resulting in less demand for oil which saw the price fall. Short term spikes in oil price can be due to events such as an oil spill, explosion (2010 BP oil rig in the Gulf of Mexico) or conflict. Conflicts between oil rich nations can have a big impact on the supply and therefore the price of oil e.g. 2013-14 Iran and Saudi Arabia failed to agree production targets, Saudi Arabia produced more and prices fell. The discovery of new sources in the USA (shale gas/tar sands) reduced imports and lowered local and global prices.

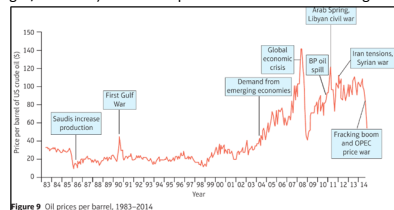


Figure 9 Oil prices per barrel, 1983-2014

When they work together, its members have immense power to influence the supply and price of oil to global markets. OPEC was founded in Baghdad, Iraq, with the signing of an agreement in September 1960 by five countries namely Islamic Republic of Iran, Iraq, Kuwait, Saudi Arabia and Venezuela.

Why are we exploiting ecologically sensitive and isolated areas?

Exploring and extracting in the Arctic

By the end of the 20th Century most of the accessible oil and gas will have already been discovered and exploited. Growing demand has led to the search for new resources in more remote and often fragile environments. In an isolated region of the Beaufort Sea coastline, Exxon Mobile corporation has been building a US\$4 billion natural gas extraction facility. The aim is to move gas 35km from Point Thompson to the Badami oil field resulting in 10,000 barrels of gas per day being exported to Asian countries boosting the US economy. It will provide employment for 800 workers but at a cost of \$4bn it is expensive. Any leaks or accidents could also be ecologically expensive with long lasting impacts.

What are the unconventional methods of oil and gas sources.

The process of fracking involves drilling down into shale rock deposits, then injecting water sand and chemicals into the rocks at high pressure, which frees natural shale gas from the rocks allowing it to flow and be collected. Fracking is most developed in the USA, where it produced 39% of natural gas in 2014. Many Americans are pleased as it has reduced energy bills and provided over 2million jobs. However, fracking has a number of environmental costs especially for water supply and ecosystems. The chemicals used contaminate groundwater supplies with methane concentrations 17x higher than normal. It has also been linked with subsidence and has significantly increased local traffic in and out of the sites.

What are the Athabasca tar sands, Alberta Canada?

There are an estimated 180bn barrels of bitumen within the tar sands which can be refined into petroleum. It is an expensive process but with falling oil supplies and the development of new technology made it worthwhile to exploit these reserves however there are environmental concerns:

1. Surface mining removes vegetation resulting in a loss of local habitats
2. Water which is used is extracted from the Athabasca river threatening wildlife and ecosystems
3. Refining the tar sands uses large amounts of energy producing 15% more CO₂ than refining crude oil
4. An estimated 11 million litres of toxic waste leaks into the Athabasca river daily.

How can we be more energy efficient?

Improving energy efficiency (same service less energy) and energy conservation (not using as much). One example of this in practice is in Woking where by 2008 the council had successfully reduced energy consumption by 52% and it's CO₂ emissions by 82% compared to levels in 1990. Thameswater energy was set up to provide sustainable energy to the council through combined heat and power generators and solar farms. They also converted an old house to show householders practical strategies.



Using energy efficient transport systems

Transport is responsible for 20% of global energy consumption. More sustainable transport uses less energy e.g. low emission cars, public transport (fuel per person), congestion charges and cycle schemes. Since London introduced it's congestion charge in 2003 there has been a 19% drop in CO₂ emissions and 20% reduction in fuel used, a 45% increase in bus passengers and a drop in air pollutants by 12%.

What are the costs and benefits of alternatives to fossil fuels?

	Costs (Disadvantages)	Benefits (Advantages)
Wind energy 3%	Visual pollution, offshore transmission lines are expensive, 4 bird deaths per turbine	Clean, no air pollution, huge generating capacity esp. offshore, cheapest source of energy to the consumer
Solar energy	Take up farm land, manufacturing of panels are made of toxic metals, desert habits are damaged	Creates 1000's jobs, little maintenance once installed, no noise pollution in energy creation
HEP 20%	Expensive, visual pollution, impact habitats altering river flows, displaced farms/villages	Reliable, flexible to meet consumption patterns, dams can help conserve/regulate water supplies
Biofuels	Large amounts of water needed, competition for land growing food crops, increased deforestation	Fewer CO ₂ emissions than FF's, cheaper option as demand grows, can use by-products otherwise wasted
Hydrogen	FF's still required to generate hydrogen, difficult to store safely	Clean, no greenhouse gases, made from water, very efficient

How are attitudes to energy and environmental issues changing?

How do attitudes to the exploitation and consumption of energy vary?

It is estimated that from 2013 to 2035 the global demand for energy will increase by 37% mainly due to improved living standards and population growth. While technology is improving to meet our needs we are still relying heavily on fossil fuels for our energy mix, having catastrophic consequences for our environment. Different stakeholders (people involved) have different opinions about the energy issues for the future. Some believe we should have a "business as usual" approach while some think we need a more sustainable approach.

How are attitudes changing?

In 2015 it was predicted that by 2020 the use of non-renewable energy could drop by 76%. This change could be linked to a number of key factors:

Rising affluence: although rising incomes increase demand on energy, they can also encourage alternative sources to be developed because people have more money to invest in new technologies.

Environmental Concerns: Greater awareness of the impacts is leading to a worldwide shift in energy choice with greater urgency for sustainable energy sources to be developed.

Education: Increasing peoples understanding of the impact of fossil fuels has led to more people wanting to reduce their carbon footprint. The UN are playing a key role in education programs in schools.

How are the attitudes or different groups changing?

TNCs – As a global company our main aim is to maintain a profitable business that meets the challenging targets set by our shareholders. Whilst we appreciate sustainability is important we don't believe our operations alone have a direct impact on the planet.

Climate scientists – Evidence shows how the world's climate has changed in the last 50 years due to human activities. Trends show that if nothing changes there will be a considerable impact on the ability of our planet to support humanity. We must look at energy alternatives.

Governments – Whilst we see the importance of investing in renewable energy resources, our main aim is to obtain and maintain energy security as cheaply as possible. We believe reliable, affordable energy is vital for economic growth and for the improvement of living standards.

Consumers – I want to be able to use energy resources that are cheap and reliable. I am now increasingly aware of the contributions I make to carbon emissions, but will my individual changes actually make a difference on a global scale?

Environmental groups – We want world leaders to invest time and money in the use of renewable energy as there is increasing concern over the impact fossil fuels are having and will have on our planet.