Imperial College London

INTERNATIONAL ENERGY AGENCY (IEA) BIOENERGY TASK40 ON:

'Sustainable International BioEnergy Trade: Securing supply and demand'

TASK 40- Country Report for United Kingdom 2011[1]

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TABLE OF CONTENTS

ABBREVIATION LIST

DECC	Department for Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DTI	Department for Trade and Industry
EC	European Commission
EMR	Electricity Market reform
FC	Forestry Commission
FiT	Feed in Tariff
GDP	Gross Domestic Product
IIED	International Institute for Environment and Development
NG	National Grid
OFGEM	Office of the Gas and Electricity Markets
RED	Renewable Energy Directive
RHI	Renewable Heat Incentive
RO	Renewable Obligation
ROCs	Renewable Obligation Certificates
RTFO	Renewable Transport Fuel Obligation

Notes:

Exchange rate: £1 = Euro1.17

Ton or tonne = 1000kg

SUMMARY

It is estimated that by 2020 over 20GWe of the existing UK power plants (mainly coal and nuclear) will be closed. The introduction of the EU Emissions Trading System (EU ETS) and the Industrial Emissions Directive (IED)) are already imposing significant additional economic pressures on the operation of fossil-fired plants. The UK will have to invest heavily in new generation capacity to replace closing plants and to meet expected increases in electricity demand.

The UK Government is playing a leading role in setting extensive greenhouse gas (GHG) emission reduction targets. The current national strategic goal is to ensure an 80% reduction in GHG emissions (from a 1990 base) by 2050. Renewable energy will play a major role e.g. it is expected to provide around 15% of the UK's energy demand by 2020.

Many studies have been carried out to assess the potential of bioenergy in the UK, be it from domestic or imported sources. For example, the AEA (2011) study concluded that by 2020 the UK could access 1,800PJ of sustainable biomass (or 20% of the UK primary energy demand) which could be more than double or even treble by 2030. The Committee of Climate Change (CCC, 2010), has also indicated that the scope for renewable energy could be between 30 to 45% of all energy consumed in the UK by 2030.

To meet this increasing demand, requires a wide range of technologies and feedstocks, essential to meet the expected extensive use of biomass for power, heating and transport, the three most important sectors in the UK. For example, the Renewable Energy Roadmap of July 2011 (DECC, 2011c) identified 8 key technologies which could deliver about 90% of the generation necessary to meet the UK's 2020 target, of which biomass-based generation could account for 100 to 150TWh (28 to 47 Mt), [(biomass electricity 32-50TWh (16-22 Mt); biomass heat 36-50TWh (5-10 Mt); and transport up to 48TWh equivalent (7-15 Mt)].

Bioenergy will be making a significant contribution to three key energy sectors:

- Electricity generation (solid biomass, primarily in co-firing power plans)
- Heat generation (solid biomass) and
- Transport (liquid biofuels, basically biodiesel and bioethanol)

The government has been supporting the development of RE through various instruments (see Table 2) of which the Renewables Obligation (RO), Renewable Transport Fuel Obligation (RTFO), Renewable Heat Incentive (RHI), and Feed-in-Tariffs (F-i-T), are the most relevant, discussed in this report.

Unlike many EU member countries e.g. Austria, Denmark or Sweden, the path towards the large scale use of bioenergy has been difficult and slow in the UK e.g. the country started from a low basis and has seen considerable policy changes of which co-firing is a good example.

Power generation from co-firing deserves particular attention because it provides security of supply benefits in terms of availability, reliability and flexibility and can respond flexibly and quickly to changes in electricity supply or demand. Co-firing

also reduces the need for significant investment in transmission. A recent study (Arup, 2011) has estimated the potential for the conversion of co-firing generation to dedicated biomass generation up to 1.8GWe of high capacity factor and low planning risk. Arup estimates that 50 to 60 dedicated biomass plants could be built around the UK, and various large plants with capacity up to 350MWe could also be located near ports to access a wide range of imported fuels on which UK will have to depend.

Further development in co-firing will have a major impact on the use of bioenergy in the UK. As stated by Wood et al 2006): "*from an avoided greenhouse gas perspective, the co-firing of biomass with coal represents one of the most effective uses of biomass resources for energy*".

Already co-firing is the major source of wood pellets imports as discussed in Section 7 of this report. This presents a considerable technical and financial challenge. Nonetheless many generators have concluded that large volumes of biomass can be successfully sourced, transported and burnt in conventional power stations, replacing coal, and therefore co-firing/conversion programs are now focusing on setting up supply chains capable of sourcing and transporting biomass in larger volumes, a significant departure from early years.

This report consists of 8 main sections: A general introduction that includes the general aspects of energy in the UK, Sect. 2 looks at policy issues, Sect. 3 examines biomass resources; Sect. 4 concerns with future bioenergy use, Sect. 5 investigates bioenergy users, Sect. 6 considers biomass energy prices, Sect. 7 looks at imports/exports and 8 concentrates in barriers and opportunities for biomass energy specific to the UK.

1. GENERAL INTRODUCTION

As in previous UK Country Reports, the aim of the 2011 report is to update the 2009 study and incorporate the changes of the past two years. The structure of this report has also changed slightly. It is not a detail analysis but an overview of the most important changes occurred since 2009; further details can be obtained by following up references. For previous UK Country Reports please see Perry & Rosillo-Calle (2009, or visit www.bioenergytrade.org/countryreports/. UK is a full Member of IEA Task 40 from 1st January 2006. Bioenergy remains one of the UK key components for the provision of low carbon energy in electricity generation, heat and road transport.

In 2010 the UK GDP was £1,443 billion and had a population of 63 million (ONS, 2011). The UK comprises England, Scotland, Wales and Northern Ireland, and has an area of 244,000 Km^2. The main natural resources are coal, oil, natural gas, tin, limestone, iron ore, salt, clay, chalk, gypsum, lead and silica.

Though the UK was the world's first country to become highly industrialized, nowadays its GDP consists primarily of services with 76% of the GDP; industry [including steel, heavy engineering and metal manufacturing, textiles, motor vehicles and aircraft construction, electronics and chemicals (21%)]. Agriculture accounts for just 0.8% of GDP- cereals, oilseed, potatoes, vegetables, fruits, wool, cattle, sheep, poultry and fish (ONS, 2011).

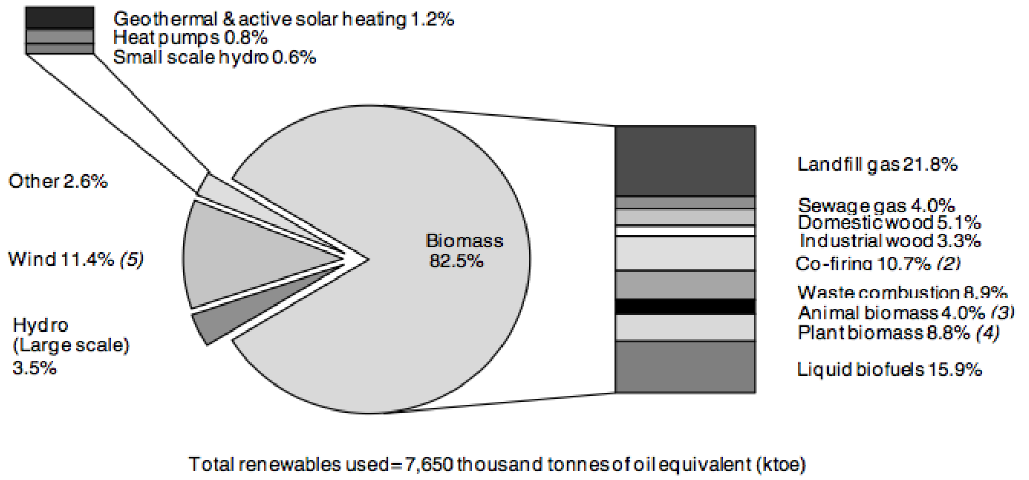
In 2010, the primary fuels supply was 227.7 million tonnes of oil equivalent (Mtoe), a 3.4 per cent increase compared to 2009. Indigenous production was 5.3 per cent lower than in 2009, with output falling each year since 1999. Oil and gas accounted for 80 per cent of UK production (DECC 2011).

