RES-H
POLICY

Current state of heating and cooling markets in United Kingdom

D3 of WP2 from the RES-H Policy project

A report prepared as part of the IEE project "Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)"

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The RES-H Policy project

The project "Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)" aims at assisting Member State governments in preparing for the implementation of the forthcoming Directive on Renewables as far as aspects related to renewable heating and cooling (RES-H/C) are concerned. Member States are supported in setting up national sector specific 2020/2030 RES-H/C targets. Moreover the project initiates participatory National Policy Processes in which selected policy options to support RES-H/C are qualitatively and quantitatively assessed. Based on this assessment the project develops tailor made policy options and recommendations as to how to best design a support framework for increased RES-H/C penetration in national heating and cooling markets.

The target countries/regions of the project comprise Austria, Greece, Lithuania, The Netherlands, Poland and UK – countries that represent a variety in regard of the framework conditions for RES-H/C. On the European level the projects assesses options for coordinating and harmonising national policy approaches. This results in common design criteria for a general EU framework for RES-H/C policies and an overview of costs and benefits of different harmonised strategies.

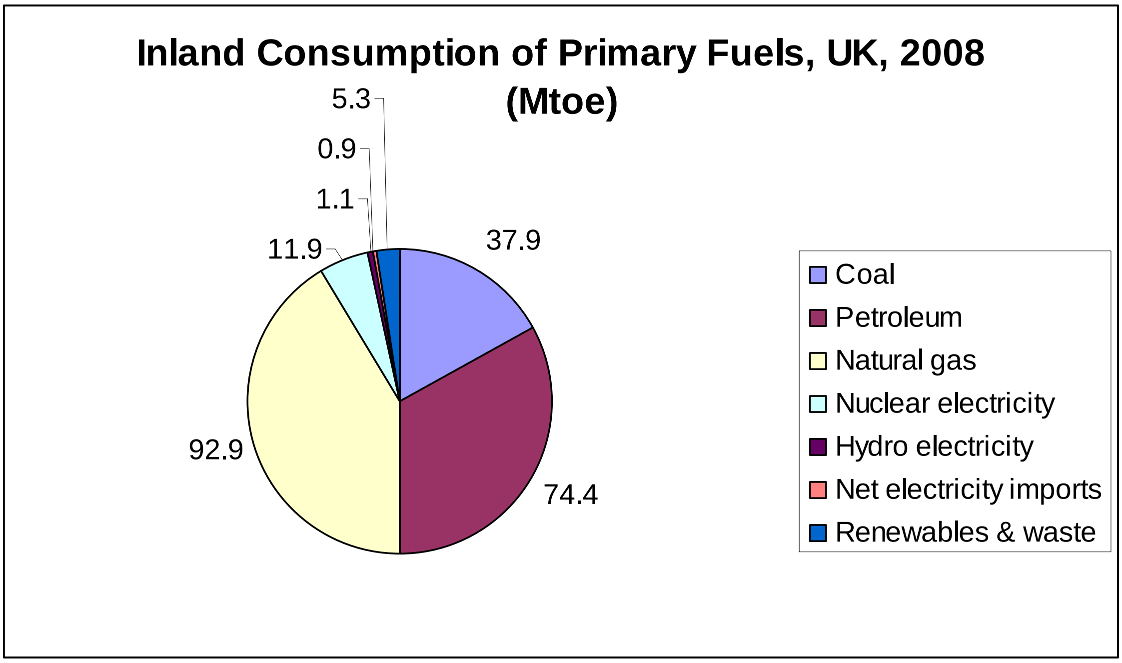
This report

The purpose of this report is to present an overall picture of the situation in the heating and cooling sectors of the United Kingdom. The report summarizes the policy and regulatory framework of the UK heating and cooling markets and gives the available statistics on the penetration rate of the different RES-H/C technologies, as well as the RES potentials for heating and cooling purposes.

1 Introduction

The UK is comparatively wealthy in terms of its energy resources. It is unusual amongst the EU Member States in that it has historically had access to enough oil and gas on its own territory to meet much of its needs, though it became a net importer of primary oils in 2007 and has been a net importer of gas since 2005. It also has substantial coal reserves, though the economics of their exploitation means that it currently relies on imports. While the UK is also relatively rich in some of the resources necessary for generation of renewable energy, the level of exploitation is low compared with nearly all other EU Member States, with only 1.8% of all primary energy requirements met from renewable energy sources in 2007 (BERR 2008d)[1]. In comparison, natural gas and petroleum are major energy sources, contributing 39.8% and 33.4% of primary energy requirements respectively (Figure 1).

Figure 1: Final Energy Consumption 2007



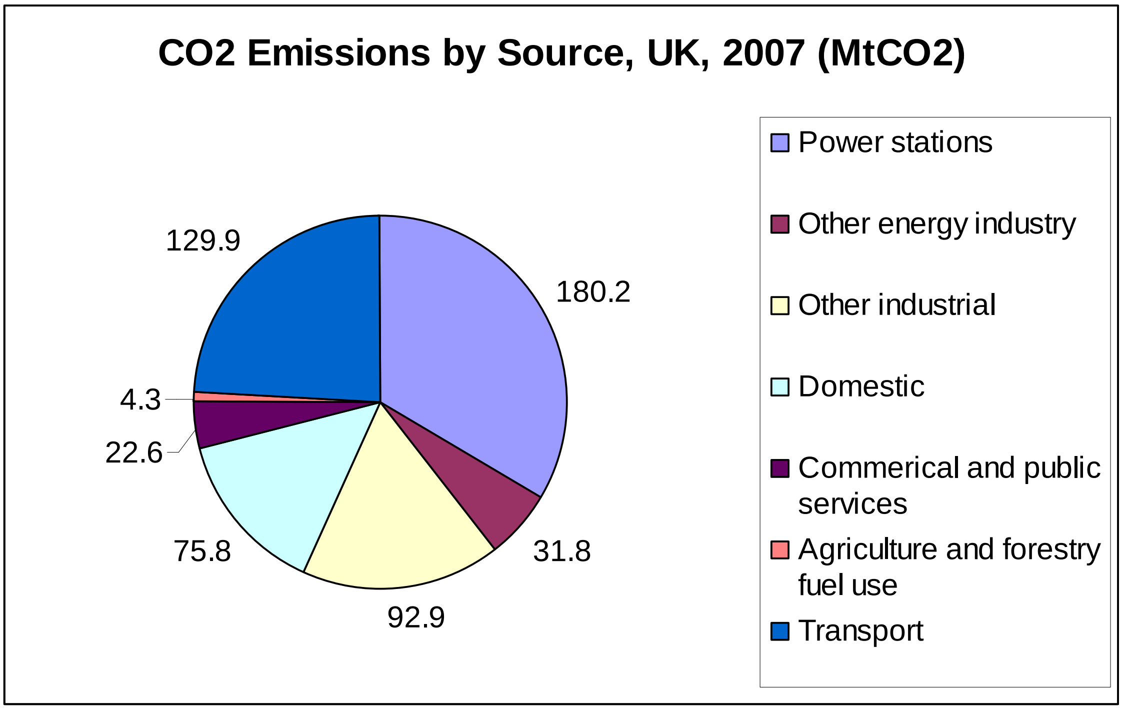
Source: BERR 2008d

Heat and cooling compose an important sector to be addressed in regard of more sustainable economic growth and to improve productivity. Statistics from the UK's Department of Business, Enterprise and Regulatory Reform (BERR) suggest that the UK con-

