Imperial College

OF SCIENCE, TECHNOLOGY AND MEDICINE

INTERNATIONAL ENERGY AGENCY (IEA) BIOENERGY TASK40 ON:

‘Sustainable International BioEnergy Trade:
Securing supply and demand’

TASK 40- Country Report for United Kingdom[1]

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Executive Summary

This UK Country Report is an update of the 2007 study. Since then the UK scene has experienced significant changes. For previous UK Country Reports please visit www.bioenergytrade.org/countryreports/

The Role of Task 40

Task 40 was established by the International Energy Agency (IEA) in December 2003 with the aim of focusing on international bioenergy trade and its wider implications[2]. Bioenergy trade has expanded rapidly in recent years. Forestry and agricultural residues, wood chips, pellets and briquettes for use in co-firing and green power, and bioethanol and biodiesel for transport, are all traded at significant scales in national, regional and global energy markets. The future vision for global bioenergy trade is that *"it will develop into a global commodity market which will secure supply and demand in a sustainable way".* The driving force behind the expansion in bioenergy is the potential it holds in providing an affordable and practical renewable source of energy for climate change mitigation, energy security, and rural socio-economic development.

In order to initiate the development of the framework for the sustainable provision of biomass for energy globally, Task40 has outlined key short-term objectives as follows:

- Provide information, modelling tools, environmental impacts analysis for evaluating biomass markets at different levels.
- Evaluate the factors influencing the supply and demand of biomass for energy.
- Investigate bioenergy trade and exchange national experiences.
- Identify strategies to overcome bioenergy trade barriers.
- Assess sustainability criteria for bioenergy trade and provide "best practice guidelines".
- Increase public awareness of international bioenergy trade.

The role of UK Task 40

UK became a full Member of IEA Task 40 on 1st January 2006[3]. The UK is increasingly dependent on energy imports as North Sea oil and gas reserves are running out. Bioenergy remains one of the key components for the provision of low carbon energy in the transport, electricity and heat sectors. The key national instruments for incentivising these bioenergy markets are either in place or under active development e.g. the Renewables Obligation (RO), the Renewable Transport Fuels Obligation (RTFO) and the Renewable Energy Strategy (RES). Biomass is likely to be the major potential source of low carbon energy in the UK as the proportion of energy from RE continue to increase. However, given its limited indigenous potential, a significant share may need to be secured through sustainable and reliable imports. Areas of particular interest for bioenergy trade in the UK include biodiesel and bioethanol for transport and woody biomass and crop residues for CHP

[2] For further details of Task 40 objectives, visit www.bioenergytarde.org

[3] In the first Triennium, 2006- 2008 UK Task 40 received some financial support from the DTI, DEFRA, Department of Transport (DfT), Czarnikow Sugar, Drax Power, E.ON-UK Energy Trading and Wessex Grain, to whom we extend our gratitude.

and co-firing. The emerging nature of the markets for these forms of biomass means that a high degree of volatility and uncertainty can be expected in both prices and security of supply (volume, quality and environmental provenance).

The aim of the UK Country Report is to:

- Present a brief overview of the UK energy sector and policy
- Assess the role of renewable energy (RE), particularly bioenergy
- Assess the market potential for biofuels
- Assess the potential for international bioenergy trade

The UK Scene

Due to the UK's unique position as net exporter of energy in the past few decades, energy from renewable sources was not regarded by successive governments as a high policy priority, compared to most other EU Member States. However, this has changed and the past or so decade has seen a rapid increase in the use of RE sources for heat and electricity generation, and biofuels (biodiesel and ethanol) for transport.

The UK economy is dominated by the service sector which accounts for 75.2% of GDP, compared to 1% for agriculture, 6% for construction and 18% for other productive industries. The total land area used to grow crops in 2008 was 4.7 Mha. The largest arable crops by area are wheat, barley and oilseed rape, accounting for 44%, 22% and 13% of the agricultural land area respectively [3].

UK Energy Consumption and Production

In 2007, total primary energy supply (TPES) was 9.87 EJ (235.9 Mtoe), greater than the 2006 level of 9.7 EJ but 4.6% lower than the level in 2000. Indigenous production accounted for 7.8 EJ. The largest single source of primary energy consumed was natural gas, accounting for 39.8%. Hydroelectricity, renewables and waste accounted for 1.8% of TPES, compared to 1.7% in 2005 and 0.9% in 2000.

Total electricity supplied in the UK was 378TWh (1.36 EJ) in 2007 and an estimated 381 TWh in 2008. Electricity generated from renewable sources in 2007 was 70.8 PJ, compared to 38.2 PJ in 2003. Co-firing of biomass coal grew by 148% between 2004 and 2005 (9.1 PJ), but fell to 7.0 PJ from 2006 to 2007.

UK heat use in 2007 is estimated to be 3.3 EJ, of which 54% was used in the domestic sector, 30% in industry and 16% in the commercial and public sectors [8], Generation of heat from renewable sources[4] was 30.5 PJ, compared to 24.9 PJ in 2003. The largest single contributor in 2007 was domestic wood combustion, which accounted for 60% of heat generated (sect. 1.5).

In 2007, UK consumption of transport biofuels stood at 15.2 PJ while consumption of petrol and diesel in road transport stood at 773 PJ and 890 PJ respectively, giving a biofuel penetration of 0.9%. In April 2008, the Renewable Transport Fuel Obligation (RTFO) came into force, mandating a biofuel penetration of 2.5% by volume.

GHG Emissions Targets

[4] Excludes generation from non-biodegradable waste fractions

The target of the 2006 Climate Change Programme [9] is a reduction in CO_2 emissions by 2010 of 20% compared to a baseline 1990 level. The UK's target under the Kyoto Protocol requires a 12.5% reduction in emissions of all GHG in the period 2008-2012. In 2007, UK GHG emissions were 18.4% below 1990 levels, and 21.7% below when net purchases under European Emissions Trading Scheme (EU-ETS) are included.

Policy Setting

The overall goals of UK energy policy up to 2050 are set out in the Energy White Paper of 2003[5]. The overall objective is "to put the UK on a path to cutting CO_2 emissions by some 60% by about 2050, with real progress by 2020". To meet this target, an overall renewable share of 15% is mandated for the UK. In 2008, The Renewable Energy Strategy consultation was launched in order to devise the policy measures that would meet the Directive's commitments. At present, renewable energy in the UK is supported primarily through the Renewables Obligation (RO) and RTFO – both of which mandate minimum renewable shares in electricity and road transport fuel supply respectively (sect. 2.2).

The RO was introduced in 2002 as a means of meeting the domestic target to supply 10% of electricity from renewable sources by 2010. In 2007/08, the RO required a renewable share of 7.9% of electricity supplied, amounting to 22.86TWh (82.3 PJ). From April 2009 onwards, the RO has been modified in an attempt to provide greater support to emerging technologies. The 2009 RO Order also introduces a reporting requirement for suppliers of electricity from biomass. Several other policy measures are available to support the use of biomass for electricity, though most are not exclusively aimed at biomass or electricity production e.g. Climate Change Levy (CCL, EU-ETS and Energy Crop Scheme (sect. 2.4).

The main policy measure to encourage renewable transport fuel is the RTFO. This is an obligation placed on transport fuel suppliers to supply renewable fuels equivalent to 2.5% of total road transport fuel sales (by volume) in 2008/09, reaching 5% by 2013 (sect 2.3).

Biomass Consumption and Potential (sect.3)

In 2007, total consumption of the biomass sources listed was 155 PJ, compared to 145 PJ in 2006 and 138 PJ in 2005. The single most important source is landfill gas 64.79 PJ, followed by straw, SRC and other biomass, with 36.54 PJ; biofuels represented just over 15 PJ.

The total UK exploitation of biomass resources in 2007 was just over 127 PJ, far below the total potential e.g. it is estimated at 690 PJ in 2020 (Table 4).

