

I. UK Energy Market-Brief Information

Today around 90% of the UK's energy needs are met by oil, gas and coal. Renewable and other low carbon technologies will play an increasing role in the longer term; however, it seems that fossil fuels will continue to be the predominant source of energy. In fact, global fossil fuel resources are still plentiful, and markets are well-developed to deal with increased trade. By 2020, fossil fuels are expected to still supply the great majority of UK energy needs.

The current Energy Policy of the UK is set out in the Energy White Paper of May 2007 that has been developed on previous work including the 2003 Energy White Paper and the Energy Review Report in 2006. The 2007 White Paper: "*Meeting the Energy Challenge*" sets out the Government's international and domestic energy strategy to address the long term energy challenges faced by the UK, and to deliver four key policy goals¹:

1. To put the UK on a path to cut carbon dioxide emissions by some 60% by about 2050, with real progress by 2020;
2. To maintain reliable energy supplies;
3. To promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve productivity;
4. To ensure that every home is adequately and affordably heated

The scope of the energy policy includes the production and distribution of electricity, transport fuel usage, and means of heating (significantly natural gas). The policy recognizes that energy is essential in almost every aspect of our lives but there are challenges:

- Tackling climate change by reducing carbon dioxide emissions both within the UK and abroad;
- Ensuring secure, clean and affordable energy as we become increasingly dependent on imported fuel
- Increasing energy demand: global energy demand will be more than 50% higher in 2030 than today, with energy related greenhouse gas emissions around 55% higher².
- Increasing competition for resources will double the international trade in fossil fuels by 2030. This trend and factors such as abuse of market power, poor energy market information, infrastructure security risks, and regulatory uncertainty (particularly concerning government actions to tackle climate change) could add to the risks to energy security and prices.

The International Energy Agency (IEA) forecasts that \$20 trillion of investment will be needed to meet these challenges by 2030.

Energy policy is an area reserved to the UK government under the Scotland Act 1998 that established devolved government for Scotland, the Scottish Government has an energy policy for Scotland at variance with UK policy, and has planning powers to enable it to put its policy priorities into effect.

The January 2008 Energy Bill updates the legislative framework in the UK to reflect their current policy towards the energy markets and the challenges faced on climate change and

¹ <http://www.berr.gov.uk/energy/whitepaper/>

² World Energy Outlook, IEA, 2006. See <http://www.worldenergyoutlook.org/>

security of supply. Key elements of the bill address nuclear, carbon capture and storage, renewables and offshore gas and oil. A framework to encourage investment in nuclear power within a new regulatory environment was simultaneously published in the January 2008 Nuclear White Paper.

Under these conditions, as a crucial issue UK will need around 30-35GW of new electricity generation capacity over the next two decades as many of the UK's current coal and nuclear power stations, built in the 1960s and 1970s, reach the end of their lives and are set to close

Historically a country emphasizing its coal, nuclear and off-shore natural gas production, the United Kingdom is currently in transition to become a net energy importer. In the year 2005 the percentage of primary energy derived from major sources was as follows:

- Natural gas: 40%
- Oil: 33%
- Coal: 17%
- Nuclear power: 8%
- Renewable: 2%

Year 2005 UK end use energy percentage is approximately:

- Transport: 35%
- Space heating: 26%
- Industrial: 10%
- Water heating: 8%
- Lighting/small electrics: 6%

II. PRIMARY SOURCES

1. Oil Policy

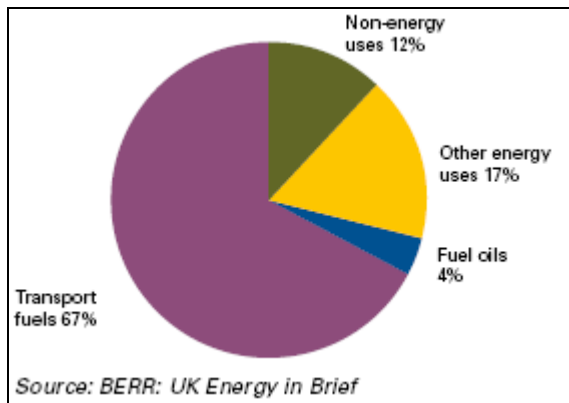
In 2006, the top ten oil producing countries accounted for 62% of global production, with the UK ranked as the 18th largest producer. Until the 2000s, the UK has been one of the few countries to have been largely self sufficient in energy, and indeed a net-exporter of oil and gas in recent decades.

Due to the decline in North Sea production, and the costs of mining and using coal cleanly, unless action is taken to reduce demand, it is expected that the UK will become a major importer of oil and gas by 2015. After becoming a net exporter of gas in 1997, the UK became a net importer again in 2004.

UK is already heavily involved in the global oil market as both importer and exporter, with the balance expected to move towards increasing import dependency over the medium and long term.

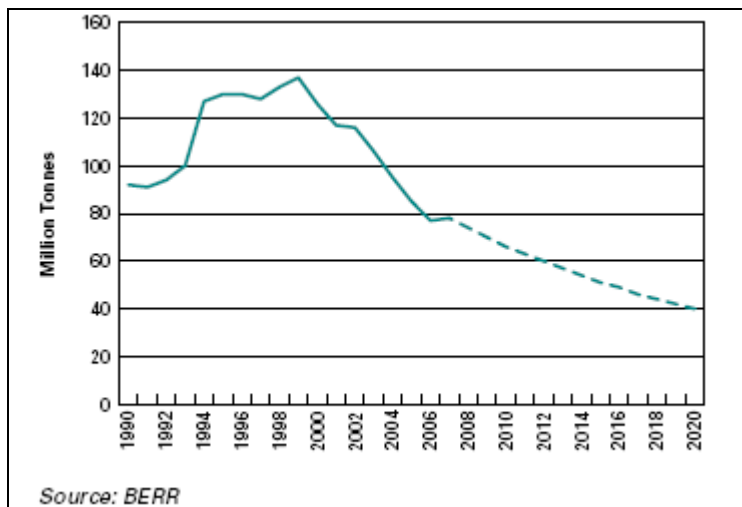
The majority (67% in 2006) of UK oil demand is derived from the demand for road or air travel, with the remainder for energy or industrial use (21%) and non-energy use (12%) for lubricants and petro-chemical feedstocks.

UK Oil Demand 2006



Concerning the oil supply, the UK's indigenous oil production peaked in 1999 but has been declining subsequently³. If recent trends continue production could fall from three million barrels of oil equivalent (boe) a day now to around 1 million boe a day by 2020.