[1] These percentages are based on the Renewables Directive definitions of what qualifies as renewable energy sources.

sumed 907 TWh of heat energy in 2005 accounting for 49% of final energy consumption in the UK, and 47% of carbon dioxide emissions, far outweighing either electrical and transport energy demand (BERR 2008b) in either of these metrics. Air conditioning is expected to reach 20 TWh/y by 2020 (DTI 2007a, DTI 2007b), indicating a rising demand for space cooling and air conditioning.

Figure 2: Carbon dioxide emissions by source, 2007



Source: BERR 2008d

The UK was one of the first Member States to adopt policy aiming to stimulate renewable energy sources of electricity (RES-E) with its first major financial support – the Non-Fossil Fuel Obligation – adopted in 1990. As with most Member States however it has been less active in its support of renewable energy sources of heating and cooling (RES-H/C). The primary energy production from RES reached 5.17 Mtoe in 2007. Only 14.1% of this figure is used to generate heat, while 78.9% is used to generate electricity. There has actually been a steady decline in the total use of renewable energy sources of heat (RES-H) that began more than 10 years ago, mainly due to tighter emission controls discouraging on-site burning of biomass, especially wood waste. Comprising around 45-50% of the renewable heat total, domestic use of wood is the main contributor to renewable sources used for heat and further significant growth in this area is anticipated. Plant biomass overtook the industrial use of wood and wood waste in 2008 to become, at 16%, the second largest component. (BERR 2008d)

The UK's heat production accounts for around 47% of the UK's total carbon emissions (including emissions from electrical heating), equivalent to 71 million tonnes of carbon

(MtC) in 2005 and is thus sufficient to ensure that more sustainable delivery of heat is essential to the UK meeting its European Union agreed goals for renewable energy installation by 2020 or to meet any of its medium or long term goals relating to reduction in climate change emissions. (DTI 2007a).

2 Architecture of the Market for Heat in the UK

2.1 Heat use in the UK

Data on the use of heat has only begun to be specifically tabulated since 2007, and this seems likely to be linked to Government efforts to understand the market ahead of efforts to adopt appropriate policy to stimulate RES-H at the national level. Statistics were presented in the Department of Trade and Industry's[2] Energy Trends publication for the first time in June 2007, more up to date data was presented in the September 2008 issue.

BERR figures suggest that heating demand accounts for 47% of total UK final energy consumption (BERR 2008a). It reports a sectoral breakdown of energy consumption as shown in Table 1.

Table 1: Energy consumption by sector and end use 2006 (all statistics: ktoe)

End use	Domestic	Services	Manufacturing[1]	Transport	Total[2]	Total[2] excluding Transport
Space heating	26,112	8,771	3,131	-	38,014	38,014
Water heating	11,248	1,667	-	-	12,915	12,915
Process use	-	-	12,927	-	12,927	12,927
Drying/separation	-	-	2,520	-	2,520	2,520
Cooking/catering	1,274	1,949	-	-	3,223	3,223
Heat total	38,634	12,387	18,577	-	69,598	69,598
Other	6,635	5,939	7,409	59,753	79,736	19,983
Total[2]	45,269	18,326	25,986	59,753	149,334	89,581
Percentage of total attributed to heat	85%	68%	71%	-	47%	78%

[1] In addition, around 5,589 ktoe was consumed by industries within SICs 13 and 14 (mining and quarying), 37 (recycling), 41 (collection, purification and distribution of water) and 45 (construction), which are part of the industry sector but not covered by the manufacturing definition; no end use estimates are available for these five SICs.

[2] Total excludes 1,245 ktoe of heat sold, 684 ktoe of renewable fuels (predominantly used for renewable heat), and 78 ktoe of blast furnace gas and 106 ktoe of coke oven gas, and those SICs covered by note 1.

Source: (BERR 2008a)

It is apparent that supply of domestic heat accounts for the largest fraction of heat demand, accounting for more than half of all heat consumption. Space heating is the dominant element of this demand, accounting for two thirds of total domestic heat demand and a third of all national heat energy use. Table 1 also makes it clear how much of the sectoral energy use for the domestic, service and manufacturing sectors is accounted for by heat energy consumption. In domestic dwellings, heat energy accounts

2 The DTI was renamed the Department for Business, Enterprise and Regulatory Reform (BERR) in June 2007, it has subsequently renamed again as the Department for Business, Innovation and Skills (BIS) in June 2009.

for 85% of energy use, emphasising the importance of addressing reduction in heat demand and the provision of more sustainable heat energy as a key element of both energy efficiency and renewable energy policy. The figures for the share of heat energy use in total energy use for the service and manufacturing sectors are 68% and 71% respectively suggest the need for similar action.

Energy Trends provides further statistics showing how heat use is broken down into the three key sectors of domestic, service sector and manufacturing sector, and detailing which sources cater for the demand in each of these sectors. (BERR 2008a)

Table 2: Domestic energy consumption by fuel and end use 2006 (all statistics: ktoe)

End use	Gas	Oil	Solid fuel	Electricity	Total[1]
Space heating	21,848	2,435	494	1,334	26,112
Water heating	8,841	812	136	1,458	11,248
Cooking/catering	679	4	4	588	1,274
Heat total	31,368	3,251	634	3,381	38,634
Lighting and appliances	3	-	-	6,632	6,635
Overall total[1]	31,371	3,251	634	10,013	45,269