The major source of electricity generation from biomass is through anaerobic digestion of landfill and sewage gas, followed by co-firing with coal. A new feature is that the total generation capacity of dedicated biomass facilities is increasing year-on-year and may also require a significant contribution from imported feedstocks in future with a combined capacity close to 2GWe (see Table 8).

[5] See UK Country Report, Dec/2007.

Co-firing electricity market more than doubled between 2004 and 2005 but has fallen since then e.g. in 2005 about 1.4 Mt of biomass were consumed but just over 1.0 Mt in 2007 (Table 6). From 2006 onwards the attractiveness of co-firing compared to other renewable electricity options has been affected by developments in the Renewables Obligation.

In April 2008, the RTFO came into force, mandating a biofuel supply equivalent to 2.5% of the total volume of fuel supplied for road transport, c.1.3 billion litres of biofuel supplied, compared to a total road transport fossil fuel supply of 46 billion litres [34]. In the 11 months from 15 April 2008 to 14 March 2009, biodiesel an bioethanol accounted for 84% (967 Ml) and 16% (190 Ml) respectively of fuel supplied under the policy. Declared imports accounted for 62% of biofuel supplied, with a further 30% coming from unknown sources (sect. 3.2).

Installed production capacity for biofuels in the UK is witnessing a significant increase. For example, biodiesel production capacity is expected to increase from 0.89Mt in 2007/08 to 2.67Mt in 2010/1; and that of bioethanol from 1.15Mt in 2008/09 to 1.93Mt in 21011 (Tables 10 & 11). The rapid demand for biofuels in the UK market will require considerable increase in imports; unfortunately, it is difficult to find reliable data. Table 13 summarises imports and exports.

Prospects for International Bioenergy Trade

It is difficult to obtain detailed reliable information concerning the level of bioenergy imports into the UK. There are two main difficulties: i) reluctance of suppliers and consumers to provide data as this is often regarded as commercially sensitive, and ii) difficulties with statistical classification as most imports are not necessarily classified as energy.

The main drivers for international bioenergy trade in the UK are the RO and RTFO, both of which provide a guaranteed market for renewable energy without specifying that eligible biomass be sourced domestically. Of the two policies, the RTFO appears to be the greater driver to bioenergy trade, mainly because the 1st year RTFO target has been fully met through supply of biofuel whereas the value of the buy-out fund continues to be significant in the RO. The transport biofuels market in 2008/09 has been dominated by imports. The import-dependency in UK biofuel consumption may diminish in the near-future as a result of the anti-dumping and countervailing duty imposed by the European Union on exports of biodiesel from the US.

Significant advances have been made on certification issues in past few years. However, certification is unlikely to solve social, economic, environmental, and sustainability problems posed by land use, resources, etc as currently most (or none) of the schemes are not an effective substitute for positive governmental legislation. In addition, if certification schemes are not easily and effectively implemented, they can hinder rather than enhance international bioenergy trade.

1. General Introduction

The population of the UK stood at 60.9 million inhabitants in mid-2007, giving average GDP per capita in the financial year 2007-08 of €33,578 (£23,984[6]) [1, 2]. The total land area of the UK is 24.2 million hectares (Mha), of which total agricultural land in 2007 accounted for 18.7 Mha (77%). Of this, arable land accounted 5.78 Mha rising to 6.01 Mha in 2008. Total forest area accounted for 2.8 Mha in 2008, around 30% higher than the 1980 level [3].

1.1 Main Industries

The UK economy is dominated by the service sector which accounts for 75.2% of GDP, compared to 1% for agriculture, 6% for construction and 18% for other productive industries. In terms of gross value added, no particular industry dominates the 'other productive' sector. The largest of these industries are food and beverages; pulp, paper, publishing and printing; and chemicals, each accounting for 1.6%-1.8% of gross value added in 2006. In 2008, agriculture, forestry, hunting and fishing employed 480,000 people [4]. The total land area used to grow crops in 2008 was 4.7 Mha. The largest arable crops by area are wheat, barley and oilseed rape, accounting for 44%, 22% and 13% of the agricultural land area respectively [3].

1.2 Greenhouse Gas Emissions & Reduction Requirements

In 2008, UK emissions of greenhouse gases (GHG) were 624 Mt of CO_2 equivalent ($MtCO_2eq$), 19.3% lower than in 1990 [5]. Under the Kyoto Protocol, the UK is committed to reducing GHG emissions by 12.5% compared to 1990 levels by 2010. An actual reduction of 19.4% is expected by that time [6]. However, it is less likely that the UK will meet subsequent GHG emissions and renewable energy targets (see Section 2).

[6] All currency conversions assume £1 = €1.4 as per Bank of England exchange rate statistics, www.bankofengland.co.uk. This is the average exchange rate for years 2006-2008, However, the £ has depreciated considerably against the € in recent years. £1 was worth over €1.40 prior to November 2007, reached a monthly average low of €1.08 in March 2009 and has been trading at €1.10-€1.20 more recently.

1.3 Domestic Energy Production and Consumption[7]

In 2007, total primary energy supply (TPES) was 9.87 EJ (235.9Mtoe), greater than the 2006 level of 9.7 EJ but 4.6% lower than the level in 2000. Indigenous production accounted for 7.8 EJ. The largest single source of primary energy consumed was natural gas, accounting for 39.8%. Hydroelectricity, renewables and waste accounted for 1.8% of TPES, compared to 1.7% in 2005 and 0.9% in 2000. The UK has been a net importer of primary energy since 2004. The UK's import dependency, the percentage of imports in gross inland consumption of primary fuels, stood at 20.2%, slightly below the level for 2006 (21.3%). Net imports of coal were equivalent to 69% of domestic coal consumption while gross imports of natural gas were equivalent to 32% of domestic consumption, compared to 23% in 2006. Domestic crude oil production stood at 70,000 tonnes, higher than 2006 production but lower than in 2002 and before when production was over 100,000 tonnes. Imports of crude oil in 2007 were 50,000 tonnes and exports 45,000 tonnes. Trade in refined petroleum products is mostly bi-directional (import and export), with the UK as a net exporter of most major petroleum products – a notable exception being diesel, in which the UK is a net importer.

1.4 Domestic Electricity Production

Total electricity supplied in the UK was 378 TWh (1.36 EJ) in 2007 and is estimated to reach 381 TWh in 2008, a breakdown by source for 2007 is shown in Figure 1.

[7] All references in this section are from the Digest of UK Energy Statistics [7] unless otherwise stated. These statistics are reported as high heating values (gross calorific values).

