



**Work package 2 – National Report on the United Kingdom
Energy Regime: composition, structure and consumption**

D13 from the BAREENERGY project

By

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Introduction

A short history of the energy system in the UK

Pearson (2003) points out that widespread energy use in the UK began during the time of the industrial revolution where the country's indigenous coal stocks were first exploited on a large scale through the development of the internal combustion engine and its ability to convert heat into mechanical energy. This combination was utilized most successfully during the post-war period where industrialization drove unprecedented levels of economic growth in the UK. Coal characterized the 'supply-side policy' perspective on UK energy regulation during this period where 'the overwhelming objective was to produce as much energy as possible (domestically) to keep pace with the demand of what has been called the 'golden age' of the British economy' (Helm, 2004:2). The political and institutional configuration that was designed to meet this programme was based principally upon the national integration of state-owned energy monopolies, whereby government agencies and economic institutions worked in tandem through long-term, integrated contractual arrangements. The capital intensity of this approach was offset onto domestic consumers via 'captured' markets.

Industrialization marked the beginning of two distinct periods of energy regulation in the UK which can be characterized as:

- A first phase nationalized, 'command and control' framework which ran from 1945 to approximately 1979. This was typified by a government led regulatory regime in which political leaders were centrally involved in decision-making regarding the institutional and operational dynamics of UK energy policy. Energy use in this era was based initially around indigenous coal, which was then supplemented by gas and oil – much of which came from discoveries in the North Sea – and a small nuclear programme;
- The subsequent *Market for Energy* regime which characterized roughly the period from 1979 to 1998 saw a shift in emphasis from government policy to faith in the market as the guiding framework for energy regulation. The market liberalization programme of this period was characterized primarily by the 'dash for gas' and a shift away from coal-fired electricity generation. The demise of UK North Sea reserves during this period also confirmed an increasing reliance on imported oil and gas.

Current targets and policies

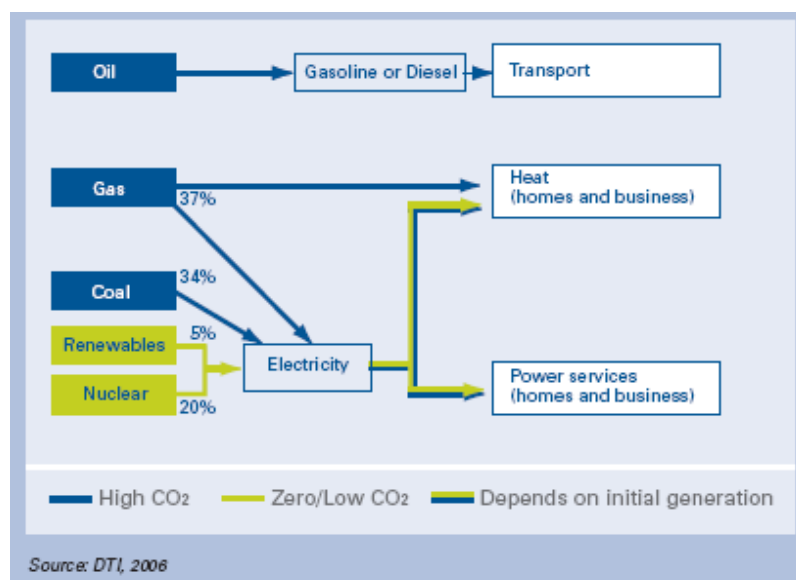
The appearance of three Energy White Papers since 1998 has been significant in acknowledging the necessity for a degree of divergence from a purely market-led approach to energy regulation in the UK. The *2000 Royal Commission Report* and the *Stern Review* in 2006 have both pointed to urgency of climate change as a form of market failure which must be addressed through a more balanced approach between economic and regulatory instruments. The challenge for the UK Government post-1998 therefore has been to reconcile the conditioning factors of market liberalization with externalities

such as climate change, security of supply and fuel poverty. Helm (2005) suggests that there are five challenges that now face the UK Government in addressing the conditions of what he describes as a ‘new energy paradigm’:

- The fact that carbon dioxide emissions have continued to rise;
- The ‘benign’ economics upon which energy policy was predicated has been opened up to challenge thrown off balance as gas and oil prices have increased;
- Assets and infrastructure have needed investment;
- A decline of competitiveness;
- Fuel poverty has not been eradicated;
- Energy demand has increased both domestically and globally.