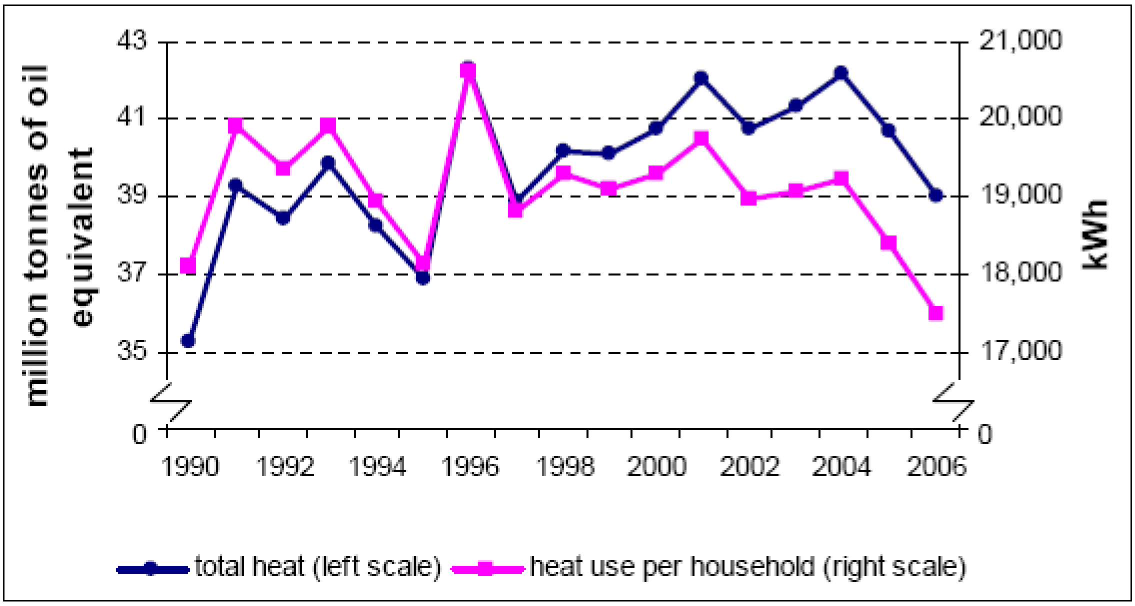
[1] Total excludes 52 ktoe of heat sold and 382 ktoe of renewable fuels (predominantly used for renewable heat).

Source: (BERR 2008a)

The breakdown of the domestic sector (Table 2) shows the focus on gas as the main source of heat energy, accounting for just over 81% of the total heat energy consumption in the domestic sector. Nearly 9% of heat to the sector still comes from and a similar amount comes from oil.

The Government publication ‘Energy Trends’ (BERR 2008a) points out that the fraction of domestic energy consumption associated with heat has remained stable over the past fifteen years, with a typical fraction of 87% of domestic sector energy use being expended on heat (See figure 3). The report notes however, that the total amount of energy used in all dwellings has risen by 20% in the period 1990-2007, while at the same time there has also been an increase in the number of dwellings from 22,7 million to 26.0 million (an increase of 14.5%).

Figure 3: Domestic energy consumption attributed to heat



Source: BERR 2008a

As already noted the service sector has a much lower heat energy consumption than the domestic sector, as shown in Table 3. The fraction of total heat energy consumption produced from gas is slightly lower, at ~69% (2006), with the difference accounted for by electricity with a 21% share of the total.

Table 3: Service sector[1] energy consumption by fuel and end use 2006 (ktoe)

End use	Gas	Oil	Solid fuel	Electricity	Total[2]
Space heating	6,472	1,073	15	1,212	8,771
Water heating	1,283	96	1	286	1,667
Cooking/catering	770	42	-	1,137	1,949
Heat total	8,524	1,211	17	2,636	12,387
Computing	-	-	-	464	464
Cooling and ventilation	36	-	-	786	821
Lighting	-	-	-	3,387	3,387
Other	135	11	-	1,119	1,266
Overall total[2]	8,695	1,222	17	8,392	18,326

[1] Excluding agriculture

[2] Total excludes 384 ktoe of heat sold and 105 ktoe of renewable fuels (predominantly used for renewable heat).

Source: BERR 2008a

The manufacturing sector shows a further variance (Table 4), with gas accounting for just over 50% of total heat consumption, while electricity accounts for 24% and oil still significant at 17%. The difference is likely to be the result of the different economics of energy supply to the industrial sector in the UK, by the less rapid turnover of energy systems in the manufacturing sector and by the requirements of industrial processes.

Table 4: Manufacturing energy consumption by fuel and end use (ktoe)

End use	Gas	Oil	Solid fuel	Electricity	Total[2]
Space heating	1,500	630	66	935	3,131
High temperature process	2,180	209	1,136	1,277	4,802
Low temperature process	4,521	1,653	271	1,680	8,125
Drying/separation	1,144	683	114	578	2,520
Heat total	9,346	3,175	1,587	4,470	18,577
Motors	-	-	-	2,244	2,244
Compressed air	-	-	-	747	747
Lighting	-	-	-	320	320
Refrigeration	-	-	-	540	540
Other	2,364	429	161	603	3,557
Overall total[2]	11,710	3,604	1,748	8,924	25,986

[1] In addition, around 5,589 ktoe was consumed by industries within SICs 13, 14, 37, 41 and 45, which are part of the industry sector but not covered by the manufacturing definition; no end use estimates are available for these five SICs.

[2] Total does not include 809 ktoe of heat sold, 198 ktoe of renewable fuels (predominantly used for renewable heat), 78 ktoe of blast furnace gas and 106 ktoe of coke oven gas and those SICs covered by note 1.

Source: BERR 2008a

In terms of emissions, the 47% figure that heat consumption contributes to overall UK CO_2 emissions breaks down to 20% from each of the domestic and industrial sectors, and 7% from the service sector (BERR 2008a).

2.2 District Heating

District heating (DH), wherein water is heated centrally then piped to buildings to be heated has the potential to improve the efficiency of space and water heating in the domestic and other UK sectors. The UK has had some district heating in place since the 1950s, however, only very limited volumes of heat have historically been delivered through networks. Less than 2% of all heat energy consumption in the UK is supplied through district heating networks. A recent study suggests that the main reason for this low penetration is the higher cost of district heating when compared with the gas or electrically based heating systems currently common in the UK. (Pöyry/Faber Maunsell 2009) Table 5 below uses data from the desktop study carried out on behalf of the UK Environment Ministry (DEFRA 2007) to give indicative figures for the level of penetration of district heating into various types of building. It is apparent that penetration is low in most types of building and very notably so in the housing sector.

The Pöyry/Faber Maunsell report suggests that the central reason for this higher cost is the initial provision of hot water pipes that would be required. It suggests that there are some limited situations where replacing electrical heating with DH could be justified on economic grounds, but that this potential is limited to only 70,000 dwellings, (a tiny fraction of the UK's 26 million dwellings).and a fraction of non-dwelling buildings where it is suggested it could account for up to 14% of modelled commercial heat demand (Pöyry/Faber Maunsell 2009). The report concludes that uptake of DH in the UK will require significant changes in the market or regulatory regime. It suggests that the inclusion of the shadow price of carbon (at time of publication) would be insufficient to change the economics of DH when compared with existing gas and electricity options. The report also compares DH networks with stand alone renewables, suggesting that the comparative carbon abatement costs favour DH, though noting that the technologies can be employed together if desired. Table 5, below, provides estimates for the extent of district heating available in the UK, broken down into building categories, while figure 4 records the proportion of UK dwellings with access to communal heating and how this has varied in the period 1988-2005. It can be noted that the figure does not rise above 1.5% during the period.