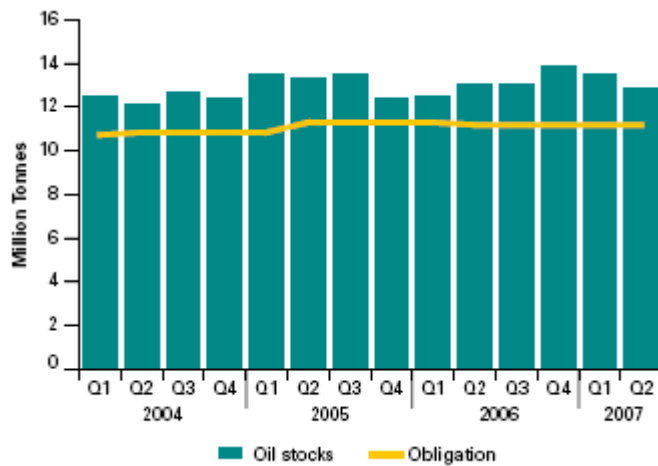
UK Crude oil and natural gas liquids production 1990 –2020



Concerning the oil stocks, UK is meeting the EU requirement, which is presently higher than the IEA requirement.

³ http://www.og.berr.gov.uk/information/bb_updates/chapters/Section4_17.htm

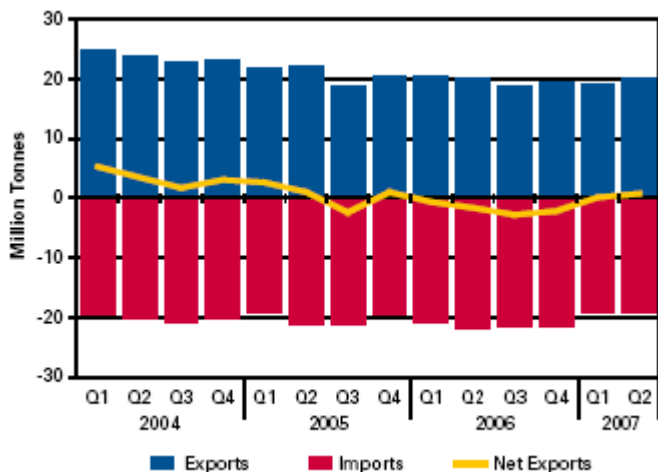
UK oil stocks compared to the EU obligation



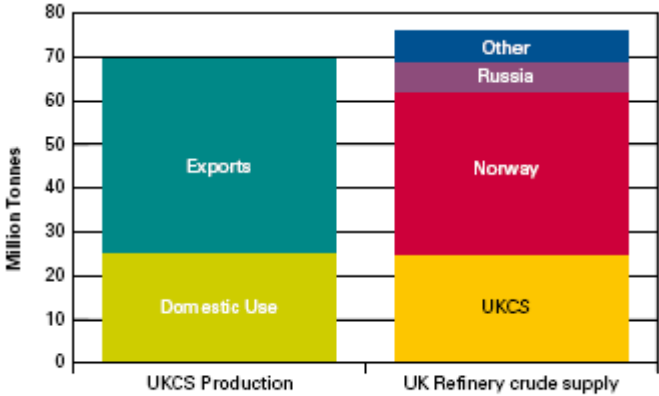
Between about 2016 and 2018 the IEA obligation is expected to overtake the EU obligation. Thereafter, the UK obligation will begin to increase steeply from its current level of 67.5 days' consumption to an eventual total of 99 days' consumption.

The UK only quite recently became a net oil importer. Overall, the UK currently produces about the same amount of oil as it consumes, such that the net import-export balance, while now shifting towards imports, is quite small.

UK trade in crude oil, NGLs and petroleum products



Destination of UK production and sources of UK supply,



Source: BERR

The UK currently has nine refineries which produce around 82 million tonnes of oil products per year.

Although the UK currently produces about the same quantity of oil as it consumes, commercial reasons mean that more than 60% of this production is exported (mostly to the EU or United States). More than threequarters of the crude oil refined in the UK comes from either the UKCS (35%) or from Norway (46%), with the remaining supplies mainly sourced from Russia (8%) and the Middle East (2%)⁴.

2. Coal Policy

Coal usage can be expected to decline steadily because of eroding cost advantages and pressure to reduce sulphur and carbon (carbon dioxide) emissions, notwithstanding ongoing subsidy policies designed to retain jobs in the coal mining industry.

It is observed that British coal production fell significantly over the last decade. In 1998 over 40 million tones was produced, while by 2006 production had fallen to 18.6 Mt. The main sources of imported coal were from Russia (22.6 million tones – 51% of steam coal imports) and South Africa (13.1 million tones – 30% of steam coal imports). Some projections demonstrate that UK coal production in 2020 will stand at 13 million tones, with net imports at 35 million tones. However, it should be underlined that the total demand for coal in the UK will depend on commercial decisions, particularly those made by generators, within the regulatory and economic environment that develops over this period.

The demand from coal-fired generators is an important driver of UK coal investment. Coal-fired generation makes an important contribution to the UK’s energy security and the flexibility of the UK energy system. However, its future depends on the effective management of its environmental impact. Generators have already committed significant investment to enable 20 gigawatts of existing coal-fired power stations to comply with new EU emissions legislation. Plans for new coal-fired power stations have also been announced which use state-of-the-art cleaner coal technologies and are designed to accept carbon capture and storage (CCS) equipment when this becomes commercially viable. England, Wales and Scotland still have

⁴ Meeting the Energy Challenge, Department of UK Trade and Industry, p114

significant recoverable coal reserves. These reserves have the potential to help to meet UK's national demand for coal and to reduce UK's dependence on imported primary fuels. However, a number of factors exist including the costs of recovery compared with the market value of the coal and the implications of planning considerations including potential environmental impacts.

UK is focusing to strengthening the coal industry, to secure the long-term future of coal-fired power generation; optimize the use of UK's coal reserves, where recovery is economic; and stimulate investment in clean coal technologies.⁵ The 2002 Energy Review concluded that the option of new investment in clean coal technology (through carbon sequestration) needed to be kept open, and that practical measures should be taken to do this.

3. Natural Gas

The UK ranks world's fourth largest producer and third largest consumer of natural gas (10 billion cubic feet per day) Domestic production is in decline with current forecasts predicting the UK becomes a net importer of gas and reliant on imports for over 50% of gas supplies by the end of the decade.