The UK was the first country to make carbon reductions legally binding through the 2008 Climate Change Act, which set targets for emissions cuts at 34% by 2020 and 80% by 2050. Renewable energy deployment is one of the vehicles to help reaching those goals, with a legally binding target of 15% of overall energy demand by 2020 (HM Government, 2009).

Interest in bioenergy in the UK as a sustainable renewable energy option has grown significantly over the past decade due to favourable policy support e.g. Renewables

Energy Strategy (RES), which states that biomass for heat and electricity has the potential to meet about a third of the 2020 UK's renewable energy target (HM Government, 2009). Figure 1 shows consumption from renewable fuels in 2010 (DECC, 2011)]. As can be appreciated biomass energy represents 82.5% of all renewables.

Figure 1: UK Consumption of renewable energy in 2010[1]

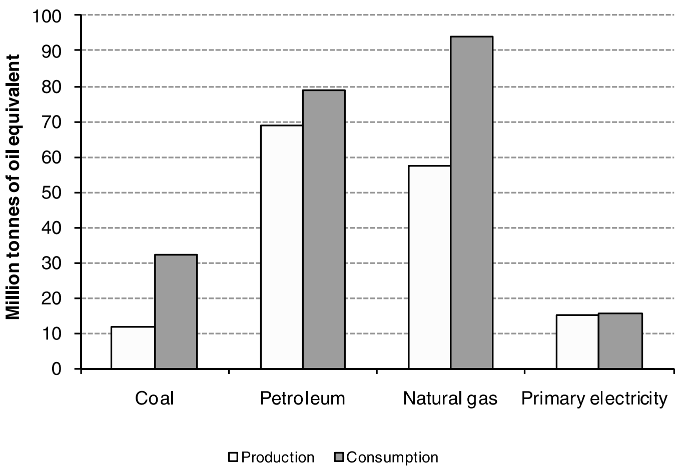


(1) Excludes all passive use of solar energy and all (520 ktoe) non-biodegradable wastes. In this chart renewables are measured in primary input terms.
(2) Biomass co-fired with fossil fuels in power stations; imported 9.8 per cent of total renewables, home produced 0.9 per cent
(3) 'Animal biomass' includes anaerobic digestion, farm waste, poultry litter, and meat and bone combustion.
(4) 'Plant biomass' includes straw and energy crops.
(5) 'Wind' includes energy from shoreline wave and tidal generation, but this accounted for less than 0.2 ktoe

Source: (DECC, 2011)

In 2004 and after many years of being a net exporter of oil, the UK became of net importer. In 2010 the UK imported more coal, crude oil, electricity and gas than it exported though it has remained a net exporter of petroleum products. Figure 2 shows production and consumption of primary energy sources and Figure 3 the share of electricity production by source in 2010.

Figure 2: Production and consumption of primary fuels in 2010

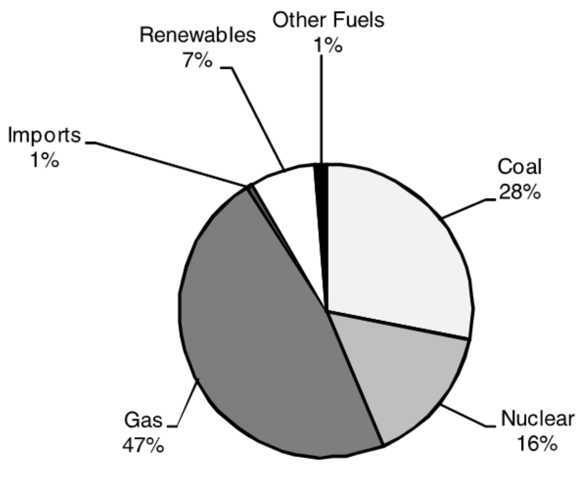


Note: Includes non-energy use of petroleum and gas. Differences between consumption and production are made up by foreign trade, marine bunkers and stock changes.

Source: (DECC, 2011)

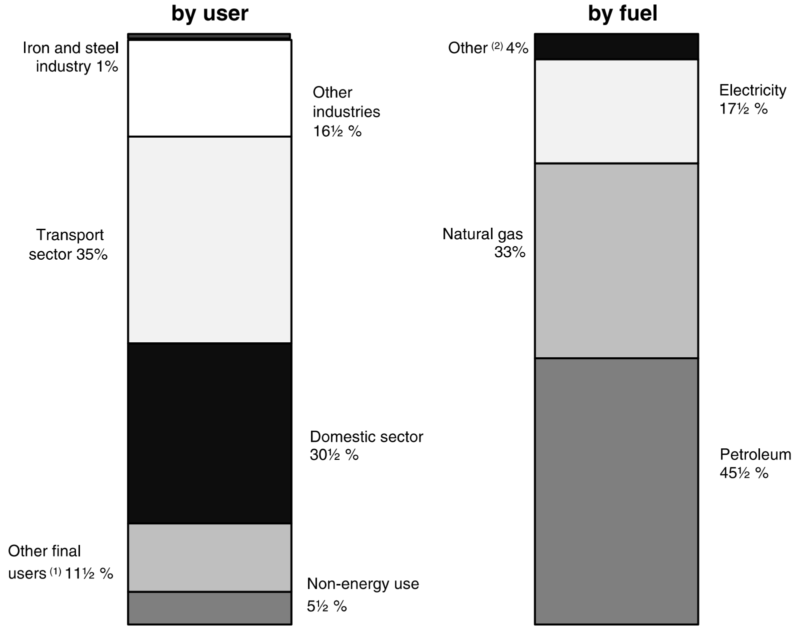
Figure 4 illustrates the final energy consumption by sector in 2010, transport represents 35%, domestic sector 30.5%, industrial 17.3%, commercial 6.2% and non-energy uses 5.6%; petroleum provides 45% and natural gas 33%, the two most important fuels (DECC, 2011).

Figure 3: Shares of net electricity supplied by fuel in 2010



Source: (DECC, 2011)

Figure 4: Final energy consumption in 2010 by sector and fuel



Total: 159.1 million tonnes of oil equivalent

(1) Includes services and agricultural sectors.
(2) Includes coal, manufactured fuels, renewables & waste, and heat sold.

Source: (DECC, 2011)

Heating accounts for 47% of total UK final energy consumption (approximately 69% of heat is produced from natural gas) and for about 77% of energy use across all non-transport sectors (DECC, 2010). The recent Renewable Heat Incentive (RHI) (DECC, 2011c) is expected to result in a significant increase in the level of renewable heat. The British Government is committed to generate 12% of heating by 2020 from renewable sources saving up to 44 million tonnes of carbon (DECC, 2011c).

2. POLICY TOWARD RENEWABLE ENERGY

This section looks at the most important policies aimed at renewable energy, with emphasis on bioenergy. The EU Renewable Energy Directive (EURED) of 2008 stipulates that by 2020, 20% of EU final energy consumption should be from renewable sources. Also, the EU National Renewable Energy Action Plans (NREAPs) forecast that an important part of the renewables will be bioenergy. At a national level, the UK Renewable Energy Strategy (UKRES) (2009) stipulates a goal of 15% of energy generation from renewable sources by 2020; this compares to just 2.3 % in 2008. Table 1 summarizes current and projected policy goals for 2020 by sector.

***Table 1*:** Current and 2020 renewable targets of energy share

Source	**Current Share**	**Target Share**
Electricity	Less than 6%	30%
Heat	Less than 1%	11%
Transport	Less than 3%	10%

Adapted from Carbon Trust, (2011b)

In order to achieve these targets, the government has promoted various policy initiatives, briefly summarised in Table 2.