Table 5: Estimation of the extent of district heating in the UK, 2007[3]

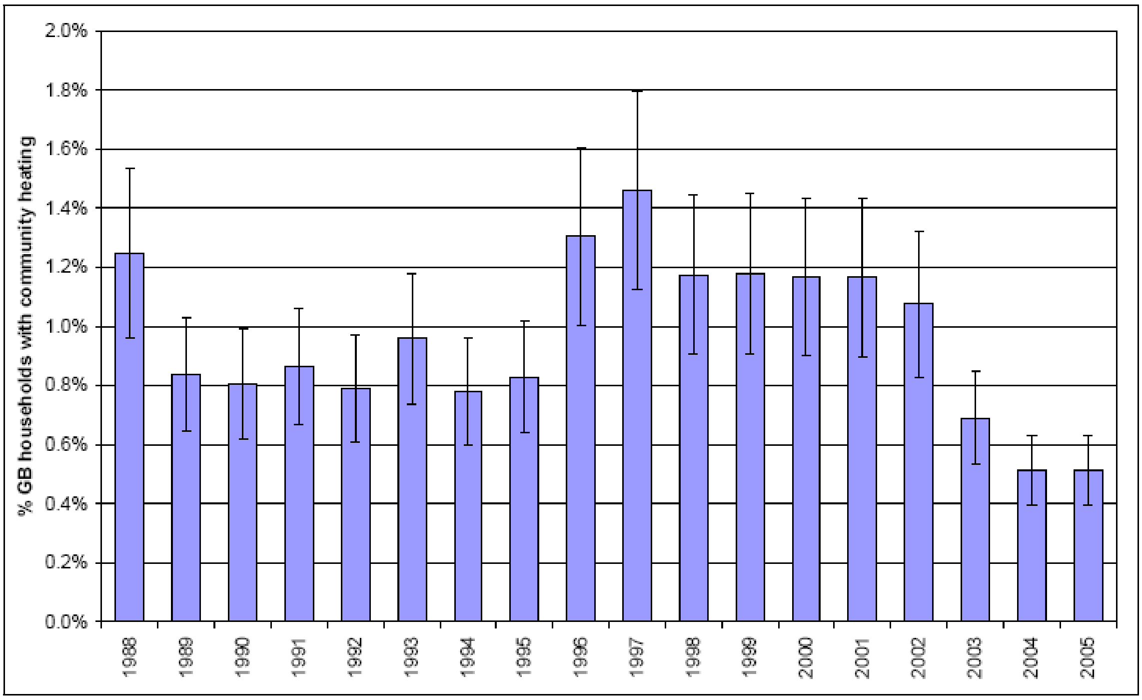
Sector	**No. of buildings**	**No. of buildings served by district heating**	**% served by district heating**
Commercial offices	54	3	5,6%
HATs	8.500	400	4,7%
Higher and further education	3.302	424	12,8%
Hospital trusts	2.846	1.146	40,3%
Hostels	7.263	58	0,8%
Housing associations	495.316	318	~0,1%
Industrial	1.587	24	1,5%
Local authorities	2.704.387	9.960	0,4%
Multi user schemes	462.002	80.482	17,4%
Nursing homes	159	86	54,1%
Private housing	72.591	53	0,1%
Public sector offices	438	13	3,0%
Schools	625	85	13,6%
Sheltered housing	80.746	220	0,3%
Grant Total	**8.839.816**	**93.272**	

Source: DEFRA, 2007

[3] This data represents an indicative survey and does not show the totality of UK building stock

Specific to the domestic sector, Figure 4, below, demonstrates the very low proportion of UK households with access to communal heating systems.

Figure 4: Proportion of GB households with communal heating (1988-2005)



Source: DEFRA 2007.

The Government's Renewable Heat Initial Business Case (DEFRA/BERR 2007a) suggested, along with other commentators, that the cost of retrofitting residential areas with DH networks is likely to prove to be a very significant barrier to their deployment, especially without regulatory intervention to ensure investors are protected from the uncertainties of post-installation heat load. The document also suggests other regulatory intervention might allow market characteristics more amenable to district heating.

2.3 CHP

The number of CHP units installed in the UK by the end of 2007 is shown in Table 6, along with a breakdown of capacities over different scales. Expansion of UK CHP capacity has been slow and it seems unlikely that the Government will reach its stated target of having 10 GW of good quality CHP in place by 2010. There are a number of reasons for this, though the economics of CHP energy production and the absence of Government action to address this with any rapidity can be regarded as the most significant.

Only 3% of energy production from CHP units came from renewables in 2007 (BERR, 2008d). There is obviously potential for deployment of CHP to increase, for greater exploitation of heat output and for renewable energy sources to make a greater contribution to the amount of energy that CHP produces. The Government's July 2009 Renewable Energy Strategy puts forward some mechanisms for greater support of CHP using renewable waste. Firstly committing to efforts to make it easier to assess the fraction of a mixed waste stream eligible for ROCs, and secondly by the establishment of a grant scheme to support the development of solid waste combustion in industrial scale CHP plants. (DECC 2009b pp124)

Table 6: CHP schemes by capacity size ranges in 2007

Electrical capacity size range	Number of schemes	Share of total (per cent)	Total electricity capacity (MWe)	Share of total (per cent)
Less than 100 kWe	475	33.0	30	0.5
100 kWe - 999 kWe	693	48.2	180	3.3
1 MWe - 9.9 MWe	198	13.8	728	13.3
Greater than 10 MWe	72	5.0	4,536	82.9
Total	**1,438**	**100.0**	**5,474**	**100.0**

Source: BERR 2008d

2.4 Housing

The UK has around 26 million dwellings of various types. Data on the housing stock of the UK is somewhat limited in terms of types of dwelling, numbers living in these types of dwelling and associated energy use, with data more frequently gathered on the basis of new stock, rates of completion, tenant tenure or the value of dwellings. (See for example CLG 2008) Where more detailed data is available it is often specific to England, Wales, Scotland or Northern Ireland individually.

Assessment of the energy efficiency of dwellings is carried out using a UK specific tool, the Standard Assessment Procedure (SAP). The SAP rating is based on the energy needed for space and water heating, adjusted to take into account the floor area of the dwelling. This can be applied to any dwelling to give a rating from 1-120 with 120 being the best. The average rating for a UK dwelling is 45. New homes will tend to do better as a result of more stringent building regulations, and will tend to be in the range 60-100, with a dwelling built to current Part L building regulations having a rating above 80. A rating above 100 indicates a dwelling with exceptional insulation.

Factors taken into account in awarding a SAP rating for a dwelling include

1. Thermal insulation
2. Efficiency and control of the heating system
3. Ventilation characteristics
4. Solar gain characteristics

5. Energy used in space and water heating

Demolition rates in the UK are low. As few as 20.000 houses were being demolished annually as of 2004 (around 0,1%) due to an inflated housing market (Boardman, Darby, et al. 2005). This will tend to mean that older less efficient houses can remain in use for long periods this will have implications for addressing the improved performance of these buildings and for the retrofitting of RES-H systems. Construction rates have been outstripping demolition by a considerable margin in recent years, 143.000 new houses were completed in 2003-4, increasing to 167.000 in 2007-8 (DEFRA 2008b) which offers some potential for at least substantial volumes of new capacity. Continued rapid expansion is likely to be impacted by the current global downturn however.