UK gas demand is set to continue growing over the next fifteen years, driven mainly by increased demand from the power sector. As gas production from the UKCS declines, UK will import increasing quantities of gas from international markets.

Natural gas has been the fuel of choice for UK energy consumption over the last 25 years, growing at an annual rate of 3.7% versus total energy consumption growth of 0.5% per annum. This bias has increased the natural gas component of overall energy demand from 19% in 1978 to 41% in 2002. Growth in the UK's domestic natural gas demand and the development of the North Sea as a major hydrocarbon basin has established the U.K. as the world's fourth largest producer and third largest consumer of natural gas, comprising 4% of the global market.

Natural gas looks set to take a smaller part in providing future UK energy needs. Domestic production from the North Sea gas fields continues to lessen. And despite investment to enhance pipelines and storage of imported natural gas (Mostly from Norway) there is a reluctance to allow too great a reliance on Russia and its gas exports for energy needs.

Gas production from the UK Continental Shelf (UKCS) is now in decline and indigenous production still supplies the majority of UK gas demand and there is a trillion cubic meters of gas reserves remaining⁶. The decline can be slowed down if the government encourages investment. It seems that there will be an import requirement in the following years.

By the year 2021, North Sea oil and natural gas production is predicted to slip 75 percent from 2005 levels to less than one million barrels per day. Oil and coal reserves for all of Europe are among the most tenuous in the developed world: for example, Europe's reserves to annual consumption ratio stands at 3.0, perilously low by world standards.

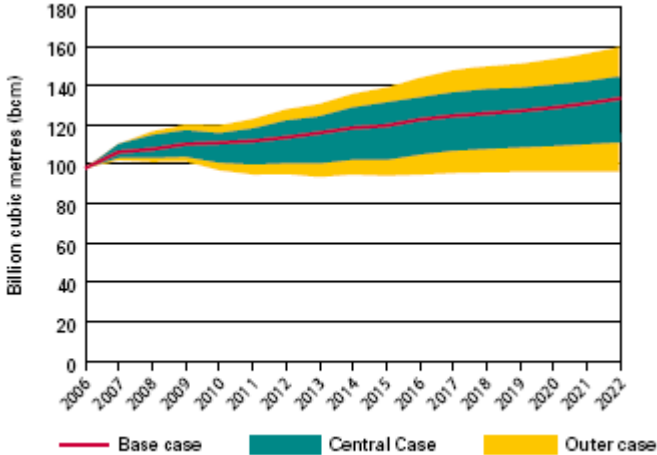
While the UK has benefited from indigenous reserves of oil and gas for many years, as the North Sea matures, UK will become increasingly dependent on imported energy. By 2010, gas

⁵ <http://www.berr.gov.uk>

⁶ http://www.og.berr.gov.uk/information/bb_updates/chapters/reserves_index.htm

imports could be meeting up to a third or more of the UK’s total annual gas demand, potentially rising to around 80% by 2020 on the basis of existing policies⁷.

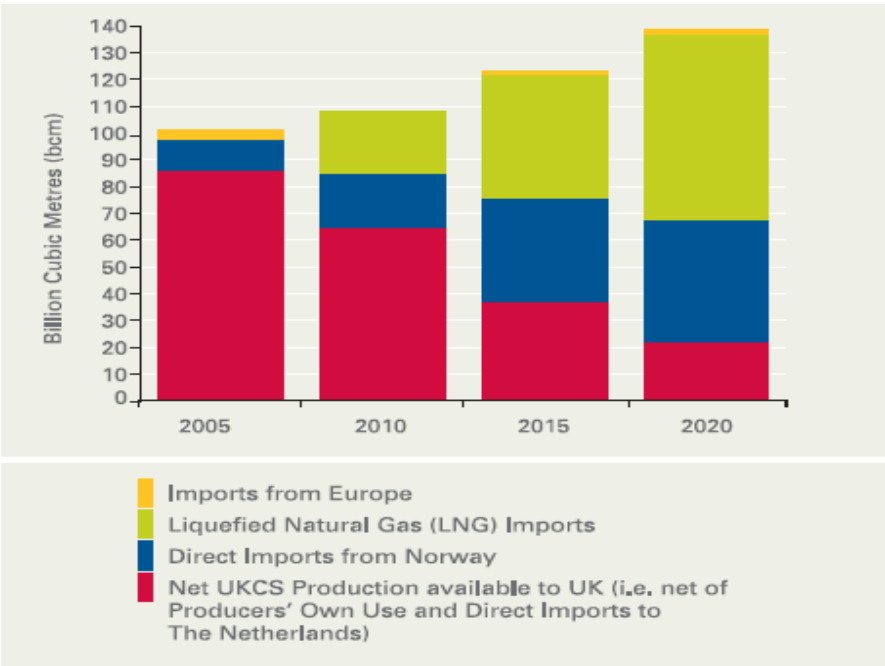
Possible future annual gas demand in Great Britain



Source: Base Case as reported in the 2007 TBE ‘Development of NTS Investment Scenarios’ Figure 1. Central & Outer Cases developed as part of EMO process.

By 2010, imports could be meeting up to a third or more of the UK’s total gas demand, potentially rising to around 80% by 2020. In the medium term, limited liquidity in the market and shipping distances mean that gas will still be largely supplied regionally through pipelines. Norway will remain a key supplier and is expected to provide up to around a third of our supplies by 2020. Other supplies will come from continental Europe, and from the development of the Liquefied Natural Gas (LNG) market

POSSIBLE SCENARIOS FOR UK ANNUAL GAS SUPPLY MIX



⁷ <http://www.berr.gov.uk/files/file39568.pdf>

UK is now a net importer of gas on an annual basis and has the capacity to import direct from Norway and from Continental Europe by pipeline, and from the global market by liquefied natural gas (LNG) tanker.

The International Energy Agency (IEA) projects that demand in Europe will be some 45% higher in 2030 than in 2004⁸. This will in part be driven by rising gas fired power generation. Import dependency is expected to rise in Europe (from 40% to over 60% by 2030) as indigenous production falls. Additionally, increased EU liberalisation, market opening and competition may lead to a greater use of improved demand management. This will also be important for security of supply for the UK.

In the short term, however, the UK's gas supply capacity appears robust against most credible scenarios and events. For the medium to long term, investments over the next five years are critical; if they come forward as expected, the capacity margin will be large enough to provide a buffer against most large single interruptions.