Table 2: Summary of renewable energy incentives

Incentive	**Description**	**Regulatory Body**
Renewable Heat Incentive (RHI)	Financial support for the production of renewable heat. Focused on non-domestic installations in the first year of operation from September 2011.	OFGEM
Renewable Heat Premium Payment (RHPP)	Support for domestic properties in- stalling renewable heat technologies in the first year of the RHI (until October 2011)	Energy Savings Trust
Renewable Obligation (RO)	The RO places a mandatory requirement for UK electricity suppliers to source a percentage of electricity that they supply from eligible renewable sources. The current target is 15%, up to 2015.	OFGEM
Renewable Obligation Certificates (ROCs)	Generators of electricity from eligible renewable sources are awarded ROCs for every megawatt hour they generate. These certificates can be sold to energy suppliers along with the electricity they buy or can be traded independently.	OFGEM
Feed-in tariffs (FiTs)	FiTs came into effect on 1 April 2010. They make the business case for installing renewable energy more attractive. Under the scheme, if you generate your own renewable power you will be paid for the electricity produced and for the excess exported to the grid.	OFGEM
Renewable Transport Fuel Obligation (RTFO)	The current RTFO was introduced in 2008 and places an obligation on owners of liquid fossil fuel intended for road transport use to ensure that either a certain amount of biofuel is supplied or that a substitute amount of money is paid. Only those organisations that supply more than 450,000 litres of fossil fuel in a	Department for Transport (DfT)

	given year are obligated by the Order. The amount of biofuel that must be supplied increases annually until April 2013 when it will reach 5% of total road transport fuel supplied by volume. It will remain at that level for subsequent years.	

Adapted from Sources: Buckinghamshire County (2011); Carbon Trust (2011 & 2011a), and DFT (2011)

2.1. Electricity from biomass

The UK provides various incentives to generate electricity from biomass such as the Renewable Obligation, the Electricity Market Reform and the Feed in Tariff, briefly discussed here. It is expected that by 2020 biomass could contribute up to a total of 6 GW, compared to 2.5 GW capacity in 2010 (DECC, 2011a). To achieve these objectives the electricity market needs institutional support.

The UK government is currently drawing up legislation to address these issues, namely: long-term contracts for both low-carbon energy and capacity as well as institutional arrangements to support electricity from biomass, continued grandfathering, and supporting the principle of no retrospective change to low-carbon policy incentives within a clear and rational planning cycle; and to create a market that allows existing energy companies and new entrants to compete on fair terms. In 2010 the UK government decided to provide further support to feedstock and energy waste plants from the RO and there also plans to review the RO for further technological development up to 2013. The new Renewable Obligation will come into force in April 2013 and will pay particular attention to waste use e.g. by setting up new landfill regulations on waste wood use (DECC, 2011a).

Policies on co-firing have changed over the past or so decade. A ROC review came into effect in October 2011 which could have a significant impact particularly on co-firing and hence on bioenergy use. Coal-fired + biomass generation currently provides security of supply benefits in terms of availability, reliability and flexibility. Hence, unlike any other large scale renewable technology, biomass-fired generation can respond flexibly and quickly to changes in electricity supply or demand and can provide large scale, reliable, and predictable power.

In addition, conversion and enhanced co-firing biomass plant will also reduce the need for transmission investment which, depending on the location, can be significant. A recent study (Arup, 2011) has considered a range of different options for biomass usage, including dedicated biomass plants as well as existing coal plants in a variety of regimes. The report recognizes that small biomass plants, (<50 MWe) tend to use locally sourced biomass fuel delivered by road. The Arup study estimated that the UK could host 50-60 dedicated biomass plants distributed around the country. In addition, large plants, up to 350 MWe, could be located near ports specifically to access a wide range of imported fuels. The study indicates that *"up to 1.8 GWe of high capacity factor, low planning risk* of conversion capacity could be feasible (ARUP, 2011).

Limited co-firing can be achieved in most UK coal plant with little modification to the plant, by pulverizing the coal and biomass simultaneously in the existing coal mills, a technique usually termed 'co-milling'. It is now considered that co-firing at rates of 20-50% (currently to benefit from ROC support co-firing must represents at least 15%), biomass throughput (or more) is possible, though there are still important technical challenges. Many generators have concluded that large volumes of biomass can be successfully sourced, transported and burnt in conventional power stations, replacing coal, which represents a significant shift from early years. Consequently, current co-firing/conversion programs are focusing on setting up supply chains capable of sourcing and transporting biomass in larger volumes. The implications of the widespread use of this technology can be profound (DECC, 2011d).

The Market Electricity Reform (MER) is an important institutional step whose aim is to address the electricity market stakeholders concerns e.g. to safeguard demand and ensure the best value for investments throughout the whole power chain; and create a flexible and competitive electricity market, enhance the market capacity to finance large investment in low carbon electricity (see DECC (2011b) for further details. A smooth change is planned from the RO which will allow new generators to have a choice between the two schemes until 2017; and following closure of the RO to new entrants, technology payments made under the RO will be grandfathered"(DECC, 2011a & 2011b).

The UK provides financial support to technology projects which are still commercially immature e.g. the Private Finance Initiative (PFI) is one of such instruments, though no without controversy. The UK government is exploring new ways to provide better funding, e.g. the Green Investment Bank plays a key part in providing support to electricity from biomass. At the same time, the Low Carbon Innovation Group is supporting R&D on technological innovation i.e. waste conversion to energy (DECC, 2011).

The FiT, introduced in April 2010, is another option to attract new investment into biomass-based electricity generation and to reduce CO_2 (DECC, 2011c). The incentive consists of payments for every kWh of electricity generated, depending of the size, technology type and date of installation. Small electricity generators also receive a payment for the surplus electricity sold to the grid, "paid over and above the generation tariff, either at a guaranteed flat rate of 3p/kWh or at the open market value. Tariffs are exempted from income tax but subjected to Corporation Tax" (Carbon Trust, 2011b). As such, profitability is guaranteed for the generator, reducing investment risk in renewable technologies.

2.2Heat from biomass

In 2010 heat from RE accounted for 1% of UK's heat demand; the target for 2020 is 12% (Carbon Trust, 2011). The most important scheme to promote heat from RE is the RHI, introduced in March 2011. The aim is to achieve 57TWh of heat and save 44 million tonnes of carbon savings by 2020 (DECC, 2011a). This is the first such scheme to foster the provision of renewable heat, providing long-term financial support for up to 20 years (Buckinghamshire County, 2011).

The RHI will be implemented in two phases, Phase 1 deals with non-domestic users and commenced in July 2011. Phase 2 will address the domestic residential sector, starting October 2012. It is predicted that Phase 1 will result in around 13,000 renewable heat installations in industry and a further 110,000 in commercial and public sectors (Hawkinks Wright, 2011).

2.3 Bioenergy in the transport sector

In 2010 biofuels represented 3.33% of road fuel consumption (against an EU projected target of 5.75%) and this is expected to reach 5% by 2014 (DECC, 2011a), if the target set by the EC Renewable Energy Directive (RED) and Fuel Quality Directive (FQD) is to be achieved (AEA, 2010). For 2020 the binding target set by the EU is 10%. A £47 million support program is being provided from 2007 to 2013 through the Rural Development Programme for England's Energy Crops Scheme, a purpose-grown perennial energy crops program.

The RFTO target for 2009-10 financial year was 3.25%, but it fact it achieved 3.33% (71% of this was biodiesel, 29% bioethanol and under 1% biomethane); around 15% of the feedstock was waste material (DECC, 2011a). On 15 December 2011 the UK parliament is expected to amend the RTFO by introducing some aspects from the Renewable Energy Directive (RED), to meet the RED targets through the RTFO. The main difference would be that RED will include renewables which are just partly renewable fuels, excluded by the RTFO. Under RED, for example, renewable bio-chemicals can be combined with crude oil-derived fuel at the molecular level to produce partially renewable fuels. Fossil fuels and biochemicals can form a homogeneous fuel, rather than blending biofuel with fossil fuel e.g. co-processed hydrotreated vegetable oil (HVO), and bio-ethyl-tertiary-butyl-ether (bio-ETBE). "*This means that partially renewable biofuels can offer greater compatibility with existing technologies (e.g. engine seals) and fewer supply issues than other biofuels"* (DfT, 2011c).