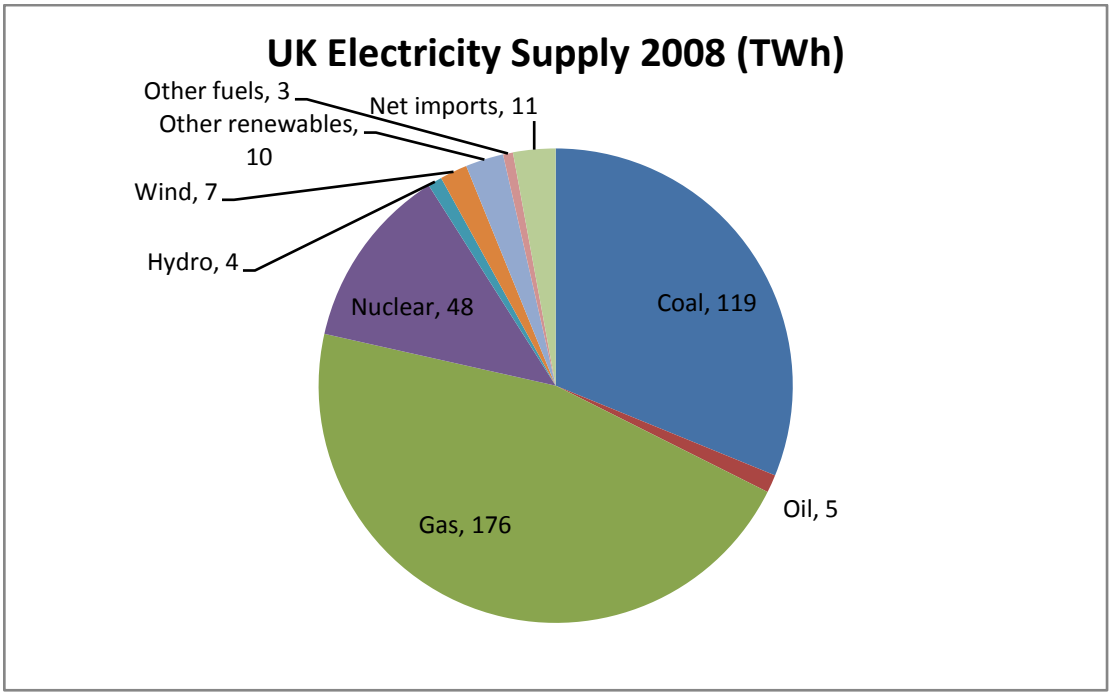

Figure 1: UK electricity supplied by source

Electricity generated from renewable sources in 2007 was 70.8 PJ, compared to 38.2 PJ in 2003. In absolute terms, the largest generation technologies are hydro and landfill methane while wind has achieved the greatest growth in generation. Co-firing of biomass with coal grew by 148% between 2004 and 2005 but from 2006 to 2007, generation from co-firing fell from 9.1 PJ to 7.0 PJ. Figure 2 shows electricity generation from renewable sources 2000 throughout 2006. As can be appreciated wind power has seen a significant growth.

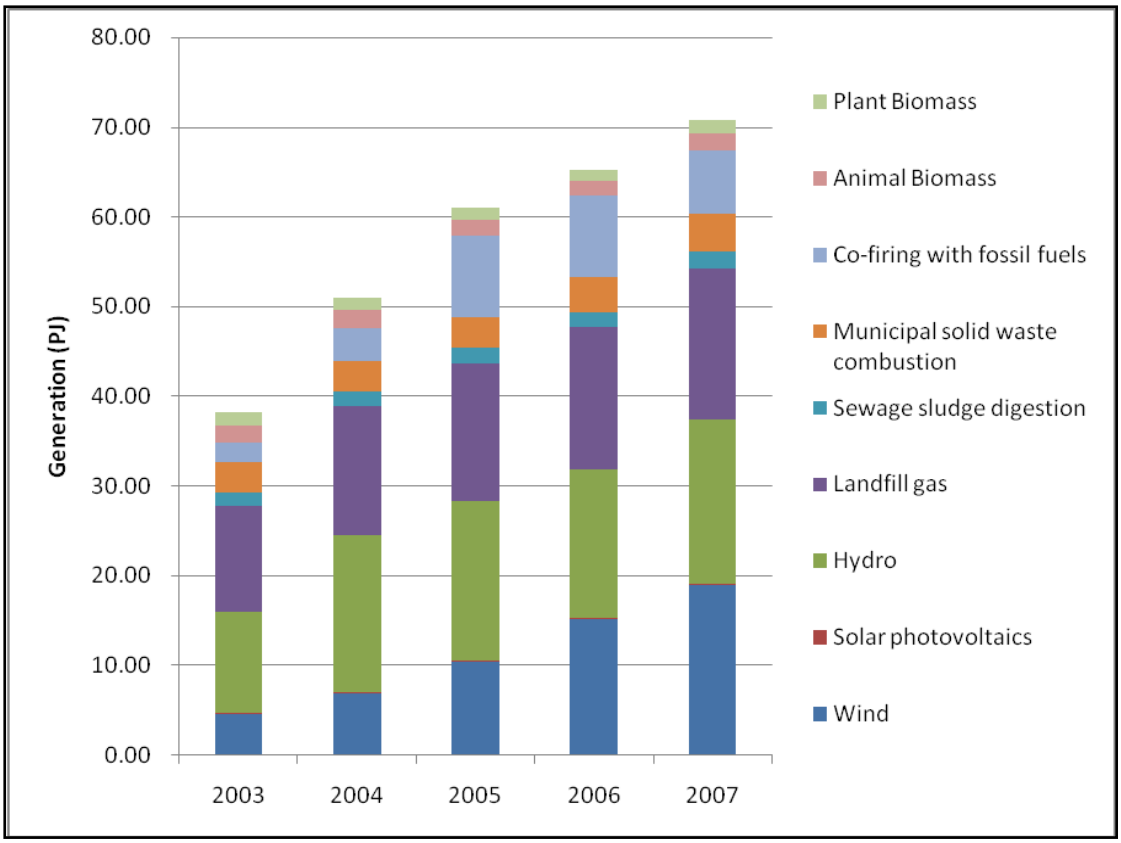

Figure 2: Electricity generation from renewable sources, 2000 - 2006

NB – Municipal solid waste combustion refers to biodegradable element only

1.5 Energy Consumption for Heat

UK heat use in 2007 is estimated to be 3.3 EJ, of which 54% was used in the domestic sector, 30% in industry and 16% in the commercial and public sectors [8], Generation of heat from renewable sources[8] was 30.5 PJ, compared to 24.9 PJ in 2003. The largest single contributor in 2007 was domestic wood combustion, which accounted for 60% of heat generated (see Figure 3).

[8] Excludes generation from non-biodegradable waste fractions

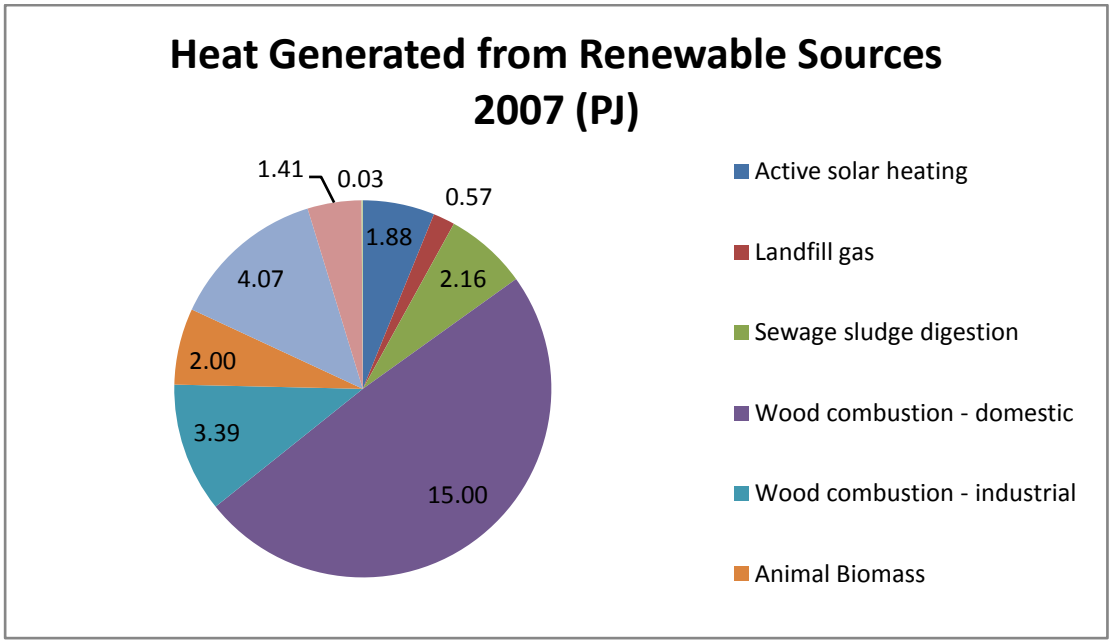

Figure 3: Heat Generated from Renewable Sources

Source: [8]

1.6 Renewable Transport Fuels

In 2007, UK consumption of transport biofuels stood at 15.2 PJ while consumption of petrol and diesel in road transport stood at 773 PJ and 890 PJ respectively, giving a biofuel penetration of 0.9%. In April 2008, the RTFO came into force, mandating a biofuel penetration of 2.5% by volume. The effect of the RTFO is discussed in greater detail in sections 2.3, 4 and 5.