The relatively slow rate of construction, and especially of demolition, against the total extant housing stock means that any change to overall energy efficiency in the UK will be slow, and this is demonstrated by the rather slow upwards creep of the average SAP in the last decade, as shown in Table 7. It has been suggested that if substantial reductions in energy use associated with housing is to be achieved then there will need to be considerable improvements made to the average SAP. One report suggested achieving a 60% reduction in domestic energy use by 2050 would require all 21.8 dwellings expected to be in existence at that point to have been raised to a SAP of 80 (Boardman, Darby et al. 2005).

Table 7: Housing conditions: Energy Efficiency Rating (EER) Bands by housing stock, England, 1996-2006 (percentage)

	Band A-C [1]	Band D	Band E	Band F	Band G	mean SAP rating
1996	2.4	17.1	44.4	27.2	9.0	42.1
2001	4.5	23.0	45.7	20.8	6.0	45.7
2003	5.4	25.2	44.1	19.9	5.4	46.6
2004	6.0	26.7	42.9	19.8	4.5	47.4
2005	6.9	27.7	41.7	19.3	4.4	48.1
2006	7.2	29.8	41.3	17.5	4.3	48.7

Base: all dwellings
1 Only a tiny proportion (0.1%) of homes achieve a Band A or B energy efficiency rating (the most efficient homes) in 2006.

Source: CLG 2008

2.5 Significant Stakeholders in the UK Heat Energy Market

The dominance of gas as the main source of heat energy in the industrial and especially domestic supply sectors in the UK means that the gas supply companies are the major stakeholders in the UK heat market. While there are more than 20 gas and electricity suppliers active in the UK market, much of the market is dominated by six major utilities: British Gas, EDF Energy, E.ON, RWE Npower, Scottish Power and Scottish and Southern Energy.

The UK gas transmission network is owned and operated by National Grid Gas plc, with responsibility for maintaining and extending the network. There are eight distribution network operators across Great Britain; these are owned by National Grid, Northern Gas Networks, Scotia Gas Networks and Wales & West Utilities.

The utilities have obligations under the Renewables Obligation (See section 5.2) which compels them to purchase a specific fraction of their electricity from RES-E or pay a fine; this has limited cost implications for RES-H in regard of support for biomass CHP. The major utilities also have an obligation to reduce the carbon emissions of consumers as part of the Carbon Emissions Reduction Targets mechanism. This can see them provide support for microgeneration, including domestic RES-H applications, though in practice this has not led to substantial investment in RES-H, and with the volume it stimulates predicted to remain limited even with the proposed 20% increase in the level of the obligation as a result of the ongoing consultation. (DECC 2009c)

2.6 Regulation of the heat sector

The UK does not have a regulatory system specific to the provision of heat energy. To the extent that gas and electricity and the key elements of heat generation in the sectors detailed above, then the Office of Gas and Electricity Markets (OFGEM) has regulatory oversight responsibilities.

The UK gas market began a process of privatisation in 1986; this process saw the state owned gas sector deregulated and the key company British Gas divided into supply and network functions which were sold into the private sector under the regulatory oversight of the Office of Gas Supply (OFGAS).

The UK electricity supply industry underwent a similar process from 1990 onwards, with the division of the sector into transmission, distribution, generation and supply functions and their privatisation. The first as regulated natural monopolies, the third on a competitive basis from 1990, and the latter opened up to competition in a graduated process up to 1998. The whole was regulated by the Office of Electricity Regulation (OFFER) up to its merging with OFGAS in 2000 to form OFGEM, which has oversight over both elements.

The UK favours a system of ‘light touch’ regulation for electricity and gas, Government legislation sets out the duties of Ofgem, the primary focus of these duties currently is to maximise competition in the belief that this will lead to the lowest possible costs for energy consumers. The Government then provides guidance as to any changes it would like to see acted upon. Ofgem may adopt or reject these; the Government may adopt new legislation if it wishes to force the issue or if primary legislation is needed to change the overall duties. The Government does provide guidance on social and environmental issues related to energy to the regulator. However, the limitations created by its duties and the significant level of regulatory independence mean that these are not a priority.

The regulator has amongst its responsibilities oversight of the Renewables Obligation, the UK's main mechanism for the financial support of Renewable Energy Sources of Electricity (RES-E). It has been suggested that this, along with its regulatory experience, makes it the most likely candidate to oversee any support mechanism for the support of RES-H and for any additional regulatory provision that may be needed.

Other fuels currently used for heating are subject to various levels of regulatory oversight linked to, for example, volumes of sales and taxation.

3 Architecture of the Cooling Sector in the UK

Historically the UK has had low uptake of cooling. A relatively low number of days requiring cooling for comfortable use of space have meant the technology was not as common as in warmer climates. However, increases in the use of IT in offices has driven up the need for effective cooling such that cooling load can now present a substantial addition to summer electrical loads. Future climate projections may lead to increased cooling days over time, though this has to be balanced against likely increases in the efficiency of office equipment and corresponding reductions in the amount of waste heat in office environments (Jenkins, Liu et al., 2008). UK Government statistics for cooling and ventilation records that 780ktoe of electricity and 37ktoe of gas were expended in the UK service sector in 2006 (DTI, 2007a).

An increase in the number of cooling days in the Greater London area has already been recorded, with an additional 30-35 cooling days been required per year in the period from 1961-2006 (POST, 2008). This has led to substantial increases in electrical demand during the summer months with associated increases in fossil fuel usage. During the warmest month recorded in the UK, July 2006, the National Grid company, responsible for managing electrical supply in Great Britain, issued an ‘insufficient margin warning’, something which the company related specifically to an increased cooling load. It is currently foreseen that the likelihood of such events will increase in coming decades. There is thus potential for renewable cooling to contribute to both environmental goals and to security and reliability of supply. The company suggests that there is an increase in UK electricity demand which becomes apparent once the summer temperature moves above roughly 17^{o}C and which continues to rise with temperature. This is most apparent in June, July and August. The company specifically suggests this is the result of increased use of air conditioning units and electric fans. (National Grid Company 2008)

Table 8: UK energy consumption projections due to air conditioning

Year	2000	2005	2010	2015	2020
TWh	11.3	14.2	17.0	18.6	20.0

Source: (Market Transformation Programme 2007)

Table 9: Carbon emissions projected due to air conditioning

Year	2000	2005	2010	2015	2020
MtC	1.59	2.14	2.41	2.41	2.29

Source: (Market Transformation Programme 2007)

It has been estimated that the demand for cooling in the UK could reach 20TWh/yr by 2020, along the path shown in Tables 8 and 9.

