

The Industrial Revolution

Introduction

In January 2007, the European Commission (EC) called on respective governments on the continent to herald a post-industrial revolution by adopting environmentally-friendly energy plans.

Unveiling its long-awaited energy strategy for the EU, the commission is proposing that all member states pledge to cut greenhouse gas emissions by 20 per cent over the next 13 years.

The EU's civil service wants more investment in renewable energy, such as wind power, wave power, solar energy and biofuels, arguing that the old fuels have a political as well as clear environmental costs. The need has been given greater urgency by Russia's oil row with Belarus, which has hit EU states Germany and Poland.

The European Commission says the days of secure, cheap energy for Europe are over.

Surging world demand for limited stocks of oil and gas has sent prices higher. The EU executive said "Europe has to look at alternatives: using more renewable energy such as wind power and biofuels."

Electricity generation will be "heavily dependent" on natural gas, it said, warning a number of countries reliant on one main supplier that they should diversify.

The EU said it is confident that relationships with oil and gas suppliers Norway, Russia and Algeria will strengthen but also that it needs to open up a range of sources, suppliers, transport routes and methods.

European concerns about the reliability of Russian supplies were underscored on Monday when shipments of oil from Russia, via a pipeline running through Belarus, were disrupted by a trade dispute between the two former Soviet republics.

In an effort to diversify supply, the EU plans to start negotiations with Turkmenistan and Uzbekistan, build on agreements with Azerbaijan and Kazakhstan and cement relations with Turkey, Egypt and other nations, including Libya, it said.

It will also explore bilateral pacts with the Gulf state of Qatar and energy exporting nations in the Caribbean and Latin America, it said.

The world also needs to make a global effort to cut energy use, it suggests, proposing an energy efficiency agreement for industrialized nations plus China, India and Brazil to be signed at the Beijing Olympics in July 2008.

Supply uncertainties mean the EU has to rely on power in its own backyard, boosting renewables and making 'clean coal' technology a reality.

The EU executive suggests setting a new target for renewable power by 2020, with a binding target for biofuels to replace oil in vehicles. It says that biofuels could take up 14 percent of that market by 2020.

"Major investment" in renewable energy is needed to create the economies of scale that would make it viable, to draw 12 percent of all EU energy from renewables by 2010.

Vast amounts of money also need to be pumped into Europe's electricity network with some 900 billion euros (\$1.17 trillion) needed just to provide more power generation alone in the next 25 years as demand grows.



Task

Match the words in the box with their definitions.

| | | | | |
|---------|-----|--------|--------|-----------|
| urgency | row | cement | pledge | unveiling |
|---------|-----|--------|--------|-----------|

1. v. promise _____
2. v. announcing _____
3. n. the need to do something quickly _____
4. n. argument, dispute _____
5. v. make secure _____

Discussion

Which of the following are 'renewable resources'?

| | | | | |
|------------|--------------|----------------------|-------------|-------------|
| wind power | solar energy | wave power | coal | electricity |
| petroleum | biofuel | hydro-electric power | natural gas | microwaves |

Historical Energy Sources

If we are planning a 'new industrial revolution', it is sensible to consider the history of energy sources.

The Great Pyramid of Giza was constructed using the human muscle power of thousands of individual workers. They were assisted by domesticated animals such as oxen, and camels. The heavy stones used for building the pyramid may have been carried by sailing ships using wind power.

Of course, solar power and biofuel were also used. The workers and animals gained their strength from the food which they consumed. This food, the meat from animals and the vegetables and grains from the fields, were the result of power from the sun and the chemicals in the earth and air.

The workers needed light in order to work. This light also came from the sun.

The ancient world was a world which exploited renewable energy sources. They cooked their food by burning wood. In the evenings, they used lamps which burnt animal and vegetable oils.

Discussion

Which sources of energy were used to build the Great Pyramid?

The industrial revolution

The industrial revolution began, in Western Europe, with the use of the first fossil fuel – coal. There is evidence from China that coal was used in metal working in 1,000 BC. We know that the Greek philosopher, Aristotle, had heard about coal because he refers to a rock which ‘burns like charcoal’. But coal was not widely used in Europe until the development of steam power.

Steam power

When water is heated to 100°C it expands and becomes a gas. Scientists had used the steam power for simple toys for many centuries, but early in the 18th century Thomas Newcomen constructed a steam powered pump for removing water from underground mines. Later in 1769, James Watt, a Scottish engineer, patented an improved design for a steam-powered piston engine.

Before the development of the steam engine, windmills and water wheels were the only source of power. They were used to turn the grinding stones for milling grain and for various small industrial activities. James Watt’s steam engine provided the power for the factories of the industrial revolution.

James Watt’s steam engine was used in factories but also in mines to pump water out of the underground passages. In 1829, George Stephenson built ‘The Rocket’ a revolutionary new steam locomotive, which could travel at 58 kph, and the railway age began. Steam engines were also used in ships, first to drive paddle wheels and later propellers. Isambard Kingdom Brunel (1806-1859), built the *Great Western* which was the first ship to start a regular passenger service from Britain to North America in 1837. Later, in 1843, he built the *Great Britain* the first iron ship to have a steam powered propeller. His greatest achievement in 1858 was the *Great Eastern*, the largest ship in the world, which was powered by both paddle wheels and propellers.

In 1884, an Irish engineer, Charles A Parsons, invented the steam turbine engine. This was much more efficient than James Watt’s reciprocating piston engines because it produced a circular motion. Turbines were quickly employed to drive dynamos in generating electricity.