4. Nuclear Power Policy

Nuclear power has been part of the UK's energy mix for the past five decades UK has met most of its energy needs from domestic sources: coal, until the middle of the 20th century, and since the 1970s, oil and gas from the North Sea. Since the 1950s, nuclear power, fuelled by imported uranium, has generated a significant proportion of UK's electricity, reaching a peak of 30% of electricity output in the 1990s. Nuclear power currently accounts for approximately 19% of the UK's electricity generation and 7.5% of total UK energy supplies. The UK currently has 19 operating reactors, which supplied 75.45 TWh. Thus, over the past decade nuclear power met about one-fifth of UK's electricity needs. *If UK had built fossil fuelled power stations rather than nuclear power stations, the UK's total carbon emissions from all sectors might have been 5% to 12% higher in 2004?*

Over the next three decades, the current fleet of nuclear power stations operating in the UK will close – Sizewell B power station is scheduled to close in 2035. In the absence of a new build programme, there will be a steady decline in the amounts of uranium fuel required to supply the UK's nuclear generation capacity. The UK nuclear industry currently sources most of its uranium from Australia under the auspices of the Euratom Supply Agency (ESA), which was established in order to implement one of the principal requirements of the European Atomic Energy Community (Euratom) Treaty to ensure that all users of nuclear power in the Community receive regular and equitable supplies of ores and nuclear fuels.

The government agrees that new nuclear power stations can help the UK to meet its objectives on climate change and energy security although it has been debated a lot in the public. The UK Government will take a number of facilitative actions to reduce regulatory and planning risks of investing in new nuclear power stations and to ensure that owners and operators of new nuclear power stations set aside funds over the operating life of the power station to cover the full costs of decommissioning and their full share of long-term waste management and disposal costs. These facilitative steps will reduce uncertainties in the pre-construction period through improvements to the regulatory and planning processes⁹.

⁸ IEA World Energy Outlook <http://www.worldenergyoutlook.org/>

⁹ <http://nuclearpower2007.direct.gov.uk/docs/WhitePaper.pdf>

Following the UK Government's January 2008 decision to support the building of new nuclear power stations, four new plants are planned to be opened in the UK by 2017. EON and Centrica have also shown interest in building further plants. However, Scotland's First Minister Alex Salmond has said there is "no chance" of more nuclear power stations being built in Scotland as the Scottish Government is opposed to new nuclear power stations and has sufficient powers to prevent any being built in Scotland.

The 2006 Energy Review reintroduced the prospect of new nuclear power stations in the UK. However, following a judicial review requested by Greenpeace, on February 15, 2007 elements of the 2006 Energy Review were ruled 'seriously flawed', and 'not merely inadequate but also misleading'. As a result, plans to build a new generation of nuclear power plants were ruled illegal at that time. In response, the Government ran "The Future of Nuclear Power" consultation from May to October 2007. The Government's response to the consultation conclusions, published in January 2008, state "set against the challenges of climate change and security of supply, the evidence in support of new nuclear power stations is compelling."

5. Renewable Energy

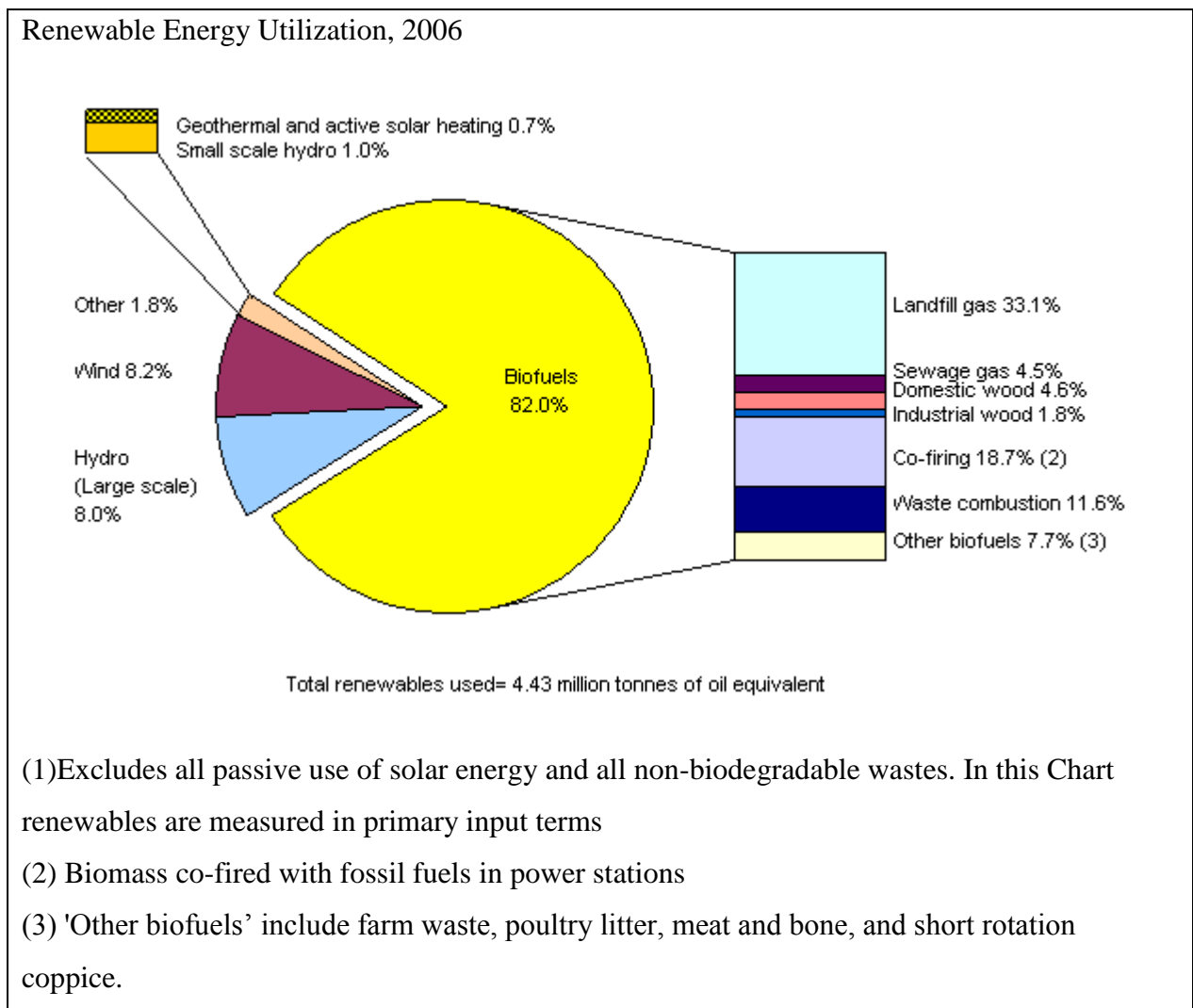
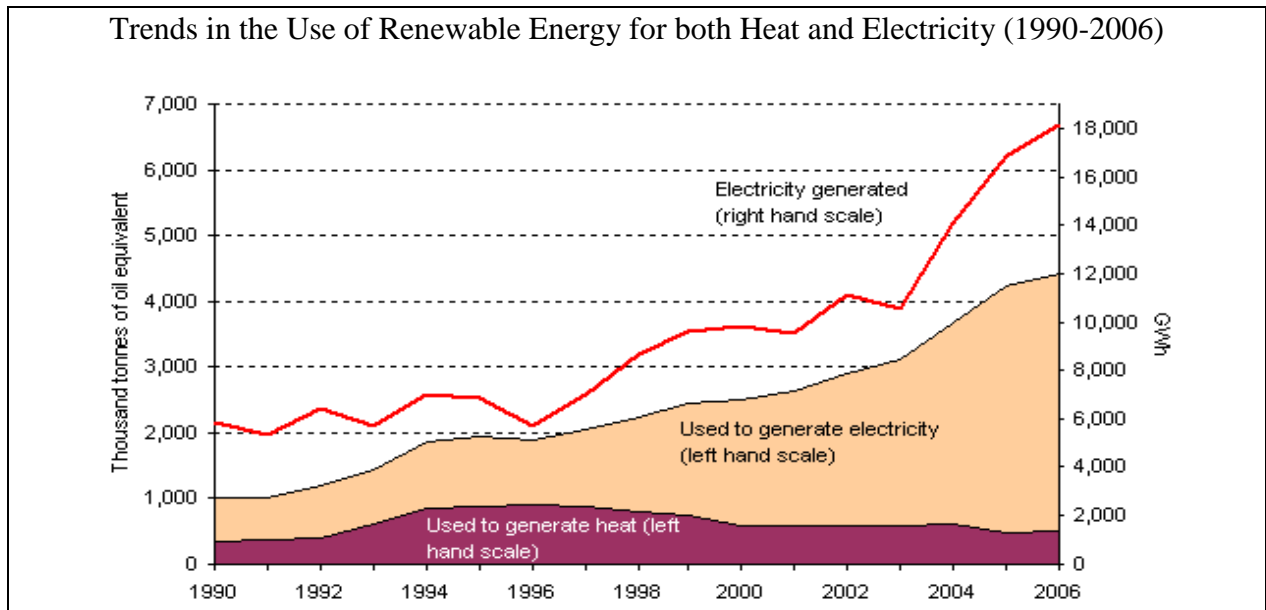
Renewable energy can be described as energy flows that occur naturally and continuously in the environment, such as energy from the wind, waves, tides, geothermal heat. Day by day renewable energy becomes to be more important for the entire world because renewable energy adds very few pollutants to the environment. As a result renewable energy prevents the air pollution. On the other hand renewable energy helps to protect global climates with reduction of carbon dioxide (CO₂) emission. Renewable energy plays an important role on helping the UK meet its energy policy goals. Renewable energy increases the diversity of primary fuel sources and reduces the fossil fuel import dependency.