3. BIOMASS RESOURCES

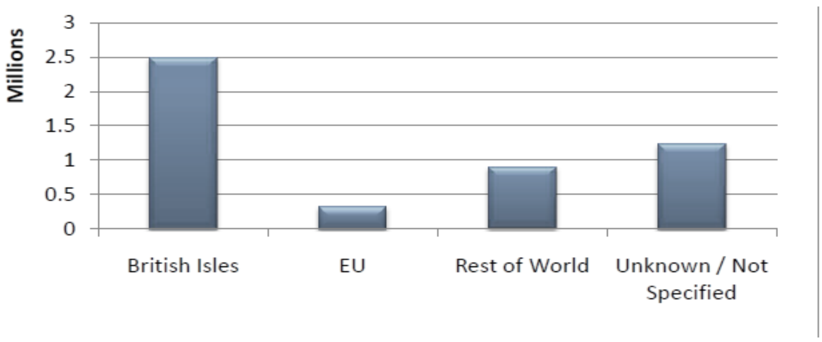
This section deals primarily with biomass resources allocated to generate electricity, heat, and transport fuels in the UK. The consumption of primary energy was 9805PJ (210 Mtoe) in 2008, to which renewables contributed with 222PJ, (approx. 207PJ were obtained from imported and domestically produced biomass (DECC, 2011). In a recent report (AEA, 2011) concluded that by 2020 the UK could access 1,800PJ of sustainable biomass (equivalent to 20% of the UK primary energy demand) and that by 2030 this could more than double or even treble. On the other hand, the Renewable

Energy Roadmap of July 2011 (DECC, 2011c) identified 8 key technologies which could deliver between them, around 90% of the generation necessary to meet the UK's 2020 target, of which biomass-based generation could account between 100 to 150 TWh (28 to 47 Mt), (biomass electricity 32-50 (16-22 Mt); biomass heat 36-50 TWh (5-10 Mt); up to 48 TWh (7-15 Mt).

3.1 Electricity from biomass

At the end of 2010 there was 2.5 GW of biomass-based electricity capacity installed in the UK, accounting for 11.9TWh of generation. This is the single largest contribution to UK's renewable electricity generation. 62% of generation is from waste (mainly landfill gas), 21% from co-firing and 17% from dedicated biomass plants; the largest share is located in England and Wales (DECC, 2011a). Figure 5 compares the amount of biomass used in electricity generation by major geographical regions in 2010-201, of which approximately 2.3 million tones come from the British Isles. Table 3 shows biomass-based electricity generation increases in the UK from 2000 to 2010 by major source.

Figure 5: Biomass used to generate electricity by region (million tonnes)



Source: (Ofgem, 2011)

Table 3: Total electricity generated from biomass by source (GWh).

Year	Land field Gas	Sewage sludge digestion	Municipal solid waste combustion	Co-firing with fossil fuels	Animal Biomass[1]	Plant Biomass[2]	Total Biomass
2000	2,188	367	840	-	456	31	3,882
2001	2,507	363	880	-	542	234	4,526
2002	2,679	368	907	286	568	272	5,080
2003	3,276	394	965	602	535	402	6,174
2004	4,004	440	971	1,022	565	362	7,364
2005	4,290	466	964	2,533	468	382	9,102
2006	4,424	445	1,083	2,528	434	363	9,277
2007	4,677	449	1,177	1,956	555	409	9,223
2008	4,757	532	1,226	1,613	587	568	9,283
2009	4,952	598	1,511	1,806	620	1,109	10,596
2010	5,037	702	1,594	2,506	670	1,406	11,915

Note:

(1) Includes the use of farm waste digestion, anaerobic digestion, poultry litter and meat and bone.

(2) Includes the use of waste tyres, straw combustion, short rotation coppice and hospital waste.

Adapted from DECC (2011)

Table 4 portraits existing biomass generating capacity in the UK in 2010 which, as can appreciated, is dominated by England, followed by Scotland.

Table 4: Summary of biomass generating capacity per region, in 2010 (MWe).

	Landfill Gas	Sewage gas	Other biomass
England	859.7	155.6	739.3
Wales	45.8	4.6	20.2
Scotland	108.9	8.2	140.1
Northern Ireland	10.1	0.2	5.8

Source: (DUKE, 2011)

Economic activity can be measured in terms of Gross Added Value (GAV). As seen from Table 5 Scotland has the largest generating capacity from renewables and the largest in terms of capacity per unit and generation per unit of GAV. Among the English regions the North East has highest in generating capacity per unit of GAV followed by the East of England and the East Midlands. In terms of Generation/GAV, Yorkshire and Humber have the highest, followed by the East of England, North East and East Midlands.

Table 5: Economic activity of biomass generation in different regions

	Electrical generating capacity from renewable sources kWe/GAV (£million)1,2	**Electricity generated from renewable sources kWh/GAV (£million)1**
England		
East Midlands	5.86	20,046
East	6.48	23,435
London	0.44	1,455
North East	7.2	21,125
North West	5.15	16,114
South East	4.81	13,803
South West	2.17	6,960
West Midlands	2.21	10,289
Yorkshire and the Humber	2.98	28,944
Wales	17.17	36,416
Scotland	42.56	92,785
Northern Ireland	12.38	27,746

1. GAV is provisional gross value added in 2009 (workplace based) as published in table NUTS1.1 at www.ons.gov.uk/ons/rel/regional-accounts/regional-economic-activity--gva-/december-2010/regional
2. Excludes capacity attributable to co-firing of biomass which has not been allocated to regions

Source: (DUKE, 2011)

3.2 Heat from Biomass

Heat generation from renewable sources has been growing for years, representing about 16% in 2010, with 12.4MWh from biomass. DECC reports that most installations are large scale, e.g. it is estimated that 74% of renewable heat output in Scotland in 2008/09 corresponded of at least 1MW, using primarily forestry residues. It is estimated that in 2010 the UK had 46 on-farm or commercial Anaerobic Digesters biogas plants, plus a further 146 plants at sewage treatment works (DECC, 2011a). Bioenergy has experimented 103% increased to 1.212ktoe since 2005. This growth has been fostered by domestic wood use (32 % of the renewable heat), and agriculture (17%). As a result of the implementation the RHI, the use of biomass for heat is expected to increase even further (DECC, 2011a). Table 6 summarizes heat production from biomass from 2000 through to 2010. The key heat generation technology is combustion of wood for industrial and domestic use. Even though heat generation grew, the increase is not as sharp as in the case of electricity.

Table 6: Total biomass used by source to generate heat (thousand toe)

Year	Land field Gas	Sewage sludge digestion	Wood combustion domestic	Wood combustion industrial	Animal Biomass[1]	Plant Biomass[2]	Municipal solid waste combustion	Total Biomass
2000	13.6	48.3	204.2	254.2	0.3	71.9	24.7	617.1
2001	13.6	49.4	204.2	225.2	0.3	71.9	26.2	590.7
2002	13.6	53.4	204.2	225.2	0.3	71.9	33.7	602.4
2003	13.6	52.4	205.8	225.2	0.3	71.9	33.7	602.9
2004	13.6	54.8	232.4	225.2	2	71.9	33.7	633.6
2005	13.6	52.9	265.6	93.1	14.4	92.4	33.7	565.8
2006	13.6	44.1	298.8	97	24.9	103	33.7	615.1
2007	13.6	50.2	332	101.2	47.8	108.8	33.7	687.4
2008	13.6	49.8	358.6	220.3	42.4	188.1	31.5	904.2
2009	13.6	51	375.2	223.4	40.3	203	31.3	937.7
2010	13.6	72.8	391.8	255.7	45.1	259	25.6	1,063.60

(1) Includes the use of farm waste digestion, anaerobic digestion, poultry litter and meat and bone.