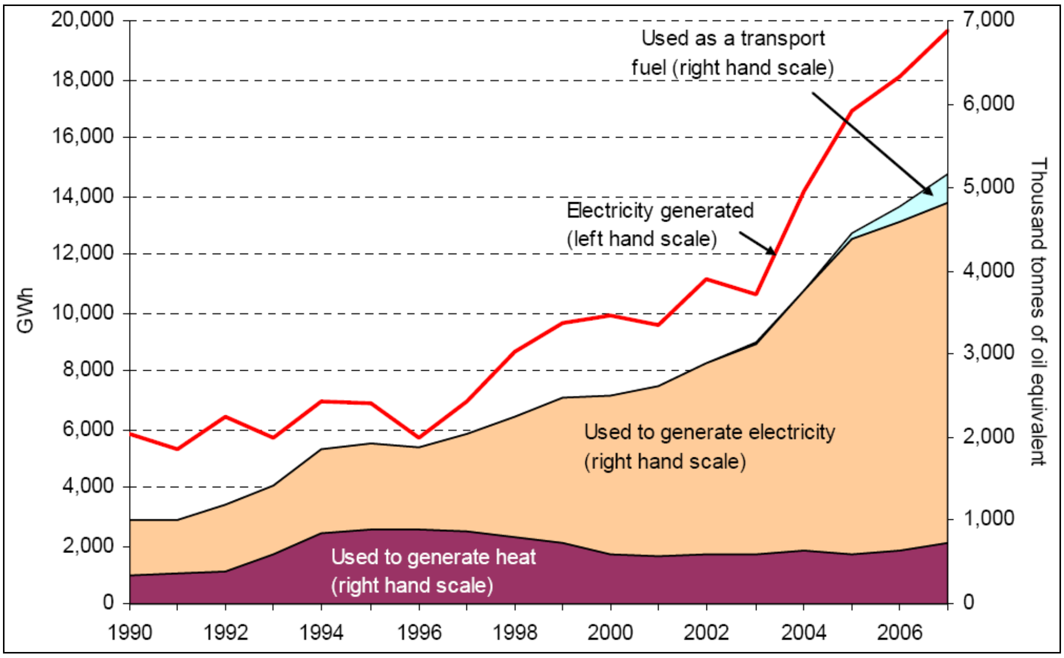
This is largely for office use, though BERR also notes the possibility that an increase in residential demand could arise and would substantially increase energy consumption associated with cooling over time. BERR also notes the potential need for improved building design to provide passive cooling; decarbonised electricity supply and the use of ground source heat pumps if such as expansion were not to lead to increased carbon dioxide emissions. The same document also notes the potential for, and superior efficiency of, centralised district cooling systems. It further notes that amongst the companies operating district heating systems, cooling enjoys an increasing market share and that the combination of both heating and cooling offers a greater degree of economic viability than provision of heating services alone. It must be borne in mind that the currently low UK capacity of installed district heating systems means that any increased demand for cooling in this area is unlikely to translate to a significant contribution to overall UK energy consumption. Expansion of district cooling seems likely to be entirely dependent on the economics of district cooling and the potential for the availability of cooling as an additional service within this context.

The UK demand for cooling is thus met almost entirely from electrical use, applied at the very local level, with direct installation of cooling systems in office blocks or at an even smaller scale. There is no oversight of this beyond health and safety.

4 Current Status of Renewable Energy Sources of Heat in the UK

The UK has had no targets specific to RES-H until the July 2009 adoption of a 12% target of all heat consumption to come from renewables by 2020. This is part of the UK's policy response to its European commitments to produce 15% of all its energy from renewables by that year. These policy commitments are discussed in more detail in section 7. The main generators of renewable heat in the UK are currently direct combustion of biofuels, active solar thermal systems and geothermal aquifers, the first of there contributing 93% of the total renewable heat generated in the UK in 2006 (DTI 2007a). Renewable generation of heat accounts for 0.6% of all heat demand, a fraction which has been in steady decline since the mid-1990s. The declination has been attributed to a tightening in emission controls relating to the burning of waste wood. While the UK has made significant efforts to increase its generation of RES-E since 1990, increasing the fraction of electricity that comes from renewables to 4.9% by 2007 (BERR 2008d), the relatively larger share of primary energy consumption associated with heat means that the total fraction of energy consumption met by renewables has risen only slowly, from 1.32% in 2004 to 1.8% in 2007[4]. (BERR 2008d)

Figure 5: Trends in the use of renewable energy for heat, electricity and transport



Source: BERR, 2008a

4 These percentages are based on the Renewables Directive definitions of what qualifies as renewable energy sources.

Figure 6 shows how RES-E deployment and generation has increased steadily in the period 1990-2008, while little gain has been made as regards RES-H deployment.

Government figures for renewable heat production suggest an estimated total of 797.2 ktoe of renewable heat was generated in the UK in 2008[5], the main technology contributing to this was biomass, contributing 740.7 ktoe, equivalent to 93% of the RES-H total. The remainder came from active solar thermal generation at 55,7 ktoe. (BERR 2008d)