2. Renewable Energy and Climate Change Policies

2.1 GHG Emissions Targets

The target of the 2006 Climate Change Programme [9] is a reduction in CO_2 emissions by 2010 of 20% compared to a baseline 1990 level. In 2007, emissions were 12.8% below the baseline once net purchases under the European Emissions Trading Scheme (EU-ETS) were included. The UK's target under the Kyoto Protocol requires a 12.5% reduction in emissions of all GHG in the period 2008-2012. In 2007, UK GHG emissions were 18.4% below 1990 levels, and 21.7% below when net purchases under EU-ETS are included [5].

The 2008 Climate Change Act [10] set a legally binding target of an 80% reduction in GHG emissions from 1990 levels by 2050, including an interim target of 26% reduction in CO_2 emissions by 2020 and various monitoring mechanisms. Despite the legally binding nature of the target, policy mechanisms to ensure it is met have yet to be fully determined.

2.2 Renewable Energy Directive

Under the Renewable Energy Directive [11], the EU as a whole is obliged to supply 20% of final energy consumption from renewable sources by 2020, including 10% renewable energy in transport. To meet this target, an overall renewable share of 15% is mandated for the UK. In 2008, The Renewable Energy Strategy consultation [8] was launched in order to devise the policy measures that would meet the Directive's commitments. At present, renewable energy in the UK is supported primarily through the Renewables Obligation (RO) and RTFO – which mandate minimum renewable shares in electricity and road transport fuel supply respectively. The eventual Renewable Energy Strategy may include the strengthening of these measures and/or introduction of new measures such as a renewable obligation for heat.

2.3 Renewable Transport Fuels

The main policy measure to encourage renewable transport fuel is the RTFO. This is an obligation placed on transport fuel suppliers to supply renewable fuels equivalent to 2.5% of total road transport fuel sales (by volume) in 2008/09[9]. The obligation increases to 5% by 2013 according to the following schedule as shown in Figure 4.

Year	2009-10	2010-11	2011-12	2012-13	2013-
New target	3.25%	3.5%	4%	4.5%	5%

Figure 4: Renewable fuel obligation levels under the RTFO
Source: Renewable Fuels Agency

Since the blends stipulated in the obligation are expressed on a volumetric basis they are substantially below the reference value of 5.75% set out in the European Biofuels Directive [12] (5% biofuel by volume is equivalent to 3.4% and 4.4% by energy

[9] Each obligation period begins on April 15th and runs for one year.

content for bioethanol and biodiesel respectively [13]). Although the RTFO is aimed at the promotion of renewable fuels in general (rather than biofuels specifically), bioethanol, biodiesel and biogas are currently the only fuels specifically dealt with in the legislation.

Under the RTFO, obligated parties must pay £0.1 (€0.14) for every litre of renewable fuel that they fail to supply. The proceeds from these payments are then repaid to participants who do supply renewable transport fuel, in proportion to the amount of fuel supplied. In addition to the RTFO, biofuels benefit from excise duties that are lower than for their fossil equivalents. Duty for unleaded petrol and diesel stands at £0.54/ litre (€0.76) compared to £0.34 (€0.48) for bioethanol and biodiesel.

The RTFO does not offer differentiated levels of support to biofuels depending on their origin, social and environmental impacts or demonstrable GHG emissions savings. However, the policy does include a reporting framework that obliges each fuel supplier to provide information concerning the carbon emissions and sustainability implications of their biofuel. It is the government's stated intention from 2011 to reward only biofuels that meet qualifying sustainability standards [8].

2.4 Renewable Electricity

The RO was introduced in 2002 as a means of meeting the domestic target to supply 10% of electricity from renewable sources by 2010. The RO operates in a similar fashion to the RTFO, with mandatory caps set annually and the ability for suppliers to trade RO certificates (ROCs) or pay into a buy-out fund if they are unable to meet their obligation through ROCs generated in-house[10]. In 2007/08, the RO required a renewable share of 7.9% of electricity supplied, amounting to 22.86 TWh (82.3 PJ). However, only 64% of the obligation was actually met by ROCs, with the rest of the obligation being discharged through payment of the buy-out price.

From April 2009 onwards, the RO has been modified in an attempt to provide greater support to emerging technologies while reducing rewards to technologies that are closer to being financially viable without government support. Rather than mandating a fixed supply of renewable electricity per MWh, the RO now requires a fixed number of ROCs – with some technologies receiving more ROCs per MWh than others, as

[10] Electricity suppliers (the obligated party under the RO) do not necessarily generate their own electricity. The ability to trade ROCs is therefore an essential part of the RO.

shown in Table 1. The number of ROCs mandated will be equivalent to at least 9.7% of the total electricity supply (in MWh) in 2009/10, rising to 15.4% by 2015/16. The 2009 RO Order also introduces a reporting requirement for suppliers of electricity from biomass. This will require each supplier who claims ROCs from biomass to supply information regarding the type of plant from which the biomass is derived, its country of origin, whether or not it is a waste or a by-product and whether it was grown in compliance with any environmental certification scheme. Table 1 lists the ROCs awarded per MWh supplied under Renewables Obligation 2009

Table 1: ROCs Awarded per MWh Supplied under Renewables Obligation 2009

Technology	**ROCs awarded per MWh**
Landfill Gas	0.25
Sewage Gas	0.5
Co-firing	
Onshore Wind	1
Hydro-electric (≤ MW capacity)	
Co-firing, Dedicated Energy Crops	
Energy fromWaste with CHP	
Geopressure	
Co-firing with CHP	
Standard Gasification	
Standard Pyrolysis	
Offshore Wind	1.5
Dedicated Biomass Plant	
Co-firing, Dedicated Energy Crops & CHP	
Wave	2
Tidal-stream	
Advanced Gasification	
Advanced Pyrolysis	
Anaerobic Digestion	
Dedicated Biomass Plant with Energy Crops	
Dedicated Biomass Plant with CHP	
Dedicated Biomass Plant with Energy Crops & CHP	
Solar Photovoltaic	
Geothermal	
Tidal Impoundment	

Note: Standard gasification and pyrolysis refers to a process in which the fuel has a calorific value of 2-4 MJ/m^3. Advanced gasification and pyrolysis refers to a process in which the calorific value of the fuel is at least 4 MJ/m^3
Source: [14]

Several other policy measures are available to support the use of biomass for electricity, though most are not exclusively aimed at biomass or electricity production. Some of these measures are listed below:

- **Climate Change Levy (CCL)** This is a tax on energy use other than in the domestic sector. The rate of the levy is adjusted annually in line with inflation. For the financial year beginning April 2008 users must pay 0.46p (€c0.64) per KWh of electricity consumed, 0.16p (€c0.22) per KWh for gas, 1.02p (€c1.42)

per kg of liquid petroleum gas and 1.24p (€1.74) per kg for other taxable fuels [15]. Biomass and electricity supplied from renewable sources, including biomass is exempt from the levy, as long as a Levy Exemption Certificate (LEC) is supplied to the consumer together with the electricity [16]. In addition, industries are collectively able to negotiate Climate Change Agreements with the government, which entitle participants to a 20% CCL discount, provided agreed conditions regarding reductions in energy use or efficiency improvements are met.