The target set by the New Labour Government on taking office of a 20% reduction in carbon emissions by 2010 is currently proving to be a difficult task – where ‘windfall’ emissions reductions gained during the ‘dash for gas’ have been offset by increases in road and air travel pollution – as is the hope for 10% increase in renewable energy generated electricity. More biting targets on CO₂ emissions of a 60% reduction by 2050 – to be introduced by the forthcoming *Climate Change Bill* – will join the EU’s proposed 20/20/20 directives in setting a unique set of challenges for UK energy regulation.

Fig. 1: Composition of energy resources in the UK



Energy for Heating

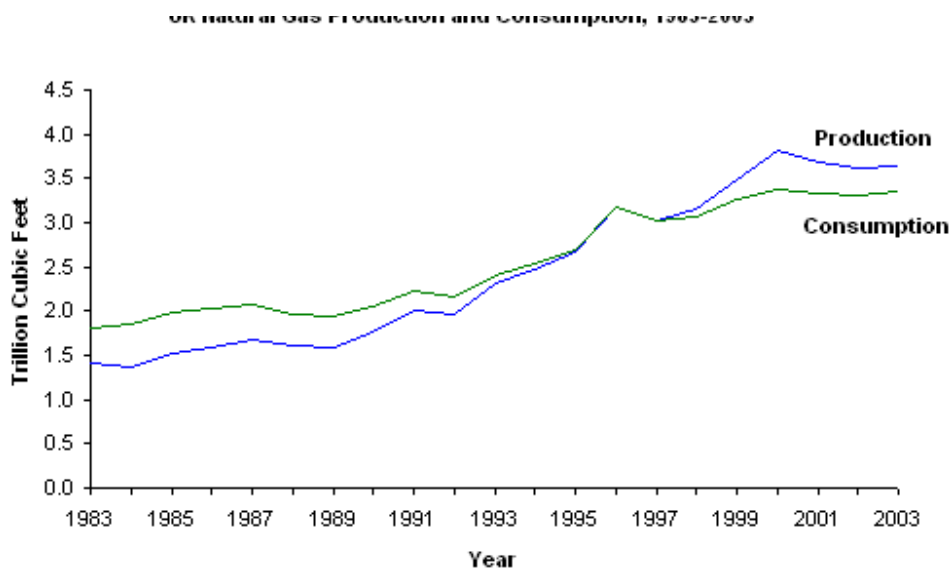
Production: natural gas

As figure 1 illustrates, electricity constitutes the largest percentage of all forms of energy use in the UK. Electricity also contributes to a small percentage of heating. However natural gas is currently estimated to be around 34% of the UK's total energy consumption (see Figure 2 for EIA estimates for natural gas production and consumption between 1983 and 2005). In heating homes and buildings, gas is piped directly and burnt at the point of use, while it is converted from its original form in order to produce electricity. The IEA (2008:1) point out that 'most of the leading oil companies in the UK are also the leading natural gas producers and include BP, Shell, and Total'. The structure of the gas industry – including its production, distribution and transmission – is privately owned. The UK's largest distribution agency is Centrica and the national Grid is controlled by Transeco (EIA, 2008).

According to the EIA, the UK is the largest producer of oil and natural gas in the EU. According to a survey carried out by the *Oil and Gas Journal* the UK possessed an estimated 18.8 trillion cubic feet of natural gas in 2005. Full use of the UK's natural gas reserves was encouraged by market liberalization of the gas sector where it replaced much of the coal industry in providing the main source of the UK's electricity generation. While coal still contributes around 34% of source energy to electricity generation, this is primarily imported from South Africa and Australia as opposed to drawing upon 'the UK's estimated 243 million tonnes of recoverable reserves' (EIA, 2008:1). It is a similar story in regard to the UK's various indigenous gas and oil sites which had enabled it to operate largely as a net exporter of both fuels up until the turn of the Millennium. In 2004 the UK became a net importer of natural gas and production from UK oil and natural gas fields began to peak in the late 1990s. This decline has taken place over the past several years, as the discovery of new reserves has not kept pace with the maturation of existing fields, more advanced exploration strategies and, more importantly, rising electricity demand.