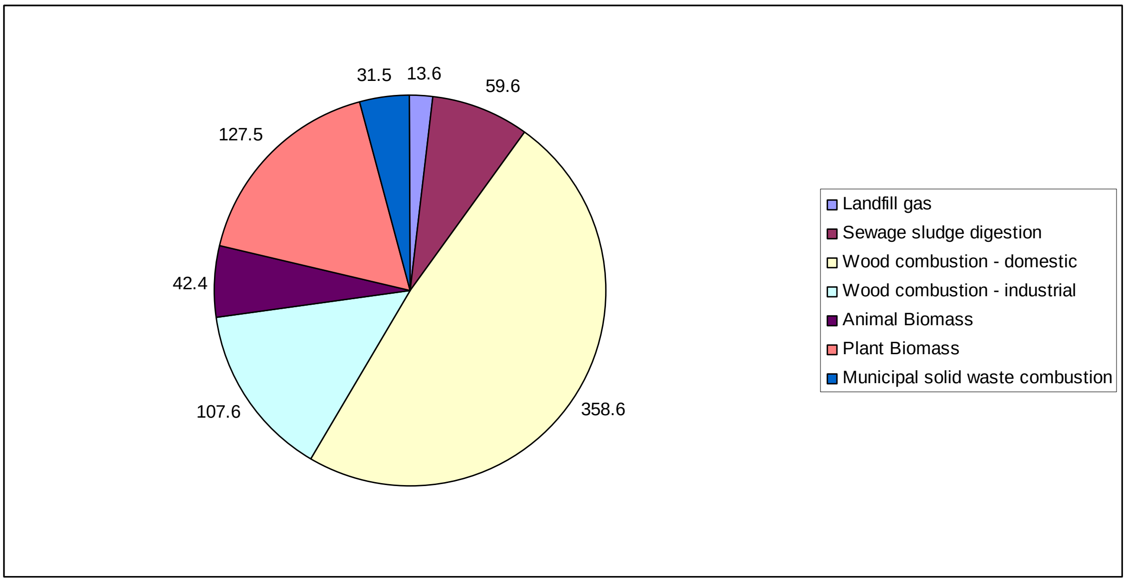
Biomass

Biomass is currently the most important contributor to renewable heat generation in the UK. The main types of biomass in use are woody biomass and waste with high biomass content, such as municipal “black bag” waste. Biomass is broken down further into key categories, as shown in Table 10. Biomass generation is dominated by domestic combustion of wood. Industrial combustion is a significantly smaller contributor, though a number of policy initiatives are in place to expand the use of wood, including support for the supply chain and the advancement of the technology, as described in section 7. The UK has seen considerable increases in the exploitation of biomass since the adoption of the Renewables Obligation (RO) in 2002, as the RO has subsidised co-firing of biomass as a method for generation of renewable electricity, though there has been little emphasis on renewable heat production, as highlighted by the Biomass Task Force (2005). The report noted that biomass was the only source of widely available high grade heat from a renewable source in the UK and that this had been largely ignored despite the potential. It suggested that the government should increase grant support for RES-H and at the same time should begin a programme of public procurement for the supply of RES-H in public buildings.

The Task Force highlights the significant potential for expansion of biomass exploitation for RES-H generation, suggesting that the UK produces 5-6 million tonnes of waste wood annually, and that an additional 1,5 million tonnes of high quality waste wood and 2-3 million tonnes of contaminated waste wood could be recovered for combustion over and above the 1,4 million tonnes currently recovered.

5 This figure includes 0.8ktoe for geothermal aquifers but does not include energy associated with ground or air source heat pumps.

Figure 6: Heat energy generated from biomass in the UK, 2008 (units: ktoe)



Source: BERR 2008d

The Task Force also sets out the barriers to the general growth of biomass use in the UK, these include:

- Ignorance of the potential of biomass as an energy source
- Heavy emphasis on RES-E, with little value attached to the carbon emission reduction potential of RES-H
- Issues related to the designation of waste and the implementation of waste regulation
- A fragmented approach by national and regional government
- Planning issues
- Lack of a robust supply chain
- Past market conditions undermining CHP project viability
- The lack of an effective single voice for the industry

The DEFRA/BERR document ‘Renewable Heat initial business Case’ sets out a similar set of barriers applying across multiple RES-H technologies, whilst also emphasising the costs associated with retrofitting of existing infrastructure with RES-H technologies as a major barrier, and the need for long-term financial support to address the high initial capital costs of RES-H (DEFRA/BERR2007a). The Biomass Task Force (2005) also highlight specific regulatory barriers specific to the use of biomass for RES-H production, which could lead to improved system economics if addressed, these include:

- That the building regulations do not recognise that biomass systems are not radiant energy devices and thus do not require the measures necessary for such systems to operate safely.
- That the building regulations do no properly acknowledge the operational differences of biomass RES-H systems.
- The need for heat boilers to be tested for use in smoke free zones, despite their having met more stringent standards attached to their normal operation. This unnecessary testing implies delays to the introduction of models and additional associated costs.

The Task Force also produced estimates of the potential for different biomass technologies within the UK, as shown in Table 10, below.

Table 10: Quantification of existing biomass resource and its potential for energy generation

Biomass source	Available tonnage (dry tonnes)	Energy contained in biomass (TJ)	Potential energy generation		
			Electricity only	Heat only	Heat & Electricity
Energy conversion efficiency (1)		(11)	**30% GWh$_e$**	**85% GWh$_h$**	**85% GWh$_{e\&h}$**
A) 'Dry' materials					
Forestry waste and arboricultural arisings	1,460,000 (4)	21,900-25,988	1,825-2,166	5,171-6,136	5,171-6,136
Waste wood (industrial)	3,000,000 (5)	35,700	2,975	8,429	8,429
Energy Crops (short rotation coppice (willow/ poplar) and miscanthus)	250,000-366,750 (6)	3,940-6,671	328-556	930-1,362	930- 1,362
Cereal straw	3,000,000 (7)	40,500-49,500	3,375-4,125	9,563-11,688	9,563-11,688
Municipal solid waste	7,600,500 (8)	60,804-76,005	5,067-6,334	14,357-17,946	14,357-17,946
Sewage sludge	384,222 (9)	5,802-7,684	483-640	1,370-1,814	1,370-1,814
Poultry manure - Meat birds (60% DM)	1,158,300 (10)	16,216	1,351	3,829	3,829
Sub-total:	16,853,022 – 16,969,722	184,862 – 217,764	15,404 – 18,147	43,649 – 51,204	43,649 – 51,204
B) 'Wet' materials (Anaerobic Digestion)					
Typical AD conversion efficiency rates (2):		See note 3	**40%**	**85%**	**80%**
Poultry manure – egg laying flock (30% DM)	356,700 (10)	2,461-4,815	270-540	580-1,140	550-1070
Dairy cattle slurry (10% DM)	2,016,000 (10)	11,592-12,600	1,290-1,400	2,740-2980	2,580-2800
Pig manures (10% DM)	535,500	2,923-3,480	320-390	690-820	650-770
Sub-total:	2,907,200	16,976-20,895	1,880-2,330	4,010-4,940	3,780-4,640
Total:	19,760,222-19,876,972	201,838-238,659	17,284-20,477	47,659-56,144	47,429-55,844

Source: Biomass Task Force 2005

Solar Thermal

The UK sources only a very limited amount of energy from solar thermal systems, with the Digest of UK Energy Statistics suggesting the 55,7 ktoe (0.65TWh) figure mentioned above (BERR 2008d) for the total output of solar thermal systems installed in the UK. The Renewable Heat Initial Business Case suggested a figure for solar thermal production of 0.3 TWh/yr generated in 2005 (DEFRA/BERR 2007a). This document also puts forward three suggestions of the potential for solar thermal energy in the UK based around three scenarios up to 2020. The first, Business as Usual, suggests a potential of 1.2 TWh by 2020. The second scenario, based on low market potential based on the total technical potential suggested a figure of 4.9TWh/yr, while the third scenario, based on high market potential, gave a figure of 17.1 TWh for potential production in 2020. This would obviously represent a substantial increase in total output. The Renewable Heat Initial Business Case document also suggests that solar thermal will require support in the range £3 - £51/MWh if deployment outlined in the two market potential scenarios is to be achieved. (DEFRA/BERR 2007a)

The same document highlights high initial capital costs and installation costs as being the key financial barriers to solar thermal deployment, even where the overall economics of the project are favourable. It highlights the need for increased education of the public, and of the need to address the public perception that solar thermal technology is “complicated, unproven and of dubious benefit”. Planning delays are also raised as an area for attention, along with building regulations. (DEFRA/BERR 2007a)

Aid is currently available for the support of solar thermal technology through the Low Carbon Buildings Programme and the Carbon Emission Reduction Target, as detailed in section 5.2.