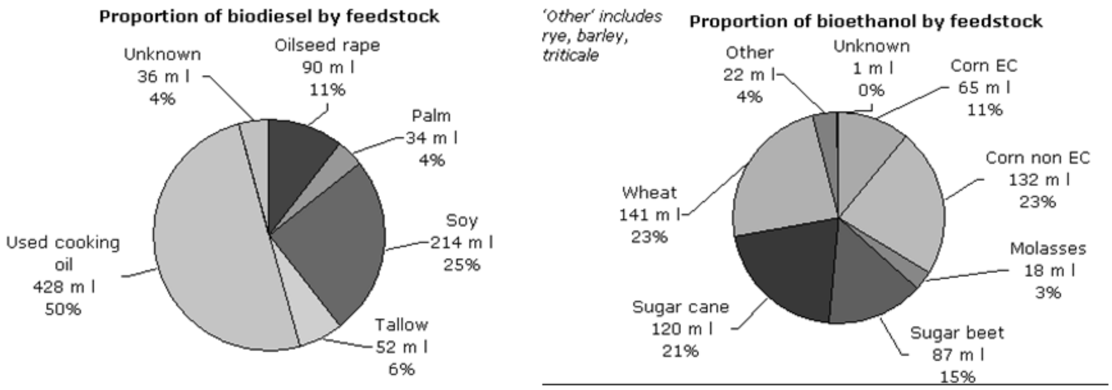
(2) Includes the use of waste tyres, straw combustion, short rotation coppice, and hospital waste.

Adapted from DECC (2011)

3.3 Bioenergy in the transport sector

In 2010 domestic energy demand for biofuels in the UK in transport was 14.1TWh (1.21Mtoe), equivalent to 3.6% of road transport energy demand, up from 0.2% in 2005 (DECC, 2011a). Figure 6 illustrates the percentage of feedstocks used in bioethanol and biodiesel from April 2010 to April 2011.

Figure 6: Type of feedstock used in the production biodiesel and bioethanol



Source: (DfT, 2011a)

It is estimated that 1.2 billion litres of biofuels were supplied, or 3.33% of total road transport fuel, of which 61% correspond to biodiesel and 39% to bioethanol (DfT, 2011b). In 2010 16 % of the renewable energy used in the UK, in primary input terms, were liquid biofuels for transport compared to less than 0.5% in 2003 (DECC, 2011).

4. CURRENT AND EXPECTED FUTURE ENERGY USE FROM BIOMASS

Section 3 provided details of the biomass energy potential & used in the three main sectors in the UK, based on the present state-of-the-art technology. Section 4 looks more into the future. If all biomass plants in Europe were developed as planned, the supply of heat and power would increase by 25 million odt above current demand (DECC, 2011a). Of course the ultimate supply will be determined by the economic costs.

4.1 Electricity and heat from biomass

To achieve the expected capacity by 2020, will require an annual growth rate of 9% in the next decade. DECC anticipates that demand will be mostly from the conversion of coal plants, dedicated biomass generation, biomass waste combustion, and anaerobic digestion. Landfill and sewage gas are not expected to increase as it is already largely exploited. Biomass electricity prices are expected to remain stable according to the DECC scenario, ranging from £70 to £173/MWh in 2020, compared to £75-£194/MW in 2010. These ranges are large due to the different technologies considered. Prices are more stable for mature technologies with no major improvements expected e.g. combustion technologies; there is, however, potential for improvement in several other processes such as anaerobic digestion, gasification and pyrolysis (DECC, 2011a).

However, the deployment of new capacity is not assured as there are many challenges ahead, i.e. minimizing the investment risk, de-risking the supply of sustainable feedstock, planning issues, and the regulatory framework. To overcome such challenges some priority actions are being proposed by the government, including

Electricity Market Reform to increase projects revenue, expand supply chains for waste wood and solid recovered fuel, better information on available waste, or incentives to feedstocks (DECC, 2011a).

According to the DECC predictions, non-domestic biomass for heat could contribute up to 50 TWh of renewable energy by 2020, mainly from biomass boilers and biogas injection to the gas grid. Other sources identify a market potential ranging from 27 to 55 TWh of non-domestic biomass for heat by the same year. Imported biomass heat prices ranged between £22 to £156/MWh in 2010 and are expected to remain more or less unchanged, between £22 to£159 per MWh in 2020. Capital and installation costs are projected to fall slightly due to the learning effects, whilst operating prices are projected to rise with increasing feedstock prices (DECC, 2011a).

4.2 Bioenergy for transport

The Department for Transport (DfT) recently introduced the Fuel Quality Directive (FQD), stating the greenhouse gas savings requirements for biofuels at 4% for 2011/12, 4.5% in 2012/13 and 5% for 2013/14 and onwards. The potential to increase for domestic biomass production is limited since about 90% of the UK land is already used (agriculture, pastures, forests + others). The Biomass Centre (2011) scenarios suggest that imported solid feedstocks such as woody biomass and agricultural residues could provide a significant resource to the UK market in the future. But this would be possible for liquid biofuels unless there are new technological breakthroughs. It is estimated that about 70% of UK demand for bioenergy may have to be met by imports (AEA, 2011). From the middle of the next decade and up to 2025 the Biomass Centre predicts a shortage of biofuels available to the UK, especially biodiesel, able to meet the requirements of the Renewable Energy Directive. This situation is expected to improve by 2030; in the meantime agricultural residues could be a significant alternative resource (AEA, 2011).

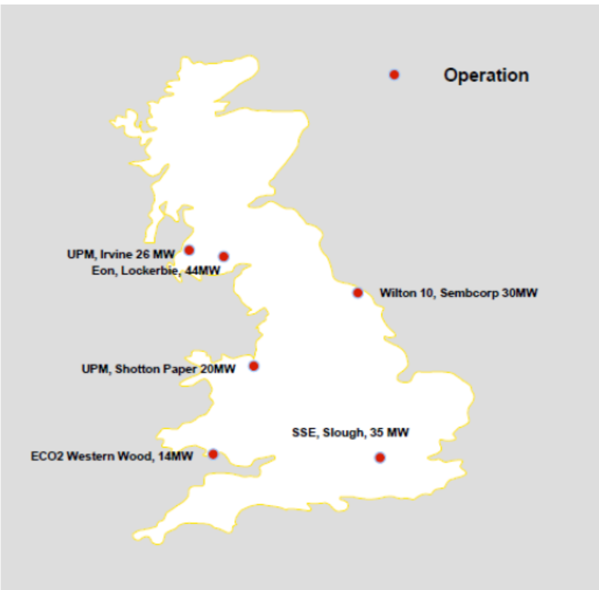
The UK National Center for Bio-renewable Energy (NNFCC) also suggests that a second generation (2G), non- traditional food crops biofuels would be necessary to meet 2020 targets. They could provide 4.3% of the renewable target transport fuel, though a major investment in this area would be necessary. To achieve this would “require around one million tonnes of woody biomass, two million tonnes of wheat and 4.4 million tonnes of household, commercial and industrial wastes" (GreenWise, 2011).

5. BIOMASS ENERGY USERS

This section identifies the main users and location of biomass-based plants in the UK. Figure 7 shows biomass power plants currently in operation in the UK (they burn approximately one million tonnes of biomass), and Figure 8 plants planned and under construction, (a) medium (up to 60MW) and (b) large biomass power plants **(**up to 300MW). There are currently 18 the plants in the planning stage and further 6 under construction. The capacity under development or planned exceeds 7GW (IIED, 2010), though it does not mean all these plants will be built.