- **European Emissions Trading Scheme (EU-ETS)** Biomass is considered to be carbon-neutral under EU-ETS, allowing installations to replace fossil fuels with biomass in order to meet their compliance obligations or generate revenue from the sale of credits. Total annual allowances of 246 $MtCO_2$ have been created under the UK allocation plan for the current phase (2008-2012). Slightly more than half of these allowances (54%) have been awarded to electricity and CHP producers [17].

- **Energy Crop Schemes** Even before the introduction of the RO, government policy has explicitly favoured the cultivation of dedicated energy crops for bioenergy use over the use of residues and other biomass. This has continued under the banding arrangement shown in Table 1. For the period 2007-2013 support for the cultivation of energy crops in England is available through the Energy Crops Scheme which provides funding to cover 40% of the costs of growing short rotation coppice or Miscanthus [18].

In addition to the policies mentioned above, there are various grant programmes that contribute towards the cost establishing bioenergy infrastructure or installing small-scale renewable energy systems. These are the Low Carbon Buildings Programme phase 1[11] and 2[12] and the Bioenergy Capital Grants Scheme[13] and Bioenergy Infrastructure Scheme[14]. Each of these schemes is stop-start in nature since a limited amount of funding is available to the scheme overall, applications are accepted in a series rounds and the precise nature of each scheme remains uncertain from one round to the next.

[11] www.lowcarbonbuildings.org.uk
[12] www.lowcarbonbuildingsphase2.org.uk
[13] http://www.bioenergycapitalgrants.org.uk/
[14] http://www.defra.gov.uk/farm/crops/industrial/energy/infrastructure.htm

3. Biomass Consumption in 2007 and Medium-term Biomass Resources

Table 2 gives a summary of total bioenergy use in the UK in 2007. It shows that the largest single category of biomass is landfill gas. The next largest category (straw, SRC and other plant biomass), consists of 43% imported material. The table also shows that in 2007, the UK was a net exporter of liquid biofuels for transport. Domestic consumption of biofuels was equivalent to 0.85% of the fossil-derived petrol and diesel oil consumed in the same year on an energetic basis. However, the use of biofuels for transport has increased substantially from 2008 onwards, see sections 3.2.

Table 2: Consumption of Biomass for Energy (PJ) in 2007

	Wood waste	Wood	Poultry litter, meat and bone, farm waste	Straw, SRC and other plant-based biomass	Sewage gas	Landfill gas	Liquid biofuels for transport
Supply							
Production	3.39	15	11.32	20.71	9.26	64.79	16.57
Imports				15.83			(**)
Exports							-1.42
Total demand	***3.39***	***15***	***11.32***	***36.54***	***9.26***	***64.79***	***15.15***
Electricity generation			9.32	32.47	7.10	64.22	
Final consumption							
Industry	3.39		1.92	1.06		0.57	
Road Transport							15.15
Domestic		15					
Public administration					2.16		
Agriculture			0.08	3.01			

Source: UK Energy Statistics [7]

** It is assumed that it is mainly biodiesel, but how much is actually produced in the UK it is still unclear (see Sect. 3.2 and Sect 8).

Table 2 excludes general waste, of which consumption for energy was 40 PJ in 2007 and 21.8 PJ of this was the organic fraction of municipal solid waste. Total consumption of the biomass sources listed in Table 2 was 155 PJ, compared to 145 PJ in 2006 and 138 PJ in 2005. The equivalent table for 2006 is given in Table 3 (note that transport biofuels are not included).

Table 3: Consumption of Biomass for Energy (TJ) in 2006

Biomass input (TJ) (Gross Calorific Value)	**Wood waste**	**Wood**	**Poultry litter, meat and bone, biomass, straw, farm waste and SRC**	**Sewage gas**	**Landfill gas**
Production	3,391	8,541	27,968	8,374	61,337
Import	-	-	20,808	-	-
Total Supply	3,387	8,541	48,776	8,374	61,337
Electricity Generation	-	-	45,762	6,364	60,750
Final Consumption	-	-	-	-	-
Industry	3,391	-	-	-	586
Domestic	-	8,541	-	-	-
Public Administration	-	-	-	2,010	-
Agriculture	-	-	3,014	-	-

Source: [19]

In many areas, biomass use is substantially below the potential resource that other studies have identified. A comparison of current use versus potential resources is given in Table 4.

Table 4: Comparison of domestic biomass exploitation in 2007 vs. 2020 potential

Resource	**Resource Use in 2007[1] (PJ[2])**	**Resource Potential in 2020 (PJ[2])**
Wood waste	**3.38**	Waste wood diverted from landfill and other waste streams: 5.74 Mt [20] HHV of wood waste: 13.7 GJ/t [7] **79**
Wood	**15.01**	Sawmill co-product & forest residues: 23 PJ [21] Small roundwood from Forestry Commission estate: 3.11 Mt [22] HHV of roundwood: 13.9 GJ/t [7] **Total: 66**
Lignocellulosic Energy Crops	Annual availability of 90,000 odt from [23] **1.7**	Potential from SRC & Miscanthus planting on identified suitable surplus land: 14.5 Modt [23] HHV (dry) of energy crops: 18.6 GJ/t [7] **269.7**
Straw	Current use in Ely Power Station [24] **3**	5.7 Mt [24] HHV of straw: 15 GJ/t **85.5**
Oilseed rape (for non-food use)	Grown on 320,000 ha, of which 80,000 ha of set aside [23] **18.14** (assuming all converted to biodiesel)	Yield: 1.31t biodiesel/ha (1.06 t/ha on setaside land) [23]. Biodiesel = 36GJ/t [13] **No particular area identified especially for additional industrial cultivation**
Landfill methane	**64.79**	**120.16** [25]
Poultry Litter	Annual requirement for Eye, Thetford and Westfield power stations [26] **5.90**	**17.93** [21]
Other manure	**5.4**	**14.39** [21]
Food waste (commercial & industrial)	Assumes 11% currently recovered **0.99 – 1.76** [21]	**9 – 16** [21]
Sewage Gas	**9.26**	**10.71** [27]

Notes:

(1) Resource use is derived from UK energy statistics (as shown in Table 2) unless otherwise specified.

(2) Energy values are high heating value as per the convention of the Digest of UK Energy Statistics

There is a considerable increase from approximately 127.58PJ in 2007 compared to about 690PJ resource potential in 2020.

4. Current and Expected Future Users of Biomass

4.1 The Electricity Market

In the UK, the largest source of electricity generation from biomass is through anaerobic digestion of landfill and sewage gas. For plant-based biomass, generation is mostly through direct combustion either in dedicated biomass power stations or through co-firing with coal. The co-firing market is the largest of these two and imports large quantities of biomass. However, the total generation capacity of dedicated biomass facilities is increasing year-on-year and may also require a significant contribution from imported feedstocks in future (see Table 5).

Table 5: Biomass Input and Electricity Generation from Plant-based Biomass (PJ)

	Dedicated Plant		**Co-firing**		**Wind**
	Biomass Input	**Electricity Generation**	**Biomass Input**	**Electricity Generation**	**Electricity Generation**
2004	4.97	1.30	14.03	3.68	6.97
2005	5.24	1.37	34.78	9.12	10.45
2006	4.98	1.31	34.71	9.10	15.21
2007	5.62	1.47	26.85	7.04	18.99

Source: [7]

As Table 5 shows, generation from co-firing more than doubled between 2004 and 2005 but has fallen since then. Over the same period, the contribution of wind to UK electricity generation has continued to increase. Biomass co-firing was able to increase rapidly in 2005 since it qualified for Renewables Obligation Certificates (ROCs) and the technology was able to be deployed at low biomass blends in existing large coal-fired power stations (see also Table 6). However, from 2006 onwards the attractiveness of co-firing compared to other renewable electricity options has been affected by developments in the Renewables Obligation. From April 2006, the proportion of renewable electricity eligible for credit under the Renewables Obligation was limited to 10%, although this will increase to 12.5% from 2010. In addition, the introduction of banding (see Table 1) means that greater reward is given per MWh of generation from dedicated biomass facilities. However, co-firing is awarded more ROCs per MWh and is ROC-eligible without quantitative restriction if the biomass used consists of dedicated energy crops and/or both heat and power are generated.