The UK has had a delivery program for renewable electricity since 1990, initially the Renewable Non-Fossil Fuel Obligation (NFFO) and, since 2002, the Renewables Obligation (RO). The Renewables Obligation (RO) is part of the UK's proposed programme to tackle climate change and to encourage a more sustainable approach to energy consumption. The Climate Change Bill, published in draft in March 2007, sets out a proposed UK target of at least 60% cuts in carbon dioxide emissions by 2050

The UK Government's goal for renewable energy production is to produce 20% of electricity in the UK by the year 2020. The 2002 Energy Review set a target of 10% to be in place by 2010/2011. The target was increased to 15% by 2015 and most recently the 2006 Energy Review further set a target of 20% by 2020. However, a November 2005 poll, conducted by YouGov for Deloitte, indicated that 35% of the population expects that the majority of electricity generation will come from renewable energy by the same date.

89 % of the renewable energy produced in 2006 was transformed into electricity. Overall, renewable sources provided 1.8 % of the United Kingdom's total primary energy requirements in 2006. All renewable sources provided 4.55% of the electricity generated (which means 18133 GWh) in the United Kingdom in 2006.

For Scotland, the Scottish Executive has a target of generating 17% to 18% of electricity from renewables by 2010, rising to 40% by 2020. Renewables located in Scotland count towards both the Scottish target and to the overall target for the UK.



Source: <http://www.restats.org.uk/utilisation.htm>

5.1. Wind

The UK has the best wind energy resource of any country in Europe. The UK has 40% of Europe's total wind energy but only 0.6% of UK's electricity requirements are generated by wind and UK's potential resource for wind generated electricity is put at about 20% of current electricity requirements. Every unit of electricity from a wind turbine displaces one from conventional power stations. As a result of wind turbines in the UK currently prevent the emission of one and three-quarter millions tones of carbon dioxide each year. In 2006, the electricity generated from wind energy is 4232 GWh in the United Kingdom¹⁰

5.2. Biomass

In 2003, biomass used for both heat and electricity generation accounted for 87 per cent of renewable energy sources in the UK. The majority of this came from landfill gas (33 per cent) and waste combustion (14 per cent) (source: BERR, UK Energy in Brief, July 2007). Smaller amounts also came from sewage gas, domestic wood and industrial wood. Electricity produced from biomass accounted for 1.55 per cent of total electricity supply in the year. Biomass sources used to generate electricity (3.5% of UK electricity production) and heat (0.6% of heat generation) is 3633 GWh in the UK in 2006. The Government's strategy for biomass is intended to realise a major expansion in the supply and use of biomass in the UK. Biomass has the potential to make a significant contribution to UK heat and energy generation in the future. Development of some forms of biomass may be constrained by limited resources, for example landfill gas. Energy crop-based solutions are also difficult to import economically, although there is the potential for many biomass feedstocks to be grown within the UK.

5.3. Wave and Tidal Stream Power

Waves in the oceans are created by the interaction of winds with the surface of the sea. Because of the direction of the prevailing winds and the size of the Atlantic Ocean, the United Kingdom has wave power levels, which are amongst the highest in the world. Currently in the UK there is one grid connected wave device, the Limpet oscillating water column which is a successor to the 75kW device.