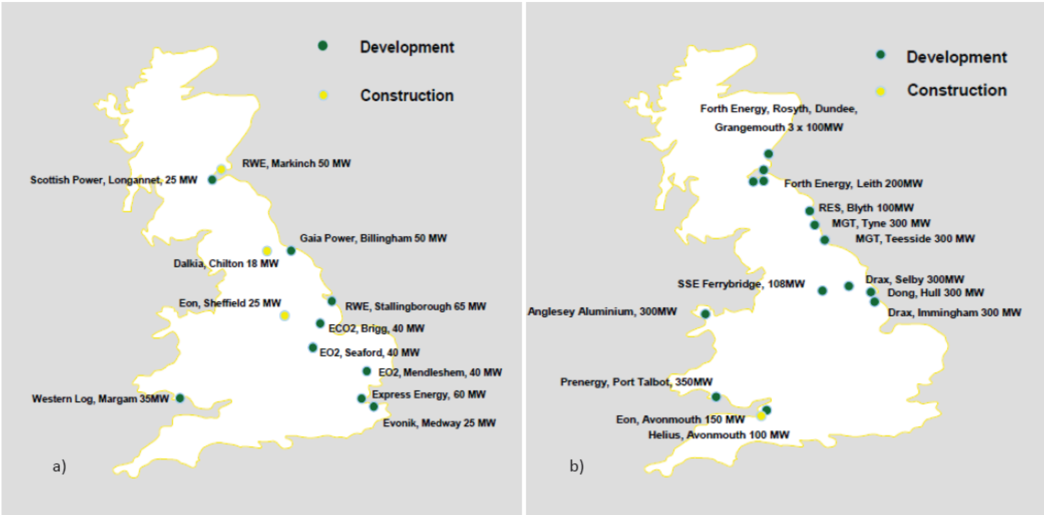
A common feature is that most of the plants are located on or close to sea ports to facilitate supply, particularly imports. For more details see Appendix 1 which provides a list of UK biomass power plants by feedstock.

Figure 7: Biomass power plants currently in operation



Source: (IIED, 2010)

Figure 8: a) Medium and b) large biomass power plants under planning or in construction



Source: (IIED, 2010)

With regards to bioethanol and biodiesel, the main companies involved include:

BP Oil Ltd, Chevron, ConocoPhillips Ltd, Esso Petroleum Company Ltd, Greenergy Fuels Ltd, Harvest Energy Ltd, INEOS Europe Ltd, Lissan Coal Company Ltd, Mabanaft UK Ltd, Morgan Stanley Capital Group Inc, Murco Petroleum Ltd, Petroplus Refining Teesside Limited, Prax Petroleum Ltd, Shell UK Ltd, Topaz Energy Limited, and Total UK Ltd.

6. BIOMASS PRICES

This section assesses current prices of biomass fuels. Given the volatility and uncertainty in predicting future prices, these are ignored. With biomass energy trading still in its early stages of development, costs fluctuate enormously and vary according to the feedstock and factors such as processing and handling, transport, storage, contract conditions and exchange rate fluctuations. For example, pellets are more expensive than wood chips due to additional processing costs, but the capital cost of pellet boilers are lower than wood chip boilers. Wood-fuel logs and straw are the cheapest but their use is limited, since community and domestic biomass boilers often require more processed fuels. Waste wood and arboricultural arising are also relatively cheap as they would otherwise be sent to landfill (DTI, 2007). Table 7 summarizes 2010 prices for large scale electricity generation, based on AEA (2011).

Table 7: Current prices for biomass fuels in the large scale electricity sector (prices delivered to power station gate)

2010 prices £/ GJ	**Low price**	**Mid Price**	**High Price**
(£1=Euro1.17)			
UK wood feedstocks[1]	6	7	8
Imported wood feedstock[1]	7.5	8.5	10
Energy crops [2]	3.5	8.5	10
Agricultural residues (UK) [2]	0.5	2.5	4.5
Mixed solid wastes[53]	-12	-8	-4
Waste wood[4]	-2	1	3
Solid recovered fuel (SRF)[5]	-6	-2	1
Wet feedstocks for anaerobic digestion[6]	-10.5	5	11

Notes:

1. Includes price of transport to plant and processing for use. Lowest prices are for chips; higher prices are for processed fuels such as wood pellets. Prices are from generators, EUbionet III (2010), Argus Media (2010), Endex (2010), and AEA own information.
2. This covers a range of different feedstocks: higher prices cover costs of pelleting for co-firing, central prices reflect straw products and lower prices chicken litter.
3. Assumes calorific value of 9GJ/t. All prices are negative to represent gate fees. High price represents more recent incineration facilities. Medium price is between that for old and new facilities. The prices vary because the prices for the more recent incinerators include the higher capital and development costs of these facilities. For new facilities WRAP gives a medium price of £10.2/GJ. None of these prices include hazardous waste. Figures are from AEA experience and WRAP (2010).
4. Waste wood prices depend on grade of waste wood (i.e. level of contamination in wood).
5. Unlikely to achieve positive price at present in UK as there is no ready market in UK. Figures assume calorific value of ~12GJ/t, although the calorific value could be as high as 16-19GJ/t for some SRF. Figures are estimated AEA experience on cost of producing SRF and likely market for the residue rather than real market prices.
6. The large range of prices for wet feedstocks for anaerobic digestion is due to the range of feedstocks available. The prices range from gate fees for food waste to prices for slurries that include the transport of these slurries to a central plant. The prices also include the cost of growing energy crops such as maize for some plants. As the way in which AD will be adopted across the UK is not yet clear we have included the range of prices. However, it is likely that developers could treat a range of these feedstocks in any one plant

Source: (AEA, 2011)

Liquid biofuels compete directly with gasoline and diesel and hence given the relative size of the energy markets in comparison with agricultural markets, these prices tend to drive biofuel prices. Since feedstocks account for the largest share of production costs, the relative prices of agricultural and the current price of oil determine the competitiveness of biofuels. The relationship differs according to crop, location, and technologies used in biofuel production. However, generally biofuel prices continue to be higher that fossil fuels (Biofuel Guide, 2011). The 2010 prices for biodiesel were £24 /GJ and £16/GJ for bioethanol (AEA, 2011).

7. BIOMASS IMPORT AND EXPORT

This section examines bioenergy imports and export issues. Global demand for biomass for energy is expected to increase in the next few decades. In the UK, given the current and planned biomass power projects, demand is bound to increase significantly e.g. some estimates indicate that the wood pellet market alone will be at least 4 million tons by 2015. The international market for bioenergy is relatively new and still immature and thus shaped by uncertainties which make it very difficult to sign long-term contracts (AEA, 2011). However, as this market expands, many of the current uncertainties will gradually be overcome. As for the UK market, if current plans mature, the country will be largely dependent on imports.

RTFO Quarterly Report 12: 15 April 2010 - 14 April 2011 released by DfT (2011) provides a detailed dataset, disaggregated at the power station level, indicating the type of feedstocks used, and country of origin and purchase price, a summary of the main points follows. About 25% of the feedstock purchased was from domestic sources (small round wood and woodchips, biogas and waste). The remaining feedstock has been imported from EU countries. A proportion was also imported from outside the EU, primarily wood pellets (North America, Russia, South Africa and New Zealand), biofuels (Brazil), and palm oil (especially Malaysia and Indonesia).

As most European countries, UK bioenergy trade centres on two major areas: i) woody biomass (primarily wood pellets and less so wood chips) for power/heat generation, and ii) liquid biofuels (basically biodiesel and bioethanol) for transport.

It is estimated that the majority of pellets manufactured and imported in the UK are co-fired for electricity generation (large-scale). But there are also increasing numbers of individuals, and organisations who are using pellets as their main source of space heating (small-scale use). But unlike other countries, in the UK pellets are not generally used in CHP or for heat in District Heating. Historically, the main driver for market development in the UK has been the Government's targets for the generation of electricity from renewable sources through various initiatives (see Table 2). In the future the RHI and development in co-firing will be the key drivers.

It is difficult to say how much of the wood pellets are produced, consumed and imported because in the case of large players this is done on a bilateral basis and considered commercially sensitive. As for the small domestic producer and consumer, the data is not very reliable because the large numbers involved. Table 8 summaries some data on pellet market in the UK from 2005 to 2008. However, the domestic production, consumption and import of pellets and wood chips have been increasing sharply recently e.g. January to June 2011 alone UK imported 367,000 tons of wood pellets primarily from Canada (240,000t), and USA (110,000t), Hawkins Wrights (2011). Anecdotic evidence indicates that by 2015, the UK market could be over 4Mt/year.