Since 2005, it appears that over half of the feedstock for co-firing in the UK has been imported. This is shown in Table 6 where, although the country of origin for each feedstock is not given, the dominance of palm and olive residues and wood pellet is notable. As can be noticed, the amount of feedstock used for co-firing decreased from 1.45 Mt in 2005 to just 1.08 Mt in 2007.

Table 6: Feedstocks in UK for co-firing (tonnes), 2005-2007 (mostly imported)

	2005	**2006**	**2007**
Palm oil	2,829	36,697	6,414
Palm residues	446,828	480,043	253,090
Olive residues	283,222	99,829	225,640
Shea residues	5,420	4,781	25,617
Wood and wood residues	285,923	206,804	280,457
of which wood pellet	*163,961*	*79,148*	*152,287*
Cereal residues and co-products	124,484	152,457	154,098
SRC & Miscanthus	4,306	2,439	9,396
Tall oil	120,129	59,735	50,060
Tallow	119,828	0	0
Sewage sludge	21,059	0	80,852
Total	1,414,028	1,042,784	1,085,624

Source: [28]

Electricity generated from co-firing fell from 2006 to 2007 despite a small increase in the quantity of biomass combusted. This appears to be due to a shift in biomass composition away from highly calorific fuels such as palm oil and tall oil and towards lignocellulosic fuel, including energy crops.

Table 7 shows co-firing activity by major coal-fired power stations in 2006 and 2007. It is difficult to predict how co-firing will develop in future given that the persistence of the quantitative cap within the Renewables Obligation creates additional uncertainty regarding the sale value of ROCs produced by this technology. Major co-firing projects include investments in rail infrastructure and direct injection systems by Drax Power – who aim to increase biomass generation to 12.5% of plant output [29]. In addition, plans have been announced by DONG Energy for construction of a multi-fuelled power station using coal and up to 15% biomass in the West of Scotland [30].

Table 7: Recent co-firing activity by major generators

Company	Co-firing (GWh)	
	2006	2007
AES Kilroot	6	0
Drax Power Station	154	187
EDF - Eggborough Power Station	162	182
EDF - Cottam	98	90
EDF – West Burton	48	112
E.ON - Ironbridge	29	8
E.ON - Kingsnorth	222	286
E.ON - Ratcliffe	0	0
RWE - Aberthaw	82	21
RWE – Didcot A	126	134
RWE - Tilbury	61	18
Iberdrola - Longannet	155	119
Iberdrola - Cockenzie	51	72
Scottish & Southern – Ferrybridge	379	396
Scottish & Southern – Fiddler's Ferry	329	265

Source: [31]

4.2 Dedicated Biomass Plants

Interest in dedicated biomass plants has increased noticeably in recent years, with two new plants coming on-stream in 2007 and others in development. Table 8 gives details of these facilities with potential between 5MW and 50MW.

In addition to these plants, construction of dedicated plants, with combined capacity of over 2GWe is planned by a number of operators [33][15] This includes the construction of three 300MW plants by Drax Power, a 350MW plant by Prenergy Power, and a 295MW plant by MGT Power. The MGT Power plant, located at Teesport in Northeast England, will provide electricity to 0.6M homes and will require 2.4 Mt/yr of woodchips which will be supplied from certified sustainable forestry projects developed by MGT team[16] and partners in North and South America and the Baltic countries. The plant will save 1.2 Mt of CO_2 annually, with cost of about £500m[17], and will create 150 permanent jobs (see www.mgtpower.com for further details).

[15] This total capacity of over 2GWe seems rather high. It is probable that some of the planned biomass-stand-alone plants would not become a commercial reality.
[16] MGT Power has been involved on sustainability issues for years and has drawn up a set of guiding principles (for further details see www.mgtpower.com/sustainability.php).
[17] Euros 700 million (exchange rate £1=E1.4, see footnote 6).

Table 8: Current dedicated bioelectricity plants between 5MW and 50MW capacity, (excludes sewage).

Plant Name	Generating Capacity (MW)	Proposed Feedstocks	Operating Company
Stevens Croft, Lockerbie	42	Sawmill and forestry residues, energy crops	E.ON UK plc www.eon-ukplc.com
Wilton 10, Teesside	10	SRC, Forestry residue	SembCorp Utilities (UK) Ltd. www.sembutilities.co.uk
Ely Power Station	38	Cereal straw	EPR Ltd. http://www.eprl.co.uk
Eye Power Station	12.7	Poultry litter. Charges a gate fee to burn feathers and other agricultural waste. Plant also produces fertiliser	EPR Ltd. http://www.eprl.co.uk
Fawley Waste to Energy Plant	8.6		
Glanford Power Station	13.5	Originally designed to burn poultry waste. Now charges gate fee to burn meat and bone marrow.	EPR Ltd. http://www.eprl.co.uk
Goosey Lodge Power Plant	16	Incineration of various waste materials	Wykes Engineering Ltd. http://www.wykesengineering.co.uk
Knypersley Renewable Generator	7.2		
PDM Widnes	9.5	Food residues	PDM Group http://www.pdm-group.co.uk
Slough Heat & Power	35		http://www.sloughheatandpower.co.uk
Thetford Power Station	38.5	Poultry litter. Fertiliser produced as a by-product	EPR Ltd. http://www.eprl.co.uk
UPM Shotton Paper Mill	19.7	Waste from paper recycling process and other biomass	UPM Kymmene (UK) Ltd. http://w3.upm-kymmene.com/
Westfield Biomass Plant	9.8	Poultry litter. Fertiliser produced as a by-product	EPR Ltd. http://www.eprl.co.uk
% of total RO-accredited biomass capacity	**95%**		

Source: [32]

4.3 Biofuels for Transport

In April 2008, the Renewable Transport Fuel Obligation (RTFO) came into force, mandating a biofuel supply equivalent to 2.5% of the total volume of fuel supplied for road transport. This target was exceeded slightly, with 1.3 billion litres of biofuel supplied, compared to a total road transport fossil fuel supply of 46 billion litres [34]. The RTFO legislation also imposes on suppliers the obligation to provide information from which the carbon balance and overall sustainability of the biofuel supplied can be estimated. However, the eligibility of biofuels for RTFO certificates does not currently depend on their carbon & sustainability performance and suppliers are permitted to report "don't know" for a number of reporting criteria.

In the 11 months from 15 April 2008 to 14 March 2009, fuel supplied under the policy consisted of 84% (967 Ml) biodiesel, 16% (190 Ml) bioethanol and 300 tonnes of biogas[18]. Declared imports accounted for 62% of biofuel supplied, with a further 30% coming from unknown countries. As Figure 4 shows, the largest sources of biodiesel feedstock were soybean oil from the USA, sugar cane from Brazil, rapeseed oil from Germany and tallow from the USA.

On the issue of previous land use (prior to December 2005), a response other than "unknown" was given for 59% of biofuel supplied. Of the fuel where land use was reported, 80% came from cropland and 20% came from by-products. For 214 Ml of biofuel (99% of which was biodiesel) both country of origin and previous land use were stated as unknown. This is equivalent to 18.5% of total biofuel supplied over the period in question. Table 9 shows for selected feedstocks the proportion of biofuel that came from land where prior use was reported as unknown.