Tidal power occurs from generating electricity from tidal currents. A recent study estimated that the available the UK tidal power resource is up to 22 TWh per year. Even though the costs of wave and tidal-current technologies are still much too high to enable profitable operation under current or foreseeable future market conditions.

5.4. Hydroelectric Power

On Earth, water is neither created nor destroyed, but is constantly moved around. Hydroelectric power uses the force of moving water to create electricity. There are three categories of hydroelectric power generators:

- I. Large-scale capacity (systems producing more than 20 megawatts) in the UK is currently 907 megawatts.
- II. Small-scale capacity (systems producing less than 20 megawatts) in the UK is currently 503 megawatts.

¹⁰ <http://www.regensw.co.uk/about-renewable-energy/wind.php>

III. Micro-scale capacity (systems producing less than 50 kilowatts) in the UK is currently 46 megawatts.

Total hydroelectric energy generated in the UK is 4605 GWh in 2006.

5.5. Solar Energy

Solar energy involves capturing and harnessing the sun's energy. There are three main ways of doing this:

- Passive solar design
- Active solar water heating
- Solar photovoltaic

Solar energy sources used to generate electricity and heat is 36,9 GWh in the UK in 2006.

At the end of 2006 the UK's installed capacity of 13 MWp (Megawatts peak) represented just 0.3% of the European total of 3.4 GWp.

III. SECONDARY RESOURCES

A. Electricity

In 2006, most of the UK's electricity was generated by gas, coal and nuclear stations. Thirty large (>1GW) power stations meet the majority of electricity demand, which is ~40GW at a typical point in time and ~60GW at peak¹¹.

The UK currently has around 76GW (gigawatts) of electricity generation capacity to meet annual consumption of about 350TWh (terawatt hours) and winter peak demand of about 63GW. This level of capacity is roughly 20% higher than the expected level of peak demand

The contribution from coal and nuclear plants will fall as stations close, leaving a 'gap' of ~15GW by 2015.³ This will be filled in the short-term by new gas and wind generation. In 2006:

- Gas provided 39% of electricity. Gas is also used to heat approximately 70% of homes.
- Coal-fired stations provided one-third of the UK's electricity, down from two-thirds in 1990. Around one-third of existing stations will close by 2015 to comply with European law restricting emissions of sulphur dioxide.
- Nuclear stations provided a fifth of electricity; but, most existing UK nuclear plants are due to close in the next decade.
- Renewable energy provides a small (4.2%) but growing proportion of electricity. There is also growing interest in Combined Heat and Power (CHP), which involves, for example, making use of the heat which arises as a byproduct of electricity generation.

The electricity supply industry has three components:

- Generation is dominated by large power stations
- The transmission network or Grid transmits electricity across the UK from power stations, via ~25,000 km of 'high-voltage' overhead lines

¹¹ Parliamentary Office of Science and Technology Postnote, February 2007 Number 280

- Regional distribution networks: Over 800,000 km of overhead lines and underground cables deliver lower voltage power (132kV and below) from Grid ‘supply points’ to consumers. There is potential for ‘distributed generation’ where small-scale generators feed power directly into the distribution networks

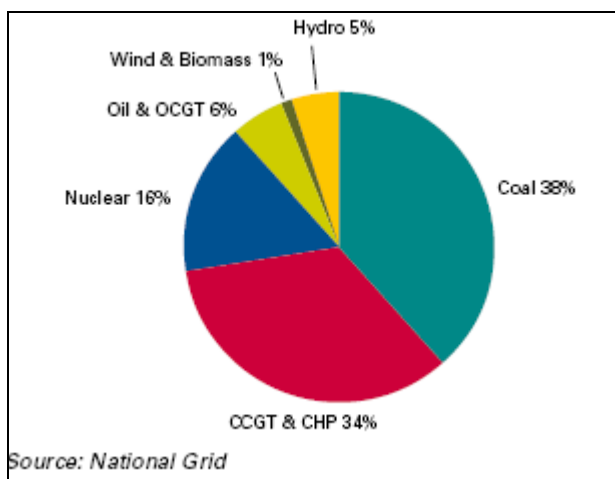
At the moment, demand is largely met by electricity transported across the transmission system from large generators to distribution networks.

Electricity generation accounts for around 30% of UK carbon dioxide (CO₂) emissions. In the next decade, many coal and nuclear plants will close, leaving the UK increasingly dependent on imported gas.

UK has a diverse mix of power stations: coal and gas account for over one third each; nuclear about a fifth; and renewables around 4%. This diversity helps avoid over-dependence on a single fuel type, contributing to security of supply. However, substantial new investments over the next 20 years have to be made since many of the nuclear and coal power stations will be close. Investment in low carbon technologies, for example renewables and carbon capture and storage is required.

As at winter 2007-08, Great Britain as a whole has a total of 75 GW of electricity generating capacity of various kinds. Coal-fired capacity presently represents the largest share of transmission-connected capacity.

Electricity Generating Capacity at the End of 2008



Issues

1. Renewal of the Grid infrastructure is required. Much of the Grid was built in the 1950-60s, and large coal-fired plants are built mainly close to mines, and transmit electricity to where it was needed. Consequently, the Grid is heavily reinforced in former coal-mining regions. By contrast, there are no high voltage transmission lines in many areas suitable for renewable electricity generation (like North West Scotland where wind speeds are high, or Mid-Wales). The net flow of electricity is from North to South.

There are bottlenecks limiting the total power that can be transmitted. For example, flow from Scotland to England is limited to 2.2GW. The Grid is linked to France and Northern Ireland via high-voltage undersea cables.

2. Reconfiguration: adapting the existing network to incorporate low-carbon generation since:
 - High gas prices mean household electricity bills have risen by 45% since 2003;
 - Under EU Emissions Trading companies can benefit financially from reducing their CO₂ emissions;
 - Government has set targets to reduce emissions, such as 10% of UK electricity from renewable energy by 2010; a 60% reduction in CO₂ emissions by 2050.
3. UK will certainly need substantial investment in new generation capacity to replace the closing coal, oil and nuclear power stations, and to meet expected increases in electricity demand. It is estimated that 22.5GW of existing power stations may close by 2020. Of this, 8.5GW of coal-fired capacity will close to meet the requirements of the EU Large Combustion Plant Directive (LCPD) by end 2015; as will about 2.5GW of oil power stations. Around 7GW of nuclear power stations are also scheduled to close until 2020, on the basis of their currently published lifetimes. Further investment is likely to be needed in subsequent years as further power station closures take place and to meet further increases in demand.