Consumption

Fig. 2: UK Natural Gas Production and Consumption, 1983-2003



Source: *International Energy Annual 2003*

Seventy-one per cent of domestic households used gas for central heating in the year 2000. This is an 89 per cent increase in 30 years (DTI, 2007). A 3 per cent use of solid fuel use has remained stable during this period. There was a 6 per cent use of electrical storage heating. There is currently small provision for Combined Heat and Power and biomass for heating but this remains fairly small scale at present.

Policies to reduce consumption/increase production

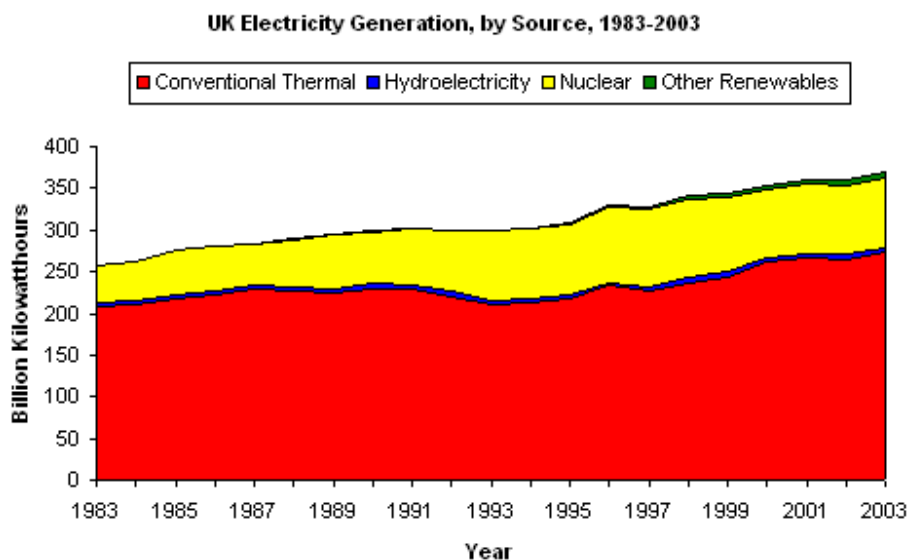
The current policy emphasis is currently based on meeting rising demand. The ‘dash for gas’ period contributed largely to the New Labour government’s 1997 pledge to cut the UK’s CO₂ emissions by 20% by 2010 in relation to 1990 levels. In practice this has proven difficult however and the market driven ethos of the electricity sector in the UK has seen periodic returns to coal when rises in gas prices – triggered by external political events – have made coal fired generation more competitive (BERR, 2008). Rising energy prices for consumers in general – EDF recently raised the price of gas by 22 per cent and the price of electricity by 17 per cent (Guardian, 2008:26) – have recently brought accusations of monopolization and price-fixing in both the gas and electricity sectors.

Electricity

Production

As with the gas industry, the electricity sector in the UK is privatized and generation and distribution is traded within a wholesale market. As argued above, natural gas is closely aligned to electricity use in the UK where liberalization, market deregulation and the availability of cheap gas from the North Sea prompted the ‘dash for gas’ and the paring back of coal as the principal source of generation consumption (see Figure 3 for EIA estimates for energy sourcing in electricity generation between 1983 and 2003). Coal still provides a percentage of generating capacity, which is supplemented by nuclear and a small percentage of renewable energy.

Fig. 3: UK electricity generation by source, 1983-2003



Source: *International Energy Annual 2003*

Consumption

Final consumption of electricity in the UK in 2007 could be broken down as follows: 28.5 per cent domestic use; 29 per cent industry; 27 per cent commerce, public administration, transport and agriculture. Fuel industries were accountable for a further 8 per cent with the remaining 7.5 per cent related to transmission and distribution losses (BERR, 2008:16). 30 per cent of the UK’s electricity consumption is related to domestic use. Rising CO₂ emissions and increased energy demand in households have been particularly problematic for policy makers in relation to both environmental goals and increasing demand. Electricity consumption grew by 12 per cent between 1990 and 2006. Approximately 27 per cent of the UK’s CO₂ emission levels are thought to originate from the electricity sector through inefficient energy use (Climate Change Programme, 2006).

Gas and electricity prices have been noticeably volatile during the last few years and the period 2006-2007 saw prices paid by domestic consumers for all fuel and light use increase by 3.9 per cent in real terms. Of this consumption, household energy use prices

increased by 4.9 per cent (including VAT) and domestic gas prices rose by 4.6 per cent (BERR, 2008). This has been linked to increased *global* demand – where gas is invariably indexed to the global oil price – and also a perceived lack of competition in the energy utilities. This has meant a difficulty for the UK Government in eradicating fuel poverty in recent times where its periodic reappearance has been linked to this price volatility.

Policies to reduce consumption/increase production

The *Energy Efficiency Commitment* was introduced in 2002 as a way by which gas and electricity use could be reduced by a producer's obligation to work with customers in installing energy efficiency measures such as loft insulation, boilers and appliances.

The total percentage of energy sourced from renewables still accounts for only 2 per cent of the UK's total energy use and the *Renewables Obligation* was introduced in 2001 as a way of incentivizing incremental electricity use from renewable energy. Unruh (2000) however argues that 'carbon lock-in' means that the price of fossil fuels at present is still low in relation to the cost of renewable energy and provides a market barrier to a greater contribution from renewable sources. Renewable energy currently remains an expensive option and market driven conditions mean that they remain currently heavily subsidized by the UK Government in order to avoid them going off the radar altogether. Thus while landfill gas, biomass co-firing, and offshore wind have made progress in contributing to post-Renewables Obligation electricity generation, other renewable energies such as biomass, wave, or solar, remain cost inefficient and often incompatible with the practicalities and economics of the existing industry infrastructure. Milner (2008:22) points out that the UK energy regulatory body OFGEM is currently preparing to redesign the rules governing access to the UK's electricity grid, where a greater percentage of renewable generation will be crucial if the UK is to reach the 20% target proposed by the latest EU driven climate change proposals.

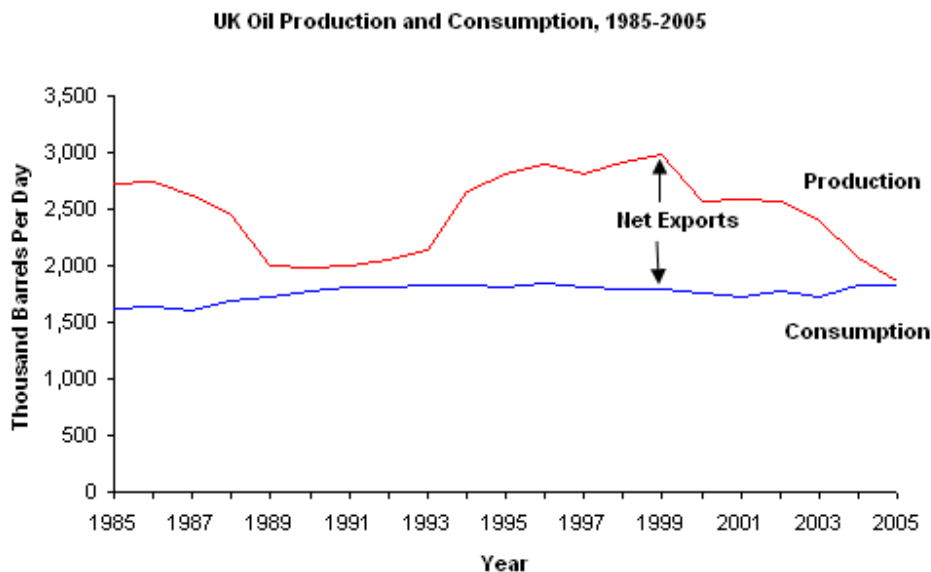
Transportation fuels

Production: oil

Oil still constitutes the largest share of energy consumption in the UK at 35 per cent of overall energy use with a 2005 estimated consumption rate of 1.8 billion barrels per day (Energy Information Administration (EIA), 2008). It is oil that underpins virtually all transportation in the UK, primarily petrol and diesel. The EIA estimates that in 2006 the UK held 4.0 billion barrels of proven crude oil with locations in the North Sea, Wytch Farm and the North Atlantic (see Figure 4 for EIA estimates for UK oil production and consumption between 1985 and 2005).