[18] According to the RTFO, 1 kg of biogas equals 1 litre of liquid biofuels

Table 9: Proportions of biofuel for which land-use prior to December 2005 was reported as unknown

Feedstock	**Biofuel Supplied (litres)**
Rape unknown	155,051,126
Rape total	282,271,110
Unknown%	55%
Palm unknown	50,596,259
Palm total	113,349,282
Unknown%	45%
Soy unknown	132,185,380
Soy total	393,621,337
Unknown%	34%
Cane unknown	95,178,956
Cane total	154,236,820
Unknown%	62%

Source: [35]

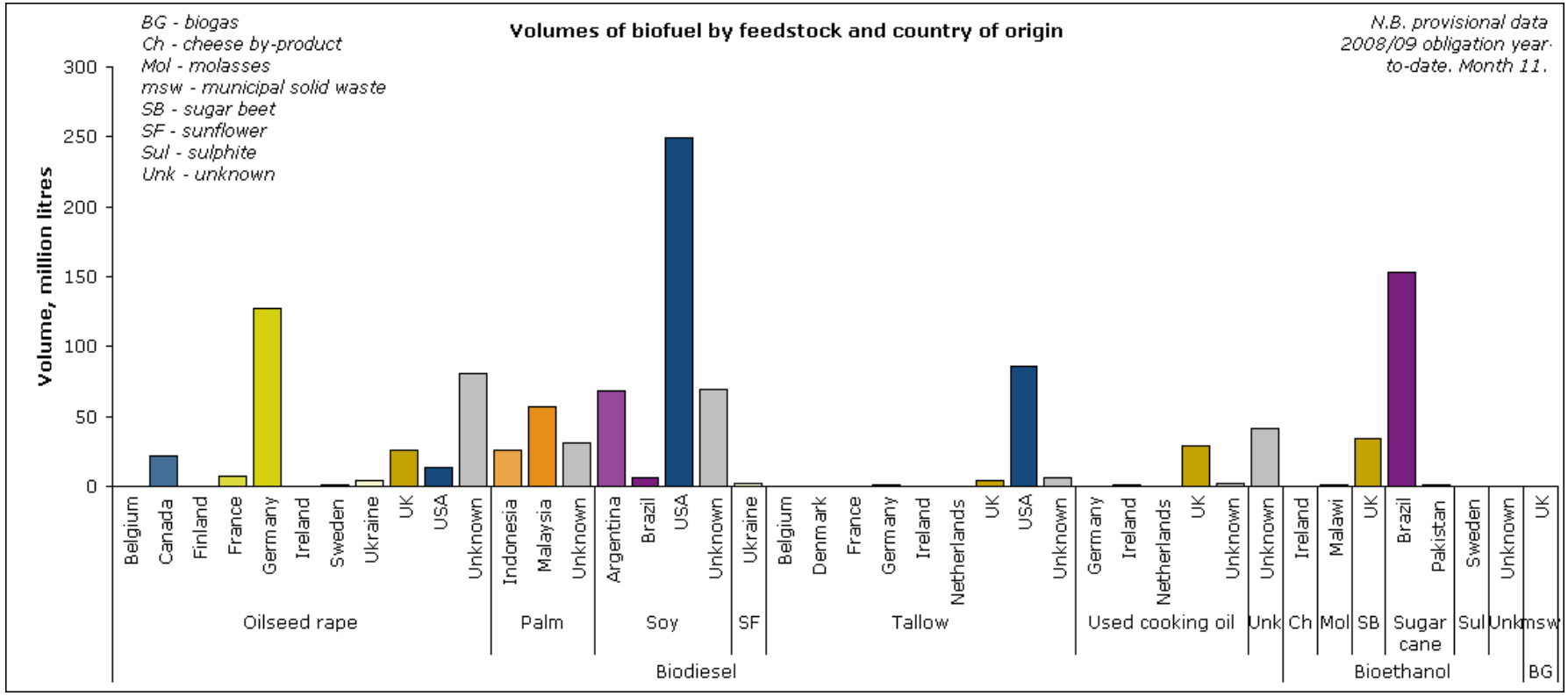

Figure 4: Biofuel Feedstocks and country of origin under the RTFO

Source: [35]

In terms of sustainability, the RTFO has its own meta-standard for environmental and social criteria. In addition, certification schemes that meet the majority of the RTFO standard's criteria are classified as Qualifying Standards. In the first 11 months of the RTFO, 33% of biofuel supplied met some sort of environmental or social standard. Qualifying environmental and social standards were met by 14% of biofuel supplied. In addition, over 90% of oilseed rape and sugar beet of UK origin (5% of total biofuel supplied) met the RTFO environmental standard. A further 13% of fuel supplied met environmental or social standards not classified as Qualifying Standards under the RTFO.

A list of existing and proposed biofuel production plants in the UK is given in Tables 10 and 11. However, development of UK production capacity of bioethanol has not been as rapid as these figures suggest, with only British Sugar's Wissington plant was producing ethanol as of May 2009 according to the European Bioethanol Association[19]. A number of biodiesel producers have suffered in recent years, partly as a result of the competition from US biodiesel which benefited from subsidies for the blending biofuel which could subsequently be exported [36]. In particular, D1 Oils has ceased UK refining and trading operations. Duties imposed by the European Commission on US biodiesel exports as well as the eligibility of biodiesel as *advanced biofuel* under the US Renewable Fuel Standard (a domestic biofuel consumption mandate) may improve market condition for UK producers.

[19] www.ebio.org

Planned UK Biodiesel Production Facilities* (000 tonnes)

Factory	Location	2007/08	2008/09	2009/10	2010/11	Feedstock
ABS Biodiesel	Avonmouth		225	225	225	Veg oil
Argent Energy	Motherwell	45	45	45	45	Tallow / Cooking oil
Argent Energy	Ellesmere Port		150	150	150	Tallow / Cooking oil
Biofuel Corp	Seal Sands	250	650	650	650	OSR
DMF Biodiesel	Fife	110	110	110	110	OSR
D1 Oils	Hull	42	220	320	320	Soy (Jatropha)
D1 Oils	Merseyside	50	-	-	-	Soy (Jatropha)
Greenergy	Immingham	200	200	200	200	OSR
Ebony Solutions	Cheshire	200	200	200	200	OSR / Soy
Goes on Green	Tyne and Wear			30	180	Cooking oil
Ineos	Grangemouth		500	500	500	OSR
Tees Valley	Stockton		170	170	170	OSR
Total fuel		**897**	**2,570**	**2,670**	**2,670**	

*Production capacities shown

Table 10: UK planned biodiesel production capacity

NOTE- can you give the full name to OSR?

Source: [37]

Planned UK Bioethanol Production Facilities* (000 tonnes)

Factory	Location	Supplier	2008/09	2009/10	2010/11	Feedstock
Abengoa	Immingham		400	400	400	Wheat
ABF/BP/Dupont	Immingham	Frontier		370	370	Wheat
Bioethanol Ltd	Immingham	Centaur	100	100	100	Wheat
British Sugar	Wissington		55	55	55	Sugar Beet
Ensus / Shell	Teeside		360	360	360	Wheat
Green Spirit	Grimsby	Gleadell		200	200	Wheat
Green Spirit	Somerset	Wessex Grain	105	105	105	Wheat
Roquette	Corby 1		95	95	95	Wheat
Roquette	Corby 2				95	Wheat
Vireol	Grimsby			150	150	Wheat
Total fuel			**1,115**	**1,835**	**1,930**	

*Production capacities shown

Table 11: UK planned bioethanol production capacity

Source: [37]

5. Biomass Prices

Indicative prices for biomass resources are given in Table 12. Since no official biomass price statistics are collected in the UK (with the exception of the fossil fuel prices shown), the usual health warnings apply. A single exchange rate of £1=€1.40 is applied in the table. However the £:€ exchange rate has altered significantly since 2007 (see footnote 6).