Heat Pumps

Ground source heat pumps (GSHP) appear to represent a potentially significant contributor to RES-H generation in the UK, though currently only a limited amount of installation has taken place. The Renewable Heat Initial Business Case (DEFRA/BERR 2007a) suggests ground source and air source heat pumps currently generate 0.03 TWh/yr in the UK, with most of this contribution coming from GSHP. The same document suggests a Business as Usual scenario wherein this increases to 0.11 TWh/yr by 2020, but also puts forward two scenarios, again based on low and high market potentials, suggesting a range between 4.9TWh/yr and 20.1 TWh/yr.

5 Historical and Ongoing Policies Applied to the Support of RES-H in the UK

5.1 General RES Policy Context of the UK

UK policy on renewable energy has historically had as its central focus the development of Renewable Energy Sources of Electricity (RES-E). Considerable attention has been given to providing financial and other support to RES-E, most notably in the period since the privatisation of the UK electricity sector in 1990. Financial assistance predated this, most notably in the form of funding for research and development of various RES-E and some other technologies.

It is not coincidental that the introduction of privatisation came alongside the first large-scale commercialisation programme for RES-E, and the shaping of the larger electricity market and its regulation have strongly influenced the shaping of policy to encourage renewable energy. Their has been a strong focus on driving RE technologies to commercialisation using mechanisms which mimic the application of markets to as great an extent as possible, and to favour mechanisms which minimise interference with the wider energy market. This experience with RES-E policy has had a demonstrable effect on thinking concerning potential support structures for RES-H in the UK since it began to be considered from around 2003 onwards, and has continued to influence the current round of new government consideration that began in 2007.

The key mechanism introduced in 1990 was the Non-Fossil Fuel Obligation (NFFO) (Mitchell 1995; Mitchell 2000; Mitchell and Connor 2004), this was a competitive tendering mechanism wherein the UK government requested bids for different RES-E projects and awarded them to the cheapest. The mechanism was initially tied to the government financial support of the UK's nuclear sector and its design was strongly influenced by this necessity. It faced a number of problems and is regarded by many as a failed mechanism. It is highly unlikely that the UK would follow a similar path for support of RES-H.

This recognition as being not entirely successful, amongst other reasons, led to the replacement of the NFFO with the UK's current mechanism, the Renewables Obligation (RO). The RO was introduced in 2002 and is a fairly typical example of a quota mechanism (Mitchell and Connor 2004; Connor 2005). It places an obligation on all supply companies to purchase an annually rising fraction of its electricity from renewable sources, and requires they pay a fine for every unit by which they fall short. Companies demonstrate compliance by submission of certificates which are awarded to RES-E generators and sold with the electricity. The fines are then divided amongst the supply companies in proportion to the number of certificates submitted.

The aim of the mechanism is to create a market for RES-E and to encourage supply companies and RES-E generators into competition with the aim of maximising competition and thus stimulating RES-E generation at the lowest price to the consumer. This focus on competition is very much in line with the prevailing approach to the energy supply market as a whole in the UK. Perhaps the key additional justification for the choice of the mechanism is that its adoption minimises interference with the wider market for electricity. Generators sell their electricity on the general electricity market; they are effectively rewarded for their environmental benefit with the certificates, which are traded on a separate market, thus maintaining the independence of the power market. An additional political benefit of the RO is that it allows the treasury to predict the annual cost of the mechanism.

Oversight of the RO is by the electricity and gas industry regulator, the Office of Gas and Electricity Markets (OFGEM). Ofgem's central purpose is to engender maximum competition in the energy markets in order to minimise costs. Its approach to doing so is centred in 'light touch' regulation, wherein interference with the market is kept to a minimum. Ofgem does take guidance from central government relating to environmental and social goals but does not have to act on this. It is likely that Ofgem will at least be considered as the overseer of any significant subsidy instrument for RES-H and it is thus important to be aware of Ofgem's perspective, particularly considering its responsibilities in the gas and electricity markets which account for much of UK heat delivery.

The adoption of the RO strongly influenced the UK's decision as to the shape of policy to support biofuels. The Renewables Transport Fuel obligation (RTFO), adopted in 2008, operates similarly to the RO, requiring an annually increasing fraction of fuel sold to vehicle users to come from renewable sources. Defaulters are again fined in proportion to their shortfall. The main justification for the choice of the mechanism was again on the grounds that the inherent competition would allow the additional prices linked to the mechanism to be held to a minimum.

It seems likely that the earlier adoption of the quota-style RO led to the slightly later adoption of the RTFO. The factors that led to the introduction were the same, and it could be argued that the pre-existence of the RO created an additional factor in that it committed political leaders to a quota mechanism as a the superior choice. This certainly influenced early attempts to push through a mechanism to support RES-H in the UK, and this has continued to be the case in some of the documents prepared to discuss options for support of RES-H through 2007 and into 2008, though the debate seems to have shifted in the last year.

Historically then the provision of financial and other support for renewable energy sources has been strongly influenced by a political preference for mechanisms which apply competition, with the belief that this will enable the deployment of new renewable energy capacity and the meeting of targets for deployment to be met at minimum cost to the consumer. The market based quota seemed likely to be the one that would prevail in the debate over the best way to support RES-H in the UK, with various variations on a quota mechanism proposed from 2005 onwards in the UK, and it is seemingly only in the period from 2008 onwards that the evidence for the benefits of a tariff-style Renewable Heat Incentive (RHI) seemed to become persuasive to key policy makers, and saw its somewhat surprise adoption as the key financial mechanism to support RES-H in the UK.

5.2 Historical and current policy instruments for the support of RES-H in the UK

The UK is in the process of creating a RES-H support policy, and despite some rapid forward movement it is still accurate to suggest there is currently no overarching policy for driving forward the deployment of RES-H. What policy initiatives there have been relevant to the sector have been small-scale and have tended to be technology specific. These policies have begun to be introduced since 2000 and include (IEA, 2007):

- Community Energy Programme (grant, biomass, 2001-2007)
- Bio-energy Capital Grants Scheme (grants, biomass, 2002-)
- Community Renewables Initiative (small-scale, limited funds, 2002-2007)
- Clear Skies Initiative (grants, biomass & solar, 2003-2006)
- Biomass Heat Acceleration Project (biomass heat, 2005-)
- Bioenergy Infrastructure Scheme (wood and straw supply chain, 2005-8)
- Low Carbon Buildings Programme (replaced Clear Skies), (grants, small scale RE inc. RES-H., oversubscribed, 2006-)
- Climate Change Programme Review (biomass, grants)

This section will describe these instruments in order to clarify the extent of their aims and their success in achieving them. A number of other policies have been introduced which, although not primarily aimed at supporting RES-H have provided some incentivisation for the adoption of RES-H. These include the EU Emissions Trading Scheme, the Climate Change Levy, the Renewables Obligation and the Carbon Reduction Commitment (BