

UNITED KINGDOM

The country report for the United Kingdom was prepared by the TV Energy Ltd..

Current situation on CHP and biomass CHP in the national energy sector.

Though the UK has sufficient gas and petroleum resources the energy scenario is quite diversified. Coal and nuclear are also important to the energy supply system.

In final consumption petroleum derivatives stand out against the rest, though gas and electricity are also significant. Gas provides 32.7% of final consumption and electricity 17.3%.

Energy balances in United Kingdom (Source: Energy Policies of IEA Countries, 2001)

	1999	%		1999	%
Population (millions)	59.5		Total final consumption	159.8	
Energy consumption/capita	2.69		Coal	5.7	3.6
Total energy production (Mtoe)	282.2		Oil	73.4	45.9
Coal	22.3	7.9	Gas	52.2	32.7
Oil	143.0	50.7	Biomass & Wastes	0.9	0.6
Gas	89.1	31.6	Geothermal	0.0	0.0
Biomass & Wastes	2.2	0.8	Solar/Wind/Other	-	-
Nuclear	25.1	8.9	Electricity	27.6	17.3
Hydro	0.5	0.2	Heat	-	-
Geothermal	0.0	0.0	Total industry consumption	45.6	
Solar/Wind/Other	0.1	0.0	Coal	3.4	7.5
Net energy imports (Mtoe)	-51.5		Oil	17.0	37.3
Coal	13.2		Gas	15.3	33.6
Oil	-60.4		Biomass & Wastes	0.5	1.1
Gas	-5.5		Geothermal	-	-
Electricity	1.2		Solar/Wind/Other	-	-
Total supply - TPES (Mtoe)	230.3		Electricity	9.3	20.4
Coal	35.3	15.3	Heat	-	-
Oil	83.0	36.0	Transport consumption	51.6	
Gas	83.1	36.1	Total other sectors consumption	62.7	
Biomass & Wastes	2.2	1.0	Coal	2.3	3.7
Nuclear	25.1	10.9	Oil	5.6	8.9
Hydro	0.5	0.2	Gas	36.9	58.9
Geothermal	0.0	0.0	Biomass & Wastes	0.4	0.6
Solar/Wind/Other	0.1	0.0	Geothermal	0.0	0.0
Electricity Trade	1.2	0.5	Solar/Wind/Other	-	-
Electricity generation	31.3		Electricity	17.5	27.9
Electricity generation (TWh)	363.9		Heat	-	-

CHP capacity in the UK reached slightly more than 4.2 GWe by the end of 1999 - more than twice the capacity in place at the start of the 1990s, and approaching the last Government's target of 5 GWe by the end of the millennium. Some 354 MWe of new plant was added during 1999 (see Table 1). The average growth rate for CHP in the 1990s was 7% per annum.

In 1999, CHP plants generated nearly 6% of the total electricity generated in the UK, or 15% of the electricity used by industry.

The current Government's target is to have at least 10 GWe of CHP in place by the year 2010. Further CHP growth is encouraged as a way of helping to tackle the threat of climate change. That would reduce carbon emissions by a further 6 Mtons - more than a quarter of the current shortfall required achieving the UK's domestic target of a 20% reduction in CO₂ emissions by 2010. This would also stimulate some £3 billion of largely private investment in the UK economy.

Large CHP plants serving industrial sites make up the majority of UK CHP capacity (see tables 1 and 2), with just 81 plants making up more than 80% of the total capacity. However, small-scale units are far more numerous. More than 600 sites are served by units rated at below 100 kWe, and more than a thousand CHP plants of under 1 MWe in size are currently at work in the UK.

Much of the industrial capacity serves industries that have used CHP for decades, most notably the chemicals, oil refining, paper, food & drink and iron & steel industries. In buildings, leisure centres, hotels, hospitals, universities and group heating schemes (using community heating) are the most popular locations for CHP.

However, with more flexible plant now available, as well as a move to design CHP schemes to serve more than one site or to export excess energy to other customers, CHP is increasingly being installed in non-traditional areas.

Recent development of CHP Source: Digest of UK Energy Statistics 2000, DTI

	Unit	1993	1994	1995	1996	1997	1998	1999
Number of sites		996	1,167	1,220	1,282	1,287	1,307	1,313
Electrical capacity	MWe	2,893	3,141	3,390	3,463	3,628	3,885	4,239
Electricity generation	GWh	14,171	12,152	14,286	15,524	16,499	18,329	20,213
Heat generation	GWh			57,901	57,402	55,152	55,682	54,062

CHP installations by capacity and by size – 1999 Source: Digest of UK Energy Statistics 2000, DTI

	Number of sites	Total capacity (MWe)
Less than 100 kWe	638	36
100 kWe- 999 kWe	447	113
1 MWe – 9.9 MWe	147	636
10 MWe and above	81	3,454
Total	1,313	4,239

The proportion of CHP plant being installed under wider energy services agreements is rising, from a 1990s average of around 80% of new capacity, to an expected 90% in the next year or so. The CHP supplier will finance, operate and maintain the plant for the customer, as well as building it, leaving the customer to concentrate on core activities. Another trend has been towards plant based on gas turbines, which in 1999 accounted for 57% of total CHP capacity, two-thirds of this operating in CC mode. The gradual switch from steam turbines to gas turbines has increased the ratio of electrical to heat output.

Natural gas now accounts for a little over half of the fuel used by CHP. Fuel oil and coal are also used, together with a variety of 'waste' fuels, including refinery gases, blast furnace gas and *renewable sources such as landfill and biogases, and solid municipal waste.*

In 2000, some 26 proposed new CHP schemes were given Government consent; representing more than 2 GW of new capacity consented in the last three years. The Government built into the Utilities Act the potential for a new 'obligation' to require either energy supply or

distribution companies to encourage the development of CHP. The obligation would be equivalent to that designed to promote electricity generation from renewables.

Two further proposed changes to the electricity licensing regime may benefit operators of CHP and district energy schemes by making their power output cheaper to buy. The Government is to raise the limit above which operators of electricity generation plant need to hold a generation licence, from 50 MW in most cases, to 100 MW. This is aimed at cushioning the effect of NETA on smaller generators, *particularly of CHP and renewables*. More significantly, the DTI is also consulting on increasing the limit for electricity suppliers from 500 kW, a measure that will help a limited number of operators of district energy systems that rely on electricity (and heat) sales to local consumers.

CHP capacity by sector - 1999. Source: Digest of UK Energy Statistics 2000, DTI

Sector	Electrical capacity (MWe)	Thermal capacity (MWth)
Chemicals	1,180	5,970
Oil refineries	838	3,918
Paper, publishing and printing	471	1,379
Electricity supply	464	650
Food, beverages and tobacco	392	1,331
Iron, steel and non-ferrous metals	268	541
Transport, commerce and administration	201	330
Sewage treatment	108	173
Other industrial sectors	118	286
Other sectors: agriculture, community heating, landfill and incineration	199	515
TOTAL	4,239	15,093

The main renewable sources that are used for CHP in the UK are biofuels particularly sewage gas, other biogases, clinical waste and municipal waste.

The following table presents the types of CHP installation using renewables as well as the electrical and the heat capacity by type of installation.

Types of CHP installation using renewables as well as the electrical and the heat capacity by type of installation. Source: Digest of UK Energy Statistics 2001, DTI

	1996			1997			1998			1999			2000		
	GWh	MW _e	MW _{th}	GWh	MW _e	MW _{th}	GWh	MW _e	MW _{th}	GWh	MW _e	MW _{th}	GWh	MW _e	MW _{th}
Back pressure steam turbine	282	16	53	284	16	54	289	16	54	119	13	46	119	18	46
Gas turbine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined cycle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reciprocating engine	1707	88	145	1692	87	149	1651	91	142	1635	92	150	1417	86	138
Pass out condensing steam turbine	202	13	30	202	13	30	301	17	52	466	18	57	466	18	57
Total renewable fuels	2190	117	229	2178	117	233	2241	124	248	2219	123	253	2002	122	241

In the following table, the CHP fuelled with renewables by sector is presented in GWh. It is clearly shown that renewables are highly used in the sewage treatment sector with 1397 GWh out of a total 1986 GWh in 2000 (70%).

CHP renewable fuels: Use by sector (GWh). Source: Digest of UK Energy Statistics 2001, DTI

Sector	1996	1997	1998	1999	2000
Food, beverages and tobacco	2	2	2	2	2
Sewage treatment ¹	1681	1666	1619	1599	1397
Other	507	507	608	603	587
Total	2180	2175	2229	2204	1986

RTD and Demonstration projects on biomass CHP

No data available.

Legislation and support mechanisms

The central aims underlying the Government's policy are to:

- Help the UK meet national/international targets for reducing greenhouse gas and other emissions.
- Help provide secure, diverse, sustainable and competitive energy supplies.
- Stimulate the development of new technologies.
- Help the UK renewables industry become competitive in home and exports markets
- Contribute to rural development.

The Government is proposing an initial 10 year strategy, in collaboration with industry, to help meet its aims. Specifically, it is proposing that 5% of UK electricity needs should be met from renewables by the end of 2003 and 10% by 2010, as long as the cost to consumers is acceptable. These targets are intended to act as a stimulus to industry and provide milestones for progress monitoring.

Regional Planning and Targets: The Government aims to provide a positive strategic approach to planning for renewable energy from the regional level downwards. This will include regional assessments of renewable energy and setting regional targets for renewables. The assessments are currently being completed.

Renewables Obligation (RO): The new Renewables Obligation and associated Renewables (Scotland) Obligation represent a vital instrument in the Government's strategy. Introduced through the Utilities Act which received Royal Assent in Summer 2000, they will require power suppliers to derive from renewables a specified proportion of the electricity they supply to their customers. The cost to consumers will be limited by a price cap. The Utilities Act also introduced transitional arrangements for NFFO-3, 4 and 5 and SRO-1, 2 and 3 projects.

The aim of the Renewables Obligation (RO) is to increase the contribution of electricity from renewables in the UK so that by 2010, 10% of licensed UK electricity sales will be from renewable sources eligible for the RO, subject to the costs to consumers being acceptable.

It is proposed that the obligation on each supplier will rise from 3% of sales in the first obligation period (ending 31st March 2003) to 10.4% of sales in the year ending 31st March 2011. It is also proposed that the Obligation will then remain at least constant at 10.4% of sales until March 2027, but may well be increased to meet more ambitious targets for renewables beyond 2010.

Climate Change Levy Exemptions: Having come into effect in April 2001 under the provisions of the Finance Act 2000, the Climate Change Levy applies to energy used in industry, commerce and the public sector. With the exception of large-scale hydro power,

¹ It is worthwhile to mention that in CHP plants for the sewage sector renewable fuels account for more than 85%, the other fuels being fuel oil and natural gas.

electricity and heat produced from renewables are exempt. The aim is to provide an incentive for business to opt for "green" electricity. Revenue from the levy will be recycled to business via a cut in employers' National Insurance Contributions and extra support for energy efficiency measures. The Levy is charged at the rate of 0.43p/kWh on electricity supplied to non-domestic customers in the United Kingdom, except where negotiated agreements have been made. Electricity from qualifying renewable sources is exempt from the Levy.

GRANTS FOR BIO-ENERGY Including CHP

The schemes that are available for bio-energy are as follows:

- Bio-energy Capital Grants Scheme
- Community and Household Capital Grants Scheme- Community Renewables Initiative
- Bio-energy Infrastructure Scheme

Bio-energy Capital Grants Scheme: The purpose of the Bio-energy Capital Grants Scheme is to promote the efficient use of biomass for energy, and in particular the use of energy crops by stimulating the early deployment of biomass fuelled heat and electricity generation projects. It will do this by awarding capital grants towards the cost of equipment in complete installations.

The scheme is a joint initiative funded by the Department of Trade and Industry (DTI), and the National Lottery New Opportunities Fund (The Fund) with input from the Department for the Environment, Food and Rural Affairs (DEFRA). The Scheme will provide a common focus and entry point into the capital grant funding available from the DTI and The Fund.

The aim of the scheme is to deliver the following capacity on the ground in the next five years;

- A small number, around 3 – 5 of substantially sized, greater than 20 MW_e installations that will convert energy crops and other biomass feedstocks to electricity with high efficiency, using state of the art technology.
- At least 10 MW_e capacity with a preference for CHP at outputs greater than 1 MW_e.
- One or more commercially scaled demonstrations of advanced technology e.g. gasification or pyrolysis, that will significantly improve the efficiency of conversion of energy crops to electricity and can look towards commercial deployment in the short to medium term.
- Several examples of biomass heating/CHP projects or clusters that will create an initial market for equipment and services and stimulate rural economies.
- A range of projects that will deliver learning benefits that will accelerate deployment in the future.

The total funding available for this round is at least £66 million, subject to sufficient quality and quantity of proposals being received under all priority areas. This comprises up to £30 million from the DTI and at least £36 million from the National Lottery New Opportunities Fund 'Transforming Communities' programme.

Community and Household Renewables Scheme: In November 2001 the Prime Minister announced the allocation of an additional £100 million of funding for renewable energy. This allocation was based on recommendations contained in a report by the Cabinet Office's Performance and Innovation Unit (PIU). In its report the PIU recognised that "... (initiatives) will not get renewable energy off the ground unless the public extends its general support for renewable energy to support for renewable energy in local situations. This makes community engagement crucial, so that more people are either individually involved in renewable energy schemes or able to see them". As such the PIU report recommended that up to £10 million of support be provided as capital grants specifically for renewable energy schemes that engage local communities or individual households.

The key criterion for this support were that schemes must be able to demonstrate a strong community or household interest, and that no restrictions will be placed on the types of

technology employed. However, eligibility will be restricted to renewables deployed at the level of households, or buildings/ land owned by non profit making organisations.

The scheme will be administered by DTI, working closely with the devolved administrations. In making its recommendations the PIU recognised that capital grants for community and household schemes could duplicate existing programmes and DTI are currently designing an approach that avoids such wasteful duplication.

Community Renewables Initiative: The Community Renewables initiative is being led by the Countryside Agency, with support from the DTI, Forestry Commission, DEFRA, and the Energy Savings Trust. It will be a means of:

- supporting local community groups and organisations establish renewable energy developments which suit their circumstances, and which they can benefit from;
- integrating renewable energy developments with other activities in the countryside, to provide livelihoods, skills, income, and community development benefits;
- providing a framework for public, private, and community level bodies to collaborate in order to deliver renewable energy developments;
- establishing renewable energy developments in ways which are environmentally sensitive and which allow all relevant people and groups to shape and influence them.

Further information is available on <http://www2.dti.gov.uk/renewable/renew.htm>

Bio-energy Infrastructure Scheme: This is a new scheme which is being drawn up by the Department for Environment, Food and Rural Affairs, National Assembly for Wales, Scottish Executive Environment and Rural Affairs Department, Department for Agriculture and Rural Development Northern Ireland and the Forestry Commission.

The scheme will help the development of the infrastructure required to harvest, store and supply biomass to energy end-users. The exact details of the scheme, including the percentage grant, are subject to State Aid approval by the European Commission. More detailed guidance will be available once State Aid approval has been granted. The scheme is expected to be in operation in early 2003.

The scheme is likely to include provision of grants to assist:

- the setting up of producer groups to supply biomass to energy end-users. Grants are likely to be available towards administrative set-up costs and the purchase of specialist capital equipment;
- new businesses or existing businesses to diversify into supplying biomass to energy end-users. Grants are likely to be available towards the purchase of specialist capital equipment.

3.5million is available for the UK as a whole. This money must be contractually committed within 3 years of the announcement of the scheme and spent by 2006.

Existing biomass CHP plants

- **Blackwater Valley Museum, Benburb**

Sited at the Blackwater Valley Museum, Benburb, the 200kW plant uses sawmill wood chips to provide heating for the museum and clean, green electricity for c. 400 homes. Designed and manufactured in Northern Ireland, the plant is the world's first downdraft, CHP unit to operate on a continuous feeding system. Swedish technology, which has used wood to power vehicles since the Second World War, was redesigned as a stationary power plant.

The plant is monitored remotely with a computer control system, requiring only two wood deliveries per week and routine servicing. Wood chips are fed automatically by an enclosed storage area into two units. In each unit a drier uses waste heat from the engine cooling system to dry the wood chips before feeding them into a gasifier. The gas is then cleaned, cooled, mixed with air and fed into the engine. 10% of the engine fuel is diesel supplied for ignition purposes. The engine exhausts heat is recovered by diverting them through heat

exchangers. The resulting hot water is then pumped to the radiators in the museum for space heating via an underground heating network. The wood fuelled plant produces around 400 kW of heat and 200 kW of electricity at 415 volts. This is transformed to 11kV and carried away on the NIE grid. The plant is capable of 24 h/day unmanned operation for a period of 6 days after which the residual charcoal will be removed and the wood chips replenished. The life expectancy of the plant should be similar to that of a conventional steam electricity plant.

- **Holsworthy**

In Holsworthy a Centralised Anaerobic Digestion plant is taking slurry from 50 nearby dairy farms for digestion with vegetable and food processing waste to produce methane that will be used to generate 2 MW_e for the grid and provide heating for public and commercial buildings. The digestate will be returned to the farmers, nutrient availability improved and pathogens, weed seeds and odour reduced.

- **De Montfort University, Caythorpe**

DeMontfort University's Anaerobic Digestion plant at Caythorpe is fed by pig slurry, poultry litter and vegetable waste and generates biogas to fuel a 40 kW_e CHP unit.

- **Carlise**

A 225000 t/y pyrolysis plant under development in Carlisle will fuel 20 MW_e of electricity generation on-site, supply district heating to nearby industrial units and supply bio-oil to two satellite CHP plants.

- **Nothorn Ireland**

In Northern Ireland a 100 kW_e biomass CHP plant generating electricity for the grid and heating a collection of houses and grain drying floors is now one of three such plants in the UK. This plant will shortly be running entirely on willow SRC energy crops grown on-site.