Table 12: Prices of Fuels in the UK

	2007-08 Low		2007 Avg		2007-08 High		Source, Comments
	GBP	EUR	GBP	EUR	GBP	EUR	
Woody Biomass							
Forestry Residues (£/t)	15.00	21.00			22.00	30.80	[20]
Unprocessed Wood Waste – High Grade (£/t)	(20.00)	(28.00)			0.00	0.00	[38] – prices are 2009 gate fees paid to recycling facilities for disposal of waste wood
Unprocessed Wood Waste - Low Grade (£/t)	(35.00)	(49.00)			(17.00)	(23.80)	
Pellets – Loose Household (£/t)	132.14	185.00			165.71	232.00	[39] – prices originally given in Euros
Pellets, CIF/ARA (£/t)	96.43	135.00			117.86	165.00	
Imported Biomass							
Palm Kernels (£/GJ delivered)	7.97	11.16			8.09	11.33	[40]
Olive Cake (£/GJ delivered)	5.03	7.04			5.35	7.49	
Sunflower Husk Pellet (£/GJ delivered)	5.80	8.12			5.98	232.00	
Other Biomass							
Straw (£/t)			35.00	49.00			[20]
Poultry Litter (£/t)			10.00	14.00			
Fossil Fuel – industrial consumers *							
Coal (£/t)	-	-	46.49	65.09	63.47	88.86	[41]
Heavy Fuel Oil (£/t)	242.40	339.36	269.70	377.58	519.40	727.16	
Gas Oil (£/t)	376.00	526.40	400.30	560.42	679.00	232.00	
Electricity (pence/kWh)	5.09	7.13	5.45	7.63	8.67	12.14	
Natural Gas (pence/kWh)	1.19	1.66	1.33	1.86	2.48	3.47	

Table 12 cont/…

Fossil Fuel – at power plants *							
Coal (£/t)	38.11	53.35	41.16	57.62	72.51	101.51	[41]
Oil (excl. transport applications) (£/t)	208.60	292.04	240.27	336.38	369.49	517.29	
Natural Gas (pence/kWh)	0.96	1.34	1.24	1.73	2.06	2.88	
Transport Fuels - retail price							
Premium Unleaded Petrol (pence/litre)	88.39	123.75	94.24	131.94	126.04	176.46	[41]
Ultra Low Sulphur Diesel (pence/litre)	92.16	129.02	96.85	135.59	132.98	186.17	
Transport Biofuels							
E85 (pence/litre)			93.90	131.46			[42]
B30 (pence/litre)			102	143			[43] price is for June 2009

Notes:

* Prices exclude VAT and Climate Change Levy

6. Biomass Import – Export, 2006

Aside from the information shown elsewhere in this report, little detailed data concerning imports and exports of bioenergy is available. Table 13 shows the 2006 imports and exports of types of biomass that have important energy uses. However, it should also be noted that many of these products have important non-energy uses in the food, animal feed or material sectors.

Table 13: Imports and exports of most important bioenergy products in 2007

CN Code	Description	Import Volume (t)	Import Value (€)*	Export Volume (t)	Export Value (€)*
Wood					
44012100, 44012200	Wood chips	110,955	6,313,539	48,056	4,571,084
44011000	Fuel wood	8,396	3,925,898	119,550	5,175,306
44013010	Sawdust	93,309	10350078	5,665	979321
44013090	Agglomerated wood waste	129,486	19,345,803	8,996	2,624,555
Tall Oil					
38030010, 38030090	Tall Oil	3,314	2,094,786	99	433,104
Ethanol					
22071000	Undenatured	247	151,496,593	101	106,374,614
22072000	Denatured	36	18,523,968	5	10,325,442
29091900	ETBE	14,041	410,847,354	16,124	28,237,966
Vegetable Oil Residues					
23063000	Palm	401,616	46,291,875	3,610	438,481
23066000	Sunflower	666,214	70,289,533	24,323	1,902,422

Notes:

***** Original data given in GBP, converted to Euro at £1=€1.4
** Data for ethanol 2207 given in million litres

Source: [44]

7. Barriers and Opportunities for International Bioenergy Trade

The main drivers for international bioenergy trade in the UK are the RO and RTFO, both of which provide a guaranteed market for renewable energy without specifying that eligible biomass be sourced domestically. Of the two policies, the RTFO appears to be the greater driver to bioenergy trade. This is because, although both obligations can be fulfilled through payment of a buy-out price, the 1st year RTFO target has been fully met through supply of biofuel whereas the value of the buy-out fund continues to be significant in the RO. In addition, the maintenance of the quantitative cap for co-firing within the RO provides a continued source of uncertainty as to the commercial viability of co-firing as total co-fired generation nears the 12.5% cap. On the other hand, the introduction of a headroom mechanism in RO Order 2009 should provide greater certainty regarding the commercial viability of renewable generation projects at the margin. This is because the headroom mechanism enables the total level of the Obligation to increase if expected renewable supply nears the level of the

Obligation. In addition, the construction of a number of new biomass plants should provide a permanent and more stable market for biomass in the electricity market.

The transport biofuels market in 2008/09 has been dominated by imports. The import-dependency in UK biofuel consumption may diminish in the near-future as a result of the anti-dumping and countervailing duty imposed by the European Union on exports of biodiesel from the US [36]. This may also provide an opportunity for imports of feedstock and export of biofuel by UK producers.

Further analysis of drivers and barriers to bioenergy trade was conducted as part of the Eubionet III project [45]. This analysis identified the following barriers and opportunities:

Barriers[20]

- Concerns have been raised about the potential for increased biomass production to impact negatively on the availability of land and on existing markets through rising commodity prices, as food and non-food markets compete for the same crops.
- Sustainability of biomass production has been raised as a concern and a barrier to expanding biomass trade especially from 'environmentally sensitive ecosystems', like south America, parts of Asia, etc as well as specific feedstocks like palm kernels.
- Immature market – established product specifications and market information still developing. Need to establish supply infrastructure
- As biomass, especially condensed forms like pellets, are related to the price of fossil fuels, recent markets are not very favourable as oil and coal prices present decreasing trends.

Opportunities

- A broader variety of feedstocks may become available in the longer term with advances in logistics and biomass conversion technologies.
- New markets for environmentally damaging residue dumping or more efficient use of currently low zero or negatively valued products could be created.

[20] Barriers have been studied in considerable details by Task 40 members. Please visit www.bioenergytrade.org for relevant documents.

8. Conclusions

Since the last UK Country Report update of December 2007, various significant developments can be noticed:

- An increase use of renewables for electricity generation as a whole, notably including a rapid increase in installed capacity of stand-alone biomass plants
- The continued failure of energy crops schemes to encourage the use of dedicate energy crops in the heat and power sectors
- A decline in the level of electricity generation from co-firing
- Increased use and production of biofuels for transport
- Advances in sustainability and certification issues resulting from the requirement to report on the origin of biomass supplied to the electricity and transport sectors.

International bioenergy trade in gaining in strength as the number of countries trading in biomass for energy is increasing, of which the UK is a good example. This trend is likely to continue given the size of the UK market, and policies that favour RE and in particular biofuels.

However, little can be added with regard to the rules that govern bioenergy trade which remain often unclear and confusing. Problems with statistical classification, quality standards, certification, sustainability issues, are good examples.

The UK has considerable potential for expansion of bioenergy trade as favourable policies will further strengthen the bioenergy market. Although UK has considerable capacity to supply this market from domestic sources, there are various reasons why international bioenergy trade is expected to play much greater role in the future, as stated in the previous report: i) the UK market is potentially quite large; ii) the cost of feedstocks are high in comparison to many other countries; iii) the need to allow market forces to have a much greater role, which is highly likely to result in large-scale imports. Doubts still hang over the co-firing market for two main reasons: i) the amount of benefits that co-firing may ultimately receive, and ii) the potential role of clean coal technology and the possible impacts on co-firing. The long-term future of this industry requires that these uncertainties be removed.

Despite advances in certification/sustainability standards, it remains a serious issue that needs careful handling to ensure that it enhances rather hinder the development of RE, particularly biofuels.

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