However, the UK Government expects indigenous supplies to peak more sharply over the next five years – the UK became a net importer of oil in 2005 (BERR, 2008) – as these fields mature, technology facilitates increased extraction rate, and demand from the transport sector continues to increase. Increased demand for oil from this sector will see the UK become a net importer of oil and more open to the vicissitudes of the global market.

Fig. 4: UK oil production and consumption, 1985-2005



Consumption

It is suggested in research by BERR research that transport can be divided into people (passengers) and goods (freight):

- in 2001 54,932 tonnes of oil equivalent were consumed in the transport sector, three quarters of which was consumed for road transport;
- Transport energy has increased by 95 per cent since 1970 and by 13 per cent since 1990;
- Between 1990 and 2001, energy consumption increased by 56 per cent in the air transport sector, by 8 per cent in the rail transport sector, and by 7 per cent in the road transport sector;
- Of the 41,451 thousand tonnes of oil equivalent consumed for road transport in 2001, it is estimated that 66 per cent was from road passengers and 34 per cent from road freight;
- Since 1990, road freight energy consumption has increased by 17 per cent whereas road passenger energy consumption has increased by just 1 per cent (BERR, 2008:14).

Of a total of 23,884.2 thousand tonnes of fuel for personal freight and 13,872.3 thousand tonnes of fuel for freight, this energy use was accounted for within the following transport categories in 2006:

Buses – 1,548.5 (thousand tonnes of fuel)

Diesel – 4,515.3

Petrol Cars – 17,678.5

Motorcycles – 141.9

Heavy Goods Vehicles – 8,280.0

Diesel LGV – 5,118.8

Petrol LGV – 473.5 (BERR, 2008).

In regard to personal road use, Goodall (2007) points out that ‘the amount of car travel per person appears to be gently declining’. He argues however that this is offset by a continuation in the number of people in the UK who own cars, which currently stands at about 27,000 or 1.1 cars per UK household.

Policies to reduce consumption/increase production

Problems in designing policies with which to address environmental concerns and demand growth in the domain of personal car use had already been flagged up during the lifespan of the *Fuel Price Escalator* (FPE): a policy introduced by the Conservative Government in the UK in 1993 to curb demand and address the growing profile of climate change. The FPE had been seen by the Conservatives as a way in which to begin to discourage unnecessary road use and also to make a political commitment to cut the need for future road building projects. Country-wide fuel demonstrations in 2000 – and again in 2008 as the price of oil rose to \$135 a barrel – have served however to illustrate some of the limitations that governments would now face in reconciling more direct regulatory instruments with ‘populist’ electoral support.

More recently, plans to widen policies such as the *London Congestion Charge* (LCC), and incentives to foster behaviour changes in private car use have accompanied changes to vehicle licensing structures in the UK. The LCC is a fee that is levied on the majority of motorists entering the central London area and has proved to be successful in decreasing private transport use in Central London. Since 2001, UK Government reforms to *Vehicle Excise Duty* (VED) – aimed at all cars that were first registered and licenced on or after 1st March 2001 – introduced a new system of road taxation based upon payment bands depending on the level of CO₂ emissions measured for when the model was tested prior to going on sale. The baseline for banding starts at ‘no taxation charge’ with an incremental rise in excise payment depending upon engine capacity and fuel choice.

The use of biofuels in addressing environment and energy efficiency objectives in road transport sector remains limited. Biofuels as a percentage of road transport fuel in the UK constituted 1 per cent in 2007 and low carbon cars represented less than 0.1 per cent of UK car sales in the same year (Lane and Potter, 2007). It is hoped that this figure will rise to around 5 per cent in 2010/11 from the impacts of 2008’s *Renewables Transport Fuel Obligation* and graduated tax incentives on both biodiesel and bioethanol

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