Gas, power and renewables

Natural gas

The most popular form of energy in houses today is natural gas. It emits fewer environmentally damaging products than oil or coal.

Liquefied natural gas (LNG)

Natural gas is cooled and liquefied, reducing its volume by 600 times. This enables gas to be transported economically by sea in LNG carriers.

Solar

BP Solar is one of the world's largest solar electric companies and solar panels are installed in over 200 of BP's service stations.

Water

Water can be utilised to provide energy through hydroelectric schemes, wave energy and tidal power.

Wind

It is estimated that the amount of energy derived from wind power will increase by 25% between 2000 and 2010. Wind turbines can be sited on land or offshore.

Biomass

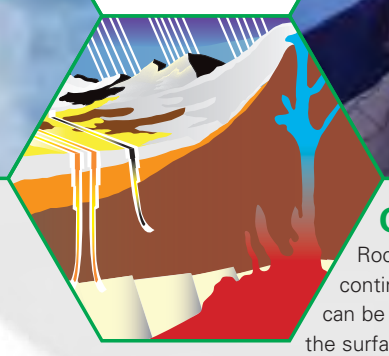
Plants and organic matter are all renewable and when burnt provide energy. However, they release carbon dioxide and other emissions into the atmosphere.

Hydrogen

Hydrogen burns more cleanly and produces fewer potentially harmful emissions. It is the most exciting potential energy source for the future.

Geothermal

Rocks beneath the earth's crust provide a continuous supply of heat. This geothermal energy can be harnessed to pipe steam and hot water to the surface to generate electricity.



Gas, Power and Renewables is a major part of BP's business. The impacts of economic growth and increased energy consumption on the environment have led to growing world demand for cleaner energy and energy services that reduce costs and emissions. In response, BP is now one of the largest world suppliers of natural gas, as well as being an industry leader in the development and marketing of renewable energy resources.

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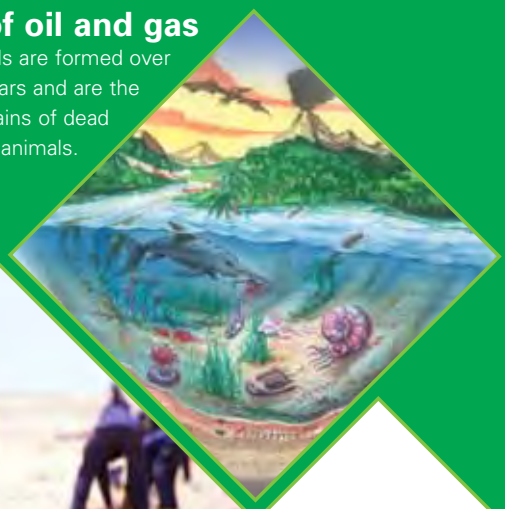
Oil and gas exploration and production

Origins of oil and gas

Fossil fuels are formed over millions of years and are the fossilised remains of dead plants and animals.



Seismic surveys

Seismic surveys use sound waves to explore rock formations to identify where oil and gas are present.

VLCC

Transportation of oil and gas depends on the distance to market. It can be moved by pipelines or by sea in huge ocean tankers (e.g. VLCCs - very large crude carriers).

HIVE

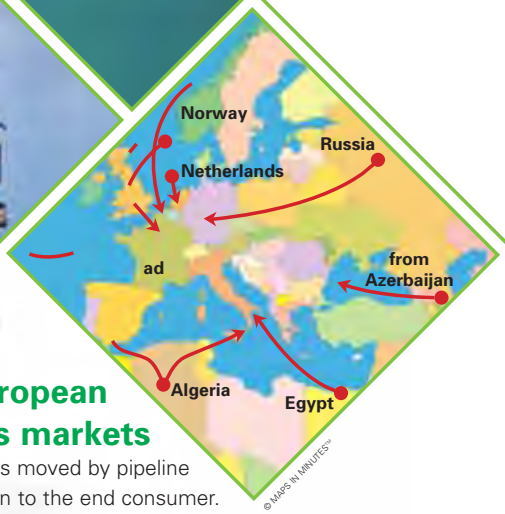
A HIVE (highly immersive visual environment) uses images from multiple computers on a large screen. This enables a number of BP staff with different skills to work together in evaluating geological structures.

Drilling rig

Offshore drilling often presents major engineering challenges, whilst onshore drilling presents technical and environmental challenges.

European gas markets

Most of the world's natural gas is moved by pipeline from point of production to the end consumer.