The steam engines which powered factories, locomotives and ships consumed enormous quantities of coal. Fortunately, there were good sources of coal in the mines of Wales and the north of England. Coal was also used for cooking and heating in the homes of the expanding population of Britain.

Coal was also used for making coal gas. In cities, coal gas was used for lighting in the streets and houses. Later, coal gas was used for cooking and heating in people’s houses.

By the end of the 19th century large amounts of coal were also used for generating electricity.



Task

Match the names of the engineers with their achievements.

| | |
|-------------------------|---|
| Isambard Kingdom Brunel | developed and improved the steam piston engine. |
| Charles A Parsons | built the first steam pump. |
| George Stephenson | built the largest ship in the world. |
| Thomas Newcomen | used a steam turbine to create rotating motion. |
| James Watt | built a railway locomotive which travelled at 58 kph. |

Discussion

**Did the development of steam power in Britain have any influence in your country?
When, where and what was that influence?**

Petroleum

People in China, Iran and Poland had been exploiting natural sources of petroleum for many hundreds of years. In Pennsylvania people were burning petroleum for lighting and using it as an industrial lubricant in the 1820s. In 1849, Dr. Abraham Gesner, a Canadian geologist, distilled kerosene from petroleum. This was the start of the oil refining business. Edwin Drake dug the first oil well for extracting petroleum in 1859.

The development of the automobile engine in 1886 by Daimler and Benz led to the rapid expansion of the car industry and an increased demand for petroleum. The lightweight but powerful internal combustion engines made possible the first powered aeroplane flights by Santos Dumont in Brazil, the Wright Brothers in the USA and others in Europe in the first years of the 20th century.

Petroleum became the most important energy source during the 20th century. Refined petroleum oil powered and lubricated industrial expansion. The petrochemical industry also started early in the 20th century with the development of the first plastics. Petroleum gas (natural gas) also became an important energy source in the second half of the century.

The world demand for crude oil increased enormously. The rich oil fields in the USA, Russia, Venezuela and Iran were not enough to feed this demand. The search for new sources of petroleum became the great adventure of the 20th century. Oil was discovered in many countries in the Middle East. Later large deposits of petroleum were found in the North Sea and Alaska. Towards the end of the century, new oil fields were discovered in Kazakhstan and nearby countries.

As the 20th century drew to a close, the prospect of exhausting the world's supply of oil became more and more likely.

Task

Choose the correct words from the box to complete the sentences below.

| | | | | |
|-----------|---------|----------|--------|------------|
| petroleum | powered | plastics | refine | automobile |
|-----------|---------|----------|--------|------------|

1. Abraham Gesner was the first person to _____ kerosene from petroleum.
2. Edwin Drake dug the first oil well for extracting _____ in 1859.
3. The _____ engine was developed in 1886 by Daimler and Benz in Germany.
4. Santos Dumont was an early pioneer of _____ flight in Brazil.
5. The first _____ were one of products of the petrochemical industry.

Nuclear Energy

Ernest Rutherford, a scientist from New Zealand, was working in Cambridge, England. He was studying the structure of atoms. He showed that at the centre of each atom there is a nucleus which is made up of different particles. Electrons are in orbit around the nucleus. In 1919, Rutherford demonstrated that it was possible to split the nucleus of an atom. This 'nuclear fission' released enormous quantities of energy. Rutherford's work was developed during the Manhattan Project in the USA to create the first atomic bombs during the second world war.

An essential part of the Manhattan project was the use of an 'atomic pile', a large quantity of radioactive materials, to create plutonium. As atomic piles work, they produce energy which could be used to generate electricity. In the period following the end of the second world war, major world powers continued their research with atomic piles.

Nuclear power stations can generate large quantities of electricity, but they also produce large quantities of dangerous nuclear waste. This waste will remain dangerous for thousands of years. Up to now, nobody has discovered how to treat nuclear waste or even how to store it safely.

We have seen the catastrophic results of accidents at nuclear power stations in Pennsylvania, USA and Chernobyl, near Kiev in Ukraine.

Biofuels

A biofuel is any fuel derived from biomass, recently living plants or their byproducts such as the manure from cows. Biofuel can be created in different ways.

Sugar cane is used to create alcohol. This alcohol can be used to drive cars and other engines. Biofuel from sugar cane has been successfully used in Brazil.

When vegetables decay methane gas is released. This gas can be used in place of coal gas or petroleum gas.

Vegetable oils, like sunflower oil or oil from the rapeseed plant can be converted into a fuel like diesel.

The next industrial revolution?

As we have seen, over the past two hundred years we have used non-renewable fossil fuels as our main sources of energy. During the 19th century industrial expansion was made possible by burning coal. During the 20th century, petroleum was the main source of our energy.

Now, in the 21st century, we need to move to different sources of energy. We need to move for two reasons. Firstly, we are finding it more and more difficult to discover new supplies of petroleum and coal. Secondly, the chemicals produced from using coal and petroleum are causing damage to the climate. The Earth is getting warmer. This is changing our weather. The ice at the North and South poles is melting. This means that there will be more water in the seas and oceans. Water from the sea will cover the land on which we live.

Task

Choose the correct words from the box to complete the sentences below.

1. In 1919, Ernest Rutherford first split the atom in | Manhattan | Cambridge | New Zealand.
2. In the USA, scientists used an atomic | nucleus | pile | bomb | to create plutonium.
3. Nuclear energy is used to create | gas | waste | electricity |.
4. | Methane | Coal | Natural | gas is produced when vegetables decay.
5. | Fossil fuels | Biofuels | Renewables | are damaging the Earth's climate.

Discussion

Is global warming affecting your country? What is happening now? What may happen in the future?