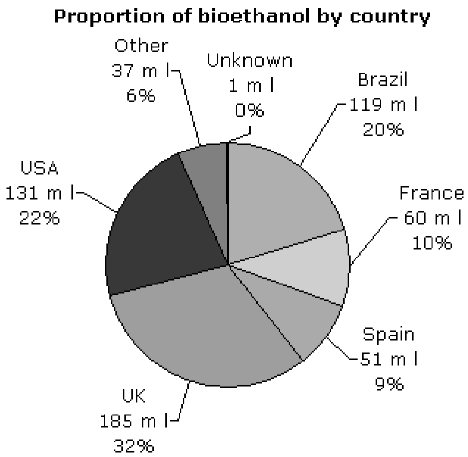
Table 8: Development of the UK pellet market between 2005 and 2008

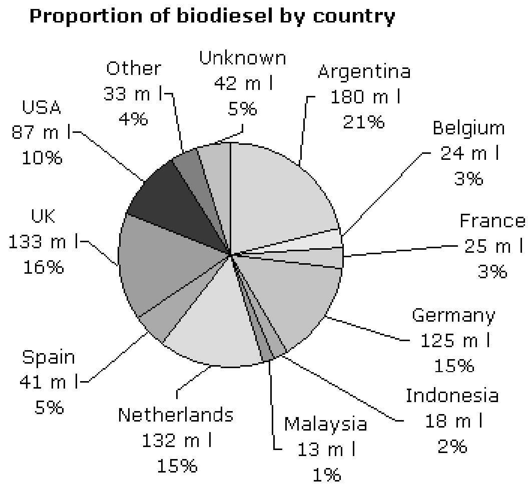
Development of the UK pellet market between 2005 and 2008 Year	Total production capacity [tonnes/year]	Total production (estimated) [tonnes/year]	Consumption [tonnes/year]
2008	218,000	125,000	Not known
2007	104,000		Not known
2006	83,000		Not known
2005	25,000		ot known

Source: (NEF, 2009)

Figure 9 shows percentage, volumes and main country of origins for biofuels imports into the UK. Argentinean soy is the main feedstock use for biodiesel (180m litres, 21% of biodiesel supplied). Brazilian sugar cane is the main feedstock used for bioethanol (119m litres, or 20% of bioethanol supplied).

Figure 9: Proportion of biodiesel and bioethanol import in the UK per country of origin in 2010





Source: (DfTa, 2011)

8. BARRIERS AND OPPORTUNITIES

Barriers are many and vary from country to country; this section focuses in the UK. The implementation of biomass for energy in the UK is hindered by a number of specific barriers and constraints e.g. lengthy planning process, difficulties with obtaining long-term contracts and financing (DECC, 2011b). There are at least six specific UK barriers to deployment of biomass power as identified by the National Grid (NG, 2011):

- fragmentation of the existing supply chains
- lack of innovation/investment on current/new technologies
- ensuring sustainable bioenergy feedstock supply
- difficulties to access to the national grid e.g. policy decisions is a low process and are often marked by long delays
- difficulties in obtaining funding (including subsidies which still remain a strong factor when private investment is involved)

All these issues impact negatively in the development of this sector. The relatively long lead times for biomass electricity projects makes it difficult for developers to commit large investments on the long term. This is further complicated by the lack of market experience with successful large scale biomass energy plants.

The National Grid (NG, 2011) is currently working to remove barriers to biomass energy deployment and is proposing the following actions:

- reform the onshore grid and establish the framework offshore necessary to deploy the levels of renewable electricity expected for 2020;
- to put in place a transparent and long lived financial framework through the introduction of incentives for heat and reforming the electricity market, and ensuring sustainability standards;
- developing a clear "bioenergy strategy" based on the availability and best use of this resource, and ensuring that sustainable feedstocks are fully implemented ;
- plans for better certification and assessment of installers for small scale technologies, including domestic heat; and,
- to encourage innovation.

Unlike many other EU countries (e.g. Denmark or Sweden) the UK lacks real market experience with large scale bioenergy. There is a real need for greater involvement of local communities, and greater awareness by the general public of the potential role of bioenergy, though this is changing e.g. the creation of the Biomass Energy Centre has helped to increase public awareness by promoting the benefits of biomass energy in the UK, both at national and local levels.

9. CONCLUSIONS

As in previous UK Country Reports, the aim of the 2011 report is to update the 2009 study (see www.bioenergytrade.org/countryreports/uk). It is not a detail analysis but an overview of the most important changes occurred since then.

The three prime areas where biomass for energy is used in the UK are in the generation of electricity, heat (solid biomass) and transport (biodiesel and bioethanol). As Table 1 indicates, electricity generation could contribute up to 30% by 2020 compared to less than 6% in 2010, heat 11% (from about 0.5% in 2010), and transport from less than 3% to 10% over the same period. UK provides various incentives/schemes to generate electricity, heat and transport fuels from biomass (see Table 2).

In 2010 the UK had 2.5 GW of electricity capacity in operation from biomass, and this could reach 6 GW by 2020 (equivalent to around 50TWh). In the case of heat, the capacity of 1,063.60 toe; the RHI aim is to achieve 57TWh of heat and save 44 million tonnes of carbon savings by 2020 (DECC, 2011a). As for transport approximately 1.2 billion liters of biofuels (biodiesel and bioethanol) were supplied, which account approximately for 3.3% of total road transport fuel. The Department for Transport (DfT) targets are 4% of biofuels in 2011/12, 4.5% in 2012/13 and 5% for 2013/14 and onwards.

As stated in this report, price fluctuations are a major concern but as the international bioenergy trade consolidates, prices should become more stable. Since feedstocks account for the largest share of total production costs, the relative prices of agricultural and the current price of oil determine the competitiveness of biofuels. The relationship differs according to crop, location, and technologies used in biofuel production.

Given the expected demand for bioenergy and limited domestic resources, the UK is expected to be a major importer. In fact the UK is already a major player e.g. from January to June 2011 the country imported 367,000 tons of wood pellets (see also Table 8). Demand for bioenergy is bound to increase significantly. In the year 2010 about 25% of the feedstock purchased were from domestic sources (small round wood and woodchips, biogas and waste). The remaining feedstock has been imported mostly from EU countries. A proportion was also imported from outside the EU, primarily wood pellets (North America, Russia, South Africa and New Zealand), biofuels (Brazil), and palm oil (especially Malaysia and Indonesia).

The implementation of biomass for energy in the UK is hindered by a number of barriers and constraints e.g. lengthy planning process, problems associated with obtaining long-term contracts and financing; ensuring sustainable bioenergy feedstock supply, difficulties to access to the national grid, etc.

10.REFERENCES

Adams, P., Hammond, G. P., McManus, M. C. and Mezzullo, W. G., (2011) Barriers to and drivers for UK bioenergy development. Renewable and Sustainable Energy Reviews, Volume 15, Issue 2, Pages 1217-1227,

ARUP (2011). UK DECC Report: Review of the Generation Costs and Deployment Potential of Renewable Electricity Technologies in the UK. June 2011. London, UK.

AEA (2011) UK and Global Bioenergy Resource, –Final Report to the UK Department of Energy and Climate Change, Didcot, Oxfordshire, UK. Available at: http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/policy/1464-aea-2010-uk-and-global-bioenergy-report.pdf

Biofuel Guide (2011) An Introduction to Ethanol and Biodiesel. Available at: http://biofuelguide.net

Buckinghamshire County, 2011. Biomass Action Plan. Chiltern Woodlands Project, Forestry Commission, Biomass Energy Centre Crown ed. Available at: http://www.buckscc.gov.uk/assets/content/bcc/docs/sustainability_fund/biomass_action_plan.pdf.

Carbon Trust, (2011a) Renewable Energy Strategy. Available at: http://www.carbontrust.co.uk/policy-legislation/Energy- Supply/renewable-energy/Pages/the-renewable-energy-strategy.aspx .