Our world depends on crude oil and natural gas for both energy and a huge range of products, from pipes that carry our water to materials for our clothes. BP has increasingly sophisticated methods to explore for oil and gas. Once discovered, an enormous amount of evaluation and planning has to be carried out before a field can be developed, in order to maximise the commercial recovery but minimise the environmental and social impacts.

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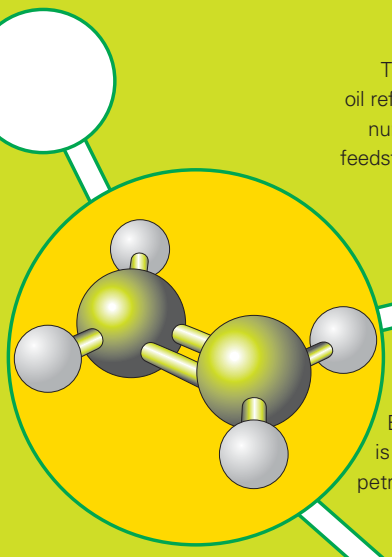
Petrochemicals



Refinery

The starting point for petrochemicals is the oil refinery where crude oil is separated into a number of fractions. Two fractions are the feedstock for petrochemicals and are further processed by cracking or distillation.

Ethene

Ethene (sometimes called ethylene) is the principal building block for petrochemicals and plastics.

Polymers

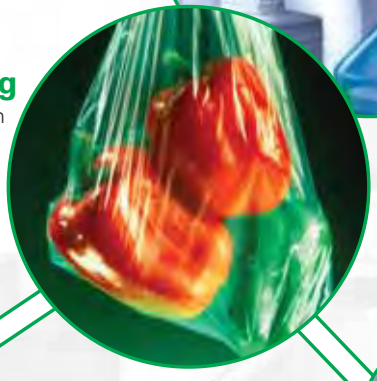
All plastics are polymers. Polymers can be engineered by a number of methods to suit particular applications. One polymer, polyethene, is one of the most commonly used in every day life.

Recycling

In the UK we create 2.8 million tonnes of plastic waste each year but there are many examples of how this can be usefully recycled.

Food packaging

Plastic packaging serves an important function by preventing food spoilage and therefore helping to save food waste.

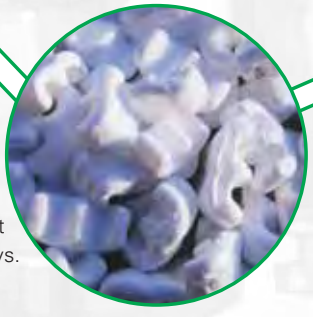


Car dashboard

Reducing the weight of cars by using plastics means less fuel used and reduced carbon dioxide emissions.

Polystyrene

Another polymer is polyphenylethene (polystyrene) which is used for a vast range of packaging, insulation and toys.



Petrochemicals are all derived from oil or natural gas. BP manufactures over 30 million tonnes of petrochemicals and plastics each year. Products made from petrochemicals are part of our everyday lives; think of a plastic like polythene which is used for shopping bags and food packaging. Other uses of plastic include fibres for clothing such as fleece jackets, adhesives, paints, cosmetics, detergents, pharmaceuticals and solvents.

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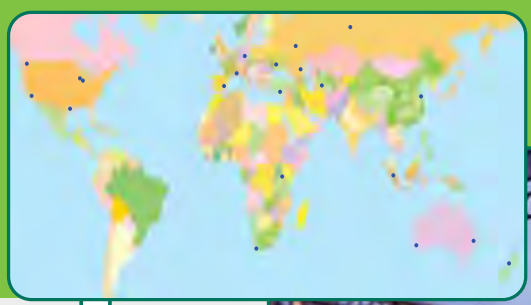
Refining and marketing of oil products

Pipeline

A pipeline is often the most economic way of moving oil, either directly to a refinery or to be loaded onto ocean tankers and taken to the refinery.

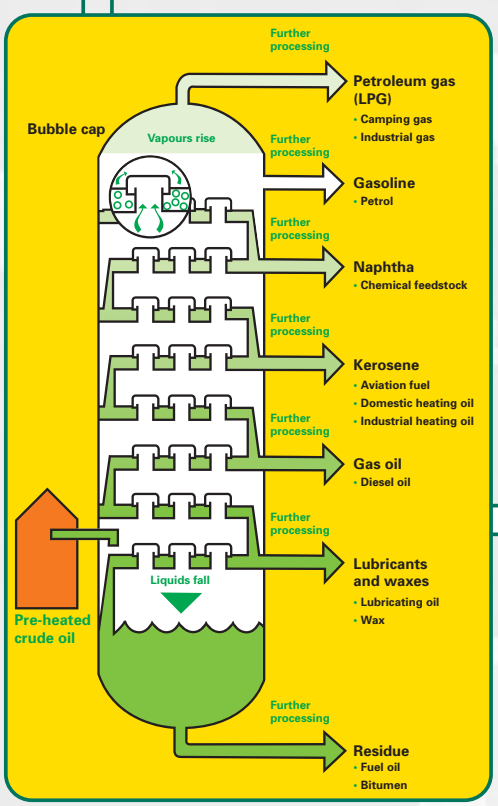
Map

BP has interests in nine refineries in Europe, five in the USA and five elsewhere, as well as others through joint ventures. They process an average of 3.2 million barrels (440 tonnes) of refined products a day.



Refinery

Oil refineries consist of miles of pipelines and vast storage tanks. The many processes are integrated by powerful computer systems.



Fractionating tower (distillation column)

The different components of crude oil are separated at the refinery by a process called fractional distillation. Each fraction is then utilised for different products.

Transportation

Road tankers are the fastest and most economical way of getting petrol from the refinery to the service station.

Service station

One of BP's 28,500 service stations. Location is crucial and increasingly service stations are offering a wider range of goods, such as food, magazines and drinks, in addition to fuel.

Once crude oil has been extracted from deep inside the earth, it still requires processing before becoming the useful products we rely on each day. This processing is carried out at huge refineries in order to turn it into petrol, diesel oil, heating and industrial oils, lubricants and plastics. BP sells its oil and gas products in about 100 countries and serves more than 13 million customers daily.

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Oil and gas exploration and production

Formation

Crude oil and gas are formed through a process which began with the death of countless tiny marine creatures and plants millions of years ago. Dead and decaying organic matter rains down on ocean floors and river beds from the teeming life above. This material becomes mixed with sand and mud and is slowly buried under increasing amounts of sediment.

As this sediment becomes ever more deeply buried, the temperatures and pressures within increase and slowly sedimentary rock is formed. Starved of oxygen, the dead organic matter in the sediment is transformed into kerogen, which forms crude oil and natural gas at temperatures greater than 110°C.

The rocks that contain the kerogen and from which the oil and gas are generated are called the source rocks. The hydrocarbons are held as tiny droplets in the minute spaces in the source rocks.

As the source rocks become further buried under more sediment, the pressure on them rises and the hydrocarbons are squeezed into neighbouring porous rocks such as sandstone. Because the oil and gas is less dense than the water held in the porous rocks, the hydrocarbons float upwards. This process is known as migration.

Eventually the migration is halted by impervious rock and the hydrocarbons collect in what is known as a reservoir. These reservoirs are not huge underground lakes but areas of oil-holding rock, very much like a sponge holding water.

Identification

The only way to be 100% sure of the location of oil and gas is to drill down through several kilometres of rock to find out. Drilling an oil well can often cost tens of millions of dollars, so a company like BP must employ other techniques first, to pinpoint locations likely to hold oil and natural gas.

Geologists and geophysicists look for evidence of the conditions which will be favourable to trapping large volumes of hydrocarbons. They must be able to show that a source rock, migration path, seal, trap and reservoir rock all exist, which together form what is called a petroleum system.

Today, the single most important way of locating oil and gas reservoirs is by means of a seismic survey. These bounce sound waves through layers of rock and 'read' the echoes to get a picture of the rock formation below. Seismic technology has advanced to the stage where it is possible to tell whether oil, gas or just water is present.

Evaluation

Once the data from seismic surveys is collected, BP experts study visual simulations to decide how to go about extracting oil and gas. For this they use a HIVE (Highly Immersive Visual Environment).

A HIVE is a workroom with a series of three-dimensional digital projectors, around which large teams of people can gather to manipulate data and pictures.

HIVEs provide the ability to give all the people involved in a project a common mental picture of the structure on which they are working but will never actually see.

Even after an oil and gas discovery has been made there is an enormous amount of evaluation and planning to be done.

There are four key technical areas where important decisions have to be made to determine how the oil and gas field should be developed.

The paper used for this resource meets the strictest environmental standards as certified by EMAS / ISO 14001 and is fully recycleable. The pulp used to produce the paper is generated locally, and is fully sustainable and totally chlorine free.

1. How should the reservoir be developed?

Geoscientists, reservoir and petroleum engineers use advanced computer programmes to model or simulate the reservoir and wells, assessing performances and predicting flow rates.

2. What should be the design of the production and injection wells?

Wells are expensive so specialist development teams need to decide on the best design, latest drilling techniques, type of equipment, angles of drilling, necessary flow, etc. to suit each location.

3. What should be the design of the production facilities?

Planning for onshore or offshore production often presents major engineering challenges. Onshore production can also present formidable technical and environmental challenges: for example, in the Alaskan tundra with its fragile ecosystem or in the intense heat of Algeria.

4. Which is the best export route for oil and gas?

When located near to major centres of population, where demand is highest, pipelines offer the most economic route. However, when oilfields are situated thousands of miles from the main markets, then transport by sea becomes more practical.

Natural gas is usually moved through pipelines but can be liquefied which makes transport by sea economical.

Exploration wells

To extract oil and/or natural gas a drilling rig is assembled. Drilling is a much more simple procedure on land than at sea because of factors such as the depth of the ocean and the likelihood of rough seas. Some rigs stand on legs attached to the seabed: in deeper waters rigs must float whilst maintaining a precise position using anchors or propellers.

During drilling, mud and cuttings are monitored, instruments analyse the quality of the reservoir and its hydrocarbons, and sometimes core samples of rock are taken for assessment.

Reserves/production ratio

This ratio indicates how soon oil reserves will run out. It divides the best estimate of how much oil can be recovered in the future from known reserves, by how much oil the world produces in the current year. However, this does not take into consideration new oil discoveries.

Discussion topics

- How are fossil fuels formed and in which types of rock are they most likely to be found?
- How do seismic surveys and seismic technology help to locate oil and gas reserves?
- What are the differences between geology and geophysics?
- What are some of the considerations necessary in developing an oil and gas field?
- What is the reserves/production ratio, and how would the world deal with no new oil discoveries?
- See **www.bp.com/bpes** for resources such as the rock and fossil boxes.

Key facts

- The world depends on crude oil and natural gas for both energy and a huge range of everyday products.
- Fossil fuels (coal, oil and gas) are formed over millions of years and are the fossilised remains of dead plants and animals.
- Seismic surveys are the single most important way of locating oil and gas reservoirs.
- A HIVE (Highly Immersive Visual Environment) is used to construct a 3D map of rock formations hundreds of metres underground.
- Rock is cut using a drill bit which contains very hard materials like tungsten or diamond, capable of cutting through the hardest rocks.
- One indicator of how soon reserves will run out is known as the reserves/production ratio.

Refining and marketing of oil products

Pipeline

Oil is essential to our lives and lifestyles, not just for mobility and heat, but for thousands of products which we use or encounter every day.

Crude oil, also called petroleum, cannot be used in its raw form; it has to be processed at a refinery in order to turn it into useful products. Refineries are often located close to major centres of population where the demand for oil products is highest.

Pipelines are the most economical way of moving oil either directly to the refinery or to where it can be loaded onto an ocean-going tanker if huge distances are involved.

In Alaska, the oilfields are in the far north of the country, so a 1,280 km pipeline was built to take the oil to a southern terminal, from where it could be exported to the west coast of America. This pipeline had to be constructed to withstand Arctic conditions whilst having minimal impact on the delicate tundra environment.

Refineries

Oil refining is the process which turns crude oil into useful products. Oil refineries are extremely large industrial units including control rooms, process units, compressors, miles of pipelines and vast storage tanks for crude oil and products.

Refineries usually operate 24 hours a day, 365 days a year, employ hundreds of staff and occupy land the equivalent of several hundred football pitches.

BP has interests in nine refineries in Europe, five in the USA and five elsewhere, as well as others through joint ventures.

Fractionating tower (distillation column)

The continuous process of separating crude oil into useable fractions takes place inside a fractionating tower.

Crude oil is heated to a temperature of 350°C and pumped into the base of the tower. The vapourised oil rises up the tower and separates into liquids as they cool - those with the lowest boiling points collect closest to the top of the tower whilst those with the highest boiling points are collected at the base. Boiling points vary from about 40°C for gasoline to over 300°C for heavy fuel oil.

The tower contains trays at half metre intervals. Each tray contains 'bubble caps' which force the vapours to rise through liquids which have already condensed in the trays. As the various fractions collect in the trays, they are run off through exit pipes. Some gases do not condense by the time they reach the top of the tower and are taken out as gas.

Very few components of crude oil come out ready for the market and some of the heavier products need to be made into lighter ones through further processes such as cracking, catalytic reforming and alkylation.

Certain impurities including sulphur, nitrogen, oxygen, water and dissolved metals also need to be removed. Without this, the end products can damage equipment, produce reduced levels of performance and pollute the environment.

Products

Products from crude oil include:

Gas – butane and propane used in heating, cooking (especially where piped gas is not available) or as fuel in industry

Naphtha – used to manufacture chemicals and plastics

Gasoline – petrol

Kerosene – (paraffin) the first major product to be refined from crude oil during the 19th century – used in central heating and stoves, and as (high quality) aviation fuel for turbines in aircraft

Diesel – higher quality diesel is used for higher speed cars, lorries and buses, and lower quality diesel (blended from heavier oils) is used for ships and lower speed engines

Lubricating oils – used in thousands of different applications to counter damage from friction

Heavy fuels oils – used for large industrial boilers in power stations

Waxes – candles, electrical insulation and waterproof covering in food cartons

Bitumen – the heaviest product – most commonly used for road construction.

Distribution

The products produced at a refinery are distributed by a variety of methods including road, rail, sea, river and canal. Most familiar are the BP road tankers delivering petrol and diesel to service stations up and down the country. BP has approximately 28,500 service stations worldwide. The service stations are often located in population centres and close to main roads and motorways where traffic is frequent and delivery is easy by road tanker.

Discussion topics

- Discuss how the products of oil refining affect everyday life.
- In discussion, list as many products as possible that emanate from crude oil. Look around the classroom – how many are there?
- Explain and describe the process of fractional distillation.
- Debate the most important aspects to consider when planning the location of a new service station.
- Consider what some of the effects would be of leaving certain impurities in the final products.
- Debate why crude oils from different locations produce different percentages of each fraction.

Key facts

- Oil is essential for thousands of products which we use or encounter everyday.
- Products derived from crude oil include liquid petroleum gas (LPG), gasoline (petrol), diesel, naphtha, kerosene, aviation fuels, lubricants, waxes and bitumen.
- Crude oil is a mixture of hundreds of substances called hydrocarbons.
- The price of crude oil varies depending on what products can be distilled from it.
- In 2004, BP produced an average of more than 3.2 million barrels (440,000 tonnes) of refined products a day.

Petrochemicals

Refineries/petrochemical manufacturing plants

The demand for products based on petrochemicals has increased rapidly since the 1940s and plants can now be found across the world. BP has plants in Europe, the USA, China, Malaysia, Korea, Taiwan, Japan and Brazil.

The starting point for petrochemicals is the oil refinery. Here, crude oil is separated into a number of fractions, based on boiling points, through the process of distillation.

Two of the fractions from distillation are important building blocks for petrochemicals: naphtha (a liquid) and the lightest fraction (a mixture of gases).

Naphtha is moved to a steam cracker where it is cracked to produce a mixture of alkenes. The gases are liquefied under pressure and moved to a gas separation plant where they are further separated into useful gases such as ethane. Ethane can then be further separated at a cracking unit into ethene and hydrogen. Ethene is the principal building block for petrochemicals and plastics.

Polymers

All plastics are polymers. Ethene, for example, is polymerised when it is heated under high pressure in the presence of oxygen. A polymer consists of large molecules, which are repeated units known as monomers, joined together in a long chain; an example of a polymer which you may encounter on a daily basis is polythene. Some polymers are natural products such as rubber.

Different polymers have different properties. The properties decide what use the polymers can be put to. For example, cross-linked polymers do not soften on heating – they have to be moulded into shape when manufactured. So plastics made from these polymers are excellent for jobs where heat resistance is important, like saucepan handles.

Various key products

BP Chemicals focuses on seven core products:

- ethene/ethylene which is used to manufacture a wide variety of products from clingfilm to cosmetics
- high-density polyethene (HDPE) is supplied mainly to customers who convert the raw product into useful rigid 'plastic' items such as containers, crates and pipes
- polypropylene is used for housewares, furniture, appliances, luggage, toys, battery cases and other durable items for home, garden or leisure use
- paraxylene (PX) is used primarily as a feedstock for the manufacture of purified terephthalic acid (PTA) - the principal raw material for most polyester
- acetic acid is also used to make purified terephthalic acid (PTA), which in turn is used to manufacture polyethene terephthalate (PET). PET is used in packaging, photographic film, magnetic tape, polyester fibres and soft drinks bottles, as well as food trays and cups
- acrylonitrile is very versatile and finds its way into many products including shirts, socks, sweaters, carpets, blankets, computers, telephones, refrigerators, food packaging and car components.

Plastics and the environment

Often when the topic of plastics and the environment arises, you just think of waste and/or recycling. However, to truly judge the environmental impact of any material you must look at its whole life cycle – through production to final disposal.

Only 8% of the world's oil production goes to make plastics (compared to 86% used for heating and transport). The amount of energy used to make plastic is less than that needed for some quantities of glass or steel. Plastics are lighter than rival materials so less energy is needed to transport them – cars are now lighter because of plastic components and therefore burn less fuel and produce fewer emissions. Plastics also help to reduce levels of food waste through food packaging.

At the end of their lives, what can be done with waste plastics?

Landfill – the least satisfactory option, especially in the UK where there is a shortage of suitable landfill sites.

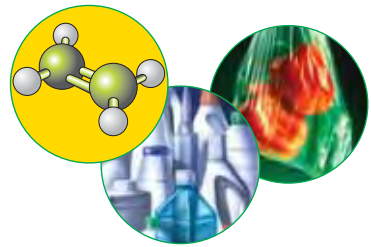
Burning – providing proper safeguards to limit emissions from incineration plants are implemented, there is good reason to use this method to generate electricity.

Recycling – the best option.

Chemical recycling – breaking the plastic down to its original feedstock which can then be used to make more plastic or fuel, but can be energy intensive.

Physical recycling – new items such as shoes and furniture can be produced from recycled plastics. Shredded plastics can even be used to produce a wool-like material used in clothing.

There are a number of industry initiatives such as Recycling of Used Plastics Limited (RECOUP), supported by BP, that are helping to encourage the recycling of plastics.



Discussion topics

- Which important social and technological developments have been made possible with the use of plastics?
- Name five items you use daily that are made of plastic.
- What would the alternatives be if plastics did not exist?
- How good do you think we are at recycling plastic products?
- Which common plastics should we make more effort to recycle?

Key facts

- Products made from petrochemicals are part of our everyday lives.
- No other combination of elements produces so many different compounds as hydrogen and carbon – estimated at 2.5 million – more than all the compounds of other elements put together.
- All plastics are polymers, which consist of large molecules (repeated units known as monomers) joined together in a long chain.
- Polyethene was first made in 1933 by heating ethene to 200°C under great pressure in the presence of oxygen.
- Only 8% of the world's oil production goes to make plastics, compared to 86% that is used for heating and transport.
- In the UK, we create around 2.8 million tonnes of plastics waste each year - this accounts for about 11% of household waste.

Gas, power and renewables

Natural gas

The 21st century has been called the "century of natural gas". Although it has been used for more than 100 years, the last 30 years has seen huge increases in consumption. By 2000 it accounted for nearly 25% of the world's energy consumption.

Natural gas has multiple uses:

- the most popular choice for domestic hot water and heating systems in the UK, many parts of Europe and the USA
- combined cycle gas turbine (CCGT) power stations burn gas to drive a turbine which generates electricity. Emissions are less from CCGT plants and efficiency can be 50% greater than a conventional power plant
- as an alternative to manufacture the building blocks of petrochemicals and plastics
- compressed natural gas is increasingly being used as a road fuel for commercial vehicles and buses.

Gas is transported either via pipeline or tanker. Huge ships carry gas which has been liquefied by cooling the gas to -151°C, thus reducing its volume by 600% and making it economical to transport in large volumes.

Renewables

Fossil fuels such as coal, oil and gas are not limitless and are known as non-renewable energy resources. Renewable energy resources, including sunlight (solar energy), wind and wave energy, will never run out because they are always available to us (finite).

Solar

Sunlight, or solar energy, reaches the earth even through clouds and can be harnessed in three ways: photovoltaic systems, flat plate collectors and concentrating collectors.

Photovoltaic systems use solar cells. When solar energy strikes the cells, electricity is generated. The technology is improving rapidly. Solar products are used extensively in industrial applications, such as telecommunications systems and transportation signals.

There is rising demand for solar panels to be fitted on commercial premises and residential homes.

In remote, isolated communities around the world, solar energy offers the opportunity for basic lighting, refrigeration and access to water via pumping.

This source of energy currently accounts for approximately 10% of all renewable energy generated.

Wind

Between 2000 and 2010, it is estimated that the amount of energy derived from wind power is likely to increase by 25% and account for the majority of renewable energy produced.

At BP's flagship project in the Netherlands at the Nerefco refinery, nine 120 metre tall turbines stand around the perimeter. The green power produced is sold locally through the national power grid. This project saves some 20,000 tonnes of CO_2 that would have been emitted annually, had this electricity been produced using conventional methods.

Hydrogen

Fuels rich in hydrogen burn more cleanly and produce fewer emissions. As hydrogen is one of two elements which make up water, the supplies are limitless in theory.

Pure hydrogen as a fuel would produce no emissions, just waste vapour. However, for now the problem is how to get the hydrogen to where its is needed and how to store enough hydrogen in a vehicle.

In addition, separating hydrogen from water requires large amounts of energy and the most energy efficient way of extracting hydrogen is from other hydrocarbon fuels, especially natural gas. One promising way is the fuel cell. Fuel cell vehicles turn hydrogen and oxygen from the atmosphere into electricity, which then powers an electric motor.

BP is actively exploring the role of hydrogen in a secure, sustainable energy future.

Geothermal

Rocks beneath the earth's crust produce a continuous supply of heat, due to high pressures and naturally decaying radioactive materials. This geothermal energy can be harnessed, using wells to pipe steam and hot water to the surface to drive turbines and generate electricity.

Water

Water can provide energy in a number of ways:

- in hydroelectric schemes, water flowing down rivers passes through a turbine which drives a generator. Most hydroelectric power is produced in hilly or mountainous areas or in river valleys where there is strong water flow
- tidal energy works in a similar way to hydroelectric river schemes. Turbines built into tidal barrages are driven by the natural rise and fall in sea level to produce electricity
- the energy in waves can be used to generate electricity by placing devices on the shoreline or out at sea. The motion of the waves can be used to compress air to drive a turbine or hydraulic pumps. Although wave energy is potentially a significant source, the technology is in its infancy.

Biofuels

Biofuels are plant material, animal waste and specifically grown crops which can be burnt to produce energy. It is sometimes known as "biomass burning". Biomass material may include tree and grass crops and forestry, agricultural and urban waste. It is the oldest source of renewable energy known to humans.

Discussion topics

- Why do we say that all energy is derived from the sun? Discuss all the different ways in which the world gets its energy:
  - from plants to food chains
  - fossil fuels
  - weather (e.g. solar, wind, wave).
- How would solar power help some of the developing countries?
- Why do we need to move towards cleaner energy solutions and what are the practical advantages?
- Which renewable energy solutions offer the most advantages and why?
- Which solutions would seem most applicable to your local area?
- Which geographical areas would generate the highest energy utilising wind power?

Key facts

- In the last 40 years natural gas has become a vital part of the world's energy balance and in 2004 accounted for nearly 25% of the world's energy consumption.
- Demand for natural gas is currently growing faster than any other fossil fuel.
- Combined Cycle Gas Turbine (CCGT) power stations burn gas to drive a turbine which generates electricity and produce far fewer emissions.
- The amount of energy derived from wind power is likely to increase by 25% by 2010.
- Solar power accounts for approximately 10% of all renewable energy generated at present.

Glossary

Biomass - The total number of living organisms in a given area, expressed in terms of living or dry weight per unit area.

Bitumen - A black viscous mixture of hydrocarbons obtained naturally or as a residue from petroleum distillation. It is used for road surfacing and roofing.

Butane - A flammable hydrocarbon gas of the alkane series, present in petroleum and natural gas. It is used in bottled form as a fuel.

Catalyst - A substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.

Climate change - Short-term climate variability and longer-term trends or shifts in climate caused by natural mechanisms or by human activity.

Cracking - Breaking down large hydrocarbons into smaller, more useful molecules by heat and pressure (with or without a catalyst), especially in oil refining.

Crude oil - Oil in a natural or raw state; not yet processed or refined.

Distillation - The act, process or product of distilling. To separate a substance into individual components by boiling.

Ecological - Relating to or concerned with ecology; the branch of biology that deals with the relations of organisms to one another and to their physical surroundings.

Enhanced greenhouse effect - The build up of gases that accelerate the process where heat from the sun is naturally occurring and is trapped in the earth's lower atmosphere.

Ethene/Ethylene - A flammable hydrocarbon gas of the alkene series, occurring in natural gas, coal gas and crude oil. It is used in chemical synthesis, especially in the manufacture of polyethene.

Fossil fuel - A natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.

Fraction - Each of the portions into which a mixture may be separated by a process in which the individual components behave differently according to their physical properties.

Fractional distillation - Separation of a liquid mixture into fractions differing in boiling point (and hence chemical composition) by means of distillation, typically using a fractionating column.

Geophysicist - Someone who studies the earth's physical properties.

Geoscientist - A person who studies or has expert knowledge relating to earth sciences.

Geothermal - Of, relating to, or produced by the internal heat of the earth.

Global warming - Climate change resulting from greenhouse gas emissions.

Greenhouse emissions - The gases, such as carbon dioxide and chlorofluorocarbons (CFCs) that contribute to, or cause, the greenhouse effect.

Hydrocarbon - Any organic compound containing only carbon and hydrogen (the chief components of petroleum and natural gas).

Hydroelectric(ity) - Relating to or denoting the generation of electricity using flowing water (typically from a reservoir held behind a dam or barrage) to drive a turbine, which powers a generator.

Impermeable - Not allowing fluid or gases to pass through.

Kerogen - A complex, fossilised organic material found in oil shale and other sedimentary rock, which is insoluble in common organic solvents and yields petroleum products on distillation.

Kerosene - A light fuel oil obtained by distilling petroleum, used especially in jet engines and domestic heating boilers; paraffin oil.

Landfill - The disposal of refuse and other waste material by burying it and covering it over with soil, especially as a method of filling in and reclaiming excavated pits.

Molecule - A group of atoms bonded together, representing the smallest fundamental unit of a chemical compound that can take part in a chemical reaction.

Naphtha - A fraction of crude oil used as a feedstock for the petrochemical industry.

Natural gas - A flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.

Petrochemicals - Relating to the substances obtained by the refining and processing of petroleum or natural gas.

Photovoltaic - Relating to the production of electric current at the junction of two substances exposed to light.

Polymer - A compound made up of one or more large molecules formed by repeated units of smaller molecules bonded together.

Refining - Making free from impurities, sediment or other foreign matter by processing.

Renewable energy - An alternative source of energy, such as wave, wind or sun that does not use up the earth's natural resources or otherwise harm the environment, especially by avoiding the use of fossil fuels or nuclear power.

Sedimentary - Of or containing sediment. Rocks formed by or from deposits of sediment.

Seismic survey - Investigating the depth and character of subsurface rock formations by noting the vibrations produced artificially by shock waves.

Source rock - A rock formation from which later sediments are derived or in which a particular mineral originates.

Definitions based on The Collins English Dictionary, Oxford English Dictionary, Penguin English Dictionary.

Curriculum Links

These notes accompanying the energy business posters can be linked to support many curriculum areas for secondary age groups including Business Studies, PSHE/PSE/PSD and Citizenship. However, below, we have concentrated on links for Science and Geography.

The key curriculum areas in England and Wales

Science
- enquiry and investigative skills
- materials and their properties, classifying, changing materials - physical, geological and chemical changes, and useful products, patterns of behaviour
- physical processes, electricity and magnetism, force and motion, waves, light and sound, energy resources and energy transfer

Geography
- enquiry skills and knowledge and understanding of places, patterns and process and environmental change and sustainable development
- breadth of study to geomorphological process and environmental and resource issues.

The key curriculum areas in Scotland

Environmental studies:

Science
- investigating skills, knowledge and understanding of earth and space, materials from the earth and changing materials
- energy and forces - properties and uses of energy, conversion and transfer of energy, forces and effects

Society
- enquiry skills, knowledge and understanding of people and physical environment and interaction.

These posters are designed to give an overview of BP as an energy business, utilising an imaginative mix of photographs, illustrations and diagrams with key points highlighted in text. It is hoped that the posters will assist teachers in the classroom to stimulate students and encourage them to investigate the issues covered.

These teacher's notes are intended to provide more detail to the events and processes depicted on the posters. You may be interested in other BPES resources which provide further information and support material:

The energy business booklets

A set of seven informative booklets with useful data, terminology and glossaries plus photographs, diagrams, charts and illustrations. They look at BP as a whole, reflecting the wide range of activities in which the company is involved and the science and technology driving it, including: the formation, exploration and production of crude oil and natural gas; refining, processing, marketing, supply and transportation; the manufacture and marketing of petrochemicals; the focus towards the use of cleaner and renewable energy forms.

About BP

A leaflet providing an overview of BP, its history, how it operates, its businesses, its policies and key statistics, as well as interesting facts.

The energy for the world series on DVD

An ideal resource for introducing energy-related topics. There are three lively, fast-paced and very informative films on the DVD touching on issues that impact at local, national and global levels.

The supporting teacher's notes contain full voice-over scripts with suggested activities, linking directly into the curriculum.

To order any of these resources or request a free copy of the BPES catalogue please contact us:

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www.bp.com/bpes