IV. POLICY AREAS

1. Renewable Energy Strategy of the UK

Although renewable energy sources have not played a major role in the UK historically, there is potential for significant use of tidal power and wind energy (both on-shore and off-shore) as recognized by formal UK policies, including the Energy White Paper. The Renewables Obligation acts as the central mechanism for support of renewable sources of electricity in the UK, and should provide subsidies approaching one billion pounds sterling per annum by 2010. A number of other grants and smaller support mechanisms aim to support less established renewables. In addition, renewables have been exempted from the Climate Change Levy that affects all other energy sources.

The UK Government's energy strategy for the future is to support increment in renewable energy. The established goals for UK renewable sources are ten percent of electricity generation by 2010 and 20% by 2020. The amount of renewable generation added in the year 2004 was 250 megawatts and 500 megawatts in 2005. There is also a program established for micro-generation (less than 50 KWe (kilowatt electrical) or 45 KWt (kilowatt thermal) from a low carbon source) as well as a solar voltaic program. By comparison both Germany and Japan have photovoltaic (solar cell) programs much larger than the installed base in the UK. Hydroelectric energy is not a viable option for most of the UK due to terrain and lack of force of rivers.

The government has established a goal of five percent of the total transport fuel that must be from renewable sources (e.g. ethanol, biofuel) by the year 2010 under the Renewable Transport Fuel Obligation. This goal may be ambitious, without the necessary infrastructure and paucity of research on appropriate UK crops, but import from France might be a realistic option

In 2005 British Sugar announced that it will build the UK's first ethanol biofuel production facility, using British grown sugar beet as the feed stock. The plant in Norfolk will produce 55,000 metric tones of ethanol annually when it is completed in the first quarter of 2007. However it has been argued that even using all the UK's set-aside land to grow biofuel crops would provide for less than seven percent of the UK's present transport fuel usage.

Energy efficiency is also a key factor of UK's energy policy because it also helps to reduce carbon dioxide emission. While renewable energy describes energy that is unlimited and not from the combustion of fossil fuels, energy efficiency is the measure that is essential for slowing down energy demand and ensuring that it is not overused. Carbon dioxide emission plays an important role on climate change. The main reason to improve renewable energy is to provide 20 per cent cutting of carbon dioxide emission by 2010 and 60 percent by 2050. On the other hand UK looks at nuclear power as an option. UK Government's January 2008 decisions support to build new nuclear power stations.

2. Carbon Emissions Reduction

Joining over 170 other nations the UK has committed to reduction of carbon dioxide emissions, with consequent constraints to its energy policy. The UK produces four percent of the world's greenhouse gases as of 2003, compared to 23 percent by the USA and 20 percent for the rest of Europe. The long term reduction goal for carbon emissions is 60 percent decrease by the year 2050. A scheme of trading for carbon emission credits has been developed in Europe that will allow some of the reduction to arise from economic transactions.

Road transport emissions reduction has been stimulated since 1999 by the banding of Vehicle Excise Duty. Bands for new vehicles are based on the results of a laboratory test, designed to calculate the theoretical potential emissions of the vehicle in grammas of CO₂ per kilometer traveled, under ideal conditions.

Average carbon emissions fell from 192 to 172 grams/mile between 1995 and 2004. Aviation fuel is not regulated under the Kyoto Protocol, so that if the UK is successful in carbon emission reduction, aviation will constitute 25 percent of UK generated greenhouse gases by the year 2030.

The UK government has one project in the planning stage for natural gas fed power generation with carbon capture by seawater. This facility is contemplated at Peterhead, Scotland, a relatively remote exposure to the North Sea.

On March 13, 2007, a draft Climate Change Bill was published following cross-party pressure over several years, led by environmental groups. The Bill aims to put in place a framework to achieve a mandatory 60% cut in the UK's carbon emissions by 2050 (compared to 1990 levels), with an intermediate target of between 26% and 32% by 2020. If approved, the United Kingdom is likely to become the first country to set such a long-range and significant carbon reduction target into law.

3. Energy poverty

Reducing occurrence of energy poverty (defined as households paying over ten percent of income for heating costs) is one of the four basic goals of UK energy policy. In the prior decade substantial progress has been made on this goal, but primarily due to government

subsidies to the poor rather than through fundamental change of home design or improved energy pricing. The following national programs have been specifically instrumental in such progress: Winter Fuel Payment, Child Tax Credit and Pension Credit. Some benefits have resulted from the Warm Front Scheme in England, the Central Heating Program in Scotland and the Home Energy Efficiency Scheme in Wales. These latter programs provide economic incentives for physical improvement in insulation, etc.

4. Security of Supply

No energy system is invulnerable to the possibility of an interruption to one or more supply sources, or to fluctuations in demand levels.

There are two main securities of supply challenges for the UK:

1. Increasing reliance on imports of oil and gas in a world where energy demand is rising and energy is becoming more politicized;
2. Need for substantial, and timely, private sector investment over the next two decades in gas infrastructure, power stations; and electricity networks.

UK has to develop effective strategies to cope with the potential risks associated with higher imports of fossil fuels. It has to take into account the increased competition for energy resources in the face of growing global energy demand. Secondly, the reserves becoming increasingly concentrated in fewer, further away places. Lastly, it is estimated that there will be insufficient investment in key producer countries in new oil and gas production.

UK needs significant private sector investment in infrastructure to bring the energy from overseas to the UK. The current projections of gas demand demonstrate that UK needs to increase its gas import capacity by 15-30% by 2020.

In electricity markets, UK needs investment in new generation capacity of around 30-35 GW over the next two decades to replace power station retirements and meet rising electricity demand as the economy grows and in order to ensure the security of electricity supplies.

Saving energy strategy in business, households and the public sector will reduce the need for energy imports by reducing overall demand. It will also reduce the level of new investment that UK needs in large scale electricity generation. Finally, by increasing the number of low carbon generation investment options available to the private sector, UK will increase the diversity of the energy supplies, reducing electricity security of supply risks.

To meet the security of supply challenges, UK aims to:

- maximize the economic production of domestic energy sources together with the energy saving measures in order to reduce the dependence on energy imports;
- work for more effective and transparent international energy markets to get fair access to the energy resources
- strengthen the UK energy investment framework in new gas and electricity infrastructure

5. Energy Efficiency

The energy saving policies and measures set out in UK's 2004 Energy Efficiency Action Plan and the 2006 Climate Change Programme³ are already delivering energy savings and those recently announced in the Energy White Paper will continue to stimulate energy efficiency in businesses, the public sector and households.

The energy efficiency policies of UK based on reducing energy demand and by promoting alternative technologies. There is potential to reduce the demand for fossil fuels by using fuels more efficiently, e.g. through Combined Heat and Power (CHP), while other distributed energy (DE) solutions could bring forward renewable technologies. The Government wants to remove barriers to the deployment of DE technologies so that they can grow. Government is committed to increasing energy efficiency in the industrial, commercial, public and domestic

In the transport sector, as part of the Government's overall strategy for carbon emissions reduction, a Renewable Transport Fuels Obligation will be introduced. This obligation is designed to ensure that by 2010 at least 5% of all road transport fuel will come from renewable sources, thus reducing the expected demand for oil.

UK also encourages the adoption of low carbon technologies, including carbon capture and storage, and support the development and deployment of non-fossil fuel energy, such as from renewable sources and new nuclear power.

The UK's target efficiency is 9% energy saving target (which is equivalent to 136.5 TWh) over the period 2008 to the end of 2016 under the European Union's Energy End-Use Efficiency and Energy Services Directive.

Key levels to reduce energy consumption in the UK

Sectors	Lower energy consumption	
	Increase technical energy efficiency	Behaviour: reducing service demand and avoiding waste
Households	Building Regulations, Code for Sustainable Homes, Market Transformation Programme and Product Standards, Energy Efficiency Commitment, Carbon Emissions Reduction Target	Energy Saving Trust programmes, billing and metering, Energy Performance Certificates, Labelling, "Act on CO ₂ " communication campaign
Business and Public	EU Emissions Trading Scheme, Climate Change Agreements, Carbon Reduction Commitment, Enhanced Capital Allowances, Building Regulations, Market Transformation Programme and Product Standards, Revolving Funds, public procurement standards	EU Emissions Trading Scheme, Climate Change Levy and Climate Change Agreements, Carbon Trust programmes, billing and metering, Energy Performance Certificates, labelling
Transport	Voluntary Agreement with motor manufacturers and successor	Vehicle Excise Duty, inter-modal shifts, eco-driving campaigns, vehicle labelling, reducing need to travel

Source: UK Energy Efficiency Action Plan 2007, Department for Environment, Food and Rural Affairs, p10

V. NATIONAL GOVERNMENT STRATEGY

The 2007 Energy White Paper: Meeting the Energy Challenge was published on May 23, 2007. The 2007 White Paper outlines the Government's international and domestic strategy for responding to two main challenges:

- Cutting carbon emissions to tackle global warming
- Ensuring secure, clean and affordable energy as imports replace declining production from North Sea oil and gas
- Securing reliable energy supplies at prices set in competitive markets.

It is estimated that the UK will increasingly depend on imported oil and gas at a time of rising global demand and prices and energy supplies are becoming more politicized. Additionally, over the next two decades almost one third of UK's coal and oil fired power stations are likely to close because of environmental legislation and life extensions. Energy companies will need to invest in around 30-35GW of new electricity generating capacity – as coal and nuclear plants retire – over the next two decades, with around two-thirds needed by 2020. This is equivalent to about one-third of the current existing capacity. These will certainly create new risks.

In this regard, UK aims to follow a strategy to save energy, develop cleaner energy supplies and secure reliable energy supplies at prices set in competitive markets.

It seeks to do this in a way that is consistent with its four energy policy goals:

- Cutting the UK's carbon dioxide emissions by some 60% by about 2050, with real progress by 2020;
- Maintaining the reliability of energy supplies;
- Promoting competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve productivity; and
- Ensuring that every home is adequately and affordably heated.

It will be necessary to install 30-35 GW of new electricity generation capacity within 20 years to plug the energy gap resulting from increased demand and the expected closure of existing power plants. It also states that, based on existing policies, renewable energy is likely to contribute around 5% of the UK's consumption by 2020, rather than the 20% target mentioned in the 2006 Energy Review.

In summary, the government's proposed strategy involves 6 components:

- Establishing an international framework to tackle climate change, including the stabilization of atmospheric greenhouse gas concentrations and a stronger European Union Emissions Trading Scheme
- Providing legally binding carbon targets for the whole UK economy, reducing emissions through the implementation of the Climate Change Bill.
- Making further progress in achieving fully competitive and transparent international markets, including further liberalization of the European Union energy market.
- Encouraging more energy saving through better information, incentives and regulation
- Providing more support for low carbon technologies, including increased international and domestic public-private sector collaboration in the areas of research, development, demonstration and deployment – for example through the launch of the Energy Technologies Institute and the Environmental Transformation Fund.

To achieve the government's aims, the White Paper proposes a number of practical measures, including:

Businesses:

- A new mandatory cap and trade scheme for organizations consuming more than 6,000 MWh of electricity per year, to be known as the Carbon Reduction Commitment.
- The introduction of Energy Performance Certificates for business premises.
- The extension of smart metering to most business premises within 5 years.

Homes:

- A requirement for all new homes to be zero-carbon buildings as soon as practically possible and preferably by 2016.
- Improving the energy efficiency of existing homes.
- Improving the efficiency of consumer electronics and domestic appliances, and the possible phase-out of inefficient light bulbs by around 2011.
- Increasing the Carbon Emission Reduction Target for the electricity and gas industries for 2008-2011.

- A requirement that new domestic electricity meters should have real time displays from 2008, and a commitment to upgrade existing domestic meters on request.

Transport:

- The introduction of a Low Carbon Transport Innovation Strategy
- Support for including aviation within the EU Emissions Trading Scheme

Energy supply

- The introduction of a Biomass Strategy to expand the use of biomass as an energy source.
- Measures to grow distributed electricity generation and distributed heat generation alongside the centralised system.
- A reconfirmation that, under the Renewables Obligation, renewable energy should supply 10% of electricity generation by 2010, an 'aspiration' to achieve 20% by 2020, together with the introduction of bands within the Obligation to support different renewable technologies.
- The launch in November 2007 of a competition to demonstrate commercial-scale carbon capture and storage technology
- A 'preliminary view is that it is in the public interest to give the private sector the option of investing in new nuclear power stations'. A consultation on this was launched at the same time as the White Paper.
- The introduction of the Renewable Transport Fuel Obligation in 2008-2009, with a commitment that biofuels should provide 5% of transport fuel by 2010-2011.
- Measures to support the recovery of the remaining oil and gas reserves from the North Sea.
- Removing barriers to developing new energy infrastructure and power plants through reform of planning permission processes, as detailed in the 2007 Planning White Paper: Planning for a Sustainable Future.