Carbon Trust (2011b). Feed-in tariffs (FITs) carbontrust.co.uk. Available at: http://www.carbontrust.co.uk/policy-legislation/Energy-Supply/renewable-energy/Pages/feed-in-tariff.aspx.

Carbon Trust(2011c) Biomass heating Available at: http://www.carbontrust.co.uk/biomass-heating/biomass-heating/pages/default.aspx .

Committee on Climate Change (2010). The Fourth Carbon budget- reducing emissions through the 2020s , December 2010, London, UK.

Secretary of State for Energy and Climate Change & HM Government, 2009. The UK Renewable Energy Strategy. Cm 7686, Office of Public Sector Information, ed.

Department of Energy and Climate Change (DECC), 2011. Digest of United Kingdom Energy Statistics 2011. London: TSO, A National Statistics publication, ed.

DECC (2011a) UK Renewable Energy Roadmap Published - Department of Energy and Climate Change. Provide also the Web page

DECC (2011b) Planning our electric future: a White Paper for secure, affordable and low-carbon electricity. Available at: http://www.official-documents.gov.uk/document/cm80/8099/8099.pdf.

DECC (2011c) Renewable Heat Incentive. URN 11D/0017 Crown, London. Available at: www.decc.gov.uk/assests/decc/

DECC (2011d) National Renewable Energy Action Plan for the United Kingdom: Article 4 of the Renewable Energy Directive 2009/28/EC; UK Department for Energy & Climate Change.

DECC (2011e) Consultation on proposals for the levels of banded support under the Renewables Obligation for the period 2013-17 and the Renewables Obligation Order 2012. URN 11D/876 Available at: http://www.decc.gov.uk/assets/decc/11/consultation/ro-banding/3235-consultation-ro-banding.pdf

Defra (2011) Indicator DD3: Net energy derived from agricultural biomass Observatory monitoring framework – indicator data sheet. Available at: http://www.defra.gov.uk/statistics/files/defra-stats-foodfarm-environ-obs-indicators-dd3-110825.pdf

DfT (2011) Department for Transport . Renewable Transport Fuels Obligation. Available at: http://www.dft.gov.uk/topics/sustainable/biofuels/rtfo/ .

DfT (2011a) RTFO Quarterly Report 12:15 April 2010 - 14 April 2011

DfT (2011b) Biofuel Statistics. Available at: http://www2.dft.gov.uk/pgr/statistics/datatablespublications/biofuels/index.html

DfT(2011c) Amendments to the Renewable Transport Fuel Obligation for compliance with the Renewable Energy Directive - (4) Partially Renewable Fuels

DUKE (2011) Renewable electricity in Scotland, Wales, Northern Ireland and the regions of England in 2010. Special feature – Sub-national renewable electricity, DECC. Available at: http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-trends/articles/2873-renewable-electricity-regions-article.pdf

Forestry Commission (2007) A Woodfuel Strategy for England.. Available at: http://www.forestry.gov.uk/pdf/fce-woodfuel-strategy.pdf/$FILE/fce-woodfuel-strategy.pdf

GreenWise (2011) Advanced biofuels could meet almost half of UK green transport needs. greenwisebusiness.co.uk. Available at: http://www.greenwisebusiness.co.uk/news/advanced-biofuels-could-meet-almost-half-of-uk-green-transport-needs-2808.aspx.

Hawkinks Wright (2011) Selected articles from the Forest Monitor. Hawkinks Wright LTD Surrey.

HM Goverment, 2009. The UK Low Carbon Transition Plan I. P. T. Office of Public Sector Information, ed. Available at: http://centralcontent.fco.gov.uk/central-content/campaigns/act-on-copenhagen/resources/en/pdf/DECC-Low-Carbon-Transition-Plan

IIED (2011) The UK's Biomass Energy Development Path: Available at: http://pubs.iied.org/pdfs/G02921.pdf

IEEP (2011) Analyzing Bioenergy Implementation in EU Member States: Results from the Biomass Futures. Biomass Futures Policy Briefings.

Keane, G. & Pearce, O (2011) Analyzing Technical Constraints on Renewable Generation To 2050 P. M. Consulting, ed. Available at: http://www.poyry.com/Sectors_and_Services/Management_Consulting/Energy/Poyry

National Grid (2011) Transmission Networks Quarterly Connections Update – April 2011 Available at: http://www.nationalgrid.com/NR/rdonlyres/41AAF4ED-4121-4C4F-B83E-7BF68C0B4FB3/46624/TNQCUApril2011v1.pdf

DEF (2009) Development and promotion of a transparent European Pellets Market- Creation of a European real-time Pellets Atlas, Pellet market country report UK, The National Energy Foundation, National Energy Centre, UK. (Prepared by Sandra Hayes)

Office for National Statistics (ONS) (2011) National Records of Scotland; Northern Ireland Statistics and Research Agency; Department for Work and Pensions, Region and Country Profiles: Key Statistics 28 October 2011

OFGEM (2011), Annual Sustainability Report 2010-11

Perry, P. & Rosillo-Calle, F. (2009) TASK 40- Country Report for United Kingdom 'Sustainable International BioEnergy Trade: Securing supply and demand'. T40UK5/09. Available at: http://www.bioenergytrade.org/downloads/ukcountryreport0930july09.pdf

Slade, R., Bauen, A. & Gross, R. (2010) The UK bio-energy resource base to 2050: estimates, assumptions, and uncertainties. UK Energy Research Centre. Available at: http://spiral.imperial.ac.uk/handle/10044/1/6020

Weighell, T. (2011) The global land use impact of the United Kingdom's biomass consumption Part I: Biomass flows through the UK economy - an overview of biomass sources and overseas land requirements. JNCC Report. Available at: http://jncc.defra.gov.uk/pdf/JNCC452_web.pdf

Whittaker, C. & Murphy,R J. (2008) Assessment of UK Biomass Resource: A Mirror Report to the US's 'Billion Ton Report'. Imperial College London

Woods,J., Tipper,R. Brown,G. Diaz-Chavez,R. Lovell,J. and de Groot,P. (2006). Evaluating the sustainability of co-firing in the UK. UK Dept. Trade and Industry (DTI) report September 2006. URN 06/1960.

APPENDIX 1 _ Summary of biomass power plants in the UK (2010)

BIOMASS FORM	***Waste wood chips/ Sawdust/ Wood chips***	***Pellet Wood/ Olive Cake Pellet***	***Meal Cake Olive/ Shea/ Rape***	***Sewage Sludge***
GENERATING STATION NAMES	Balcas Biomass CHP Power Station, Drax Power Station, Western Wood Energy Plant, Eccleshall Biomass, Enviropower, Stevens Croft, Eye Power Station, Thetford Power Station (RA), Fibrepower (SLOUGH), P.B.M. Power Limited, Aberthaw B Power Station, Royal Brewery Biomass, Tadcaster Brewery Biomass, Wilton 10 Biomass Gen, Slough Electricity Contracts, Caledonian CHP1, UPM Shotton Paper Boiler 7 , Fawley Waste to Energy Plant	Alcan Lynemouth Power Station, Cottam Power Station, Drax Power Station, Eggborough Power, Kingsnorth Power Station, Ferrybridge C Power Station, Fiddler's Ferry Power Station , Cockenzie Power Station Longannet Power Station West Burton Power Station	Cottam Power Station, Drax Power Station (RB), Eggborough Power Ltd, Fiddler's Ferry Power Station , Aberthaw B Power Station, Didcot 'A' Power Station, Longannet Power Station, Cheetham Hill, Dumfries Peel Centre, Ramsey, Beckton STW Sludge Powered Generator (RB) , Crossness STW Sludge Powered Generator (RB) , UPM Shotton Paper Boiler 7 (RA) , Uskmouth Power Station	Longannet Power Station, Beckton STW Sludge Powered Generator (RB), Crossness STW Sludge Powered Generator (RB)
APPROXIMATE MASS (Mt) (rough estimates)	32.73	26.71	0.52	0.16

For further details see (OFGEM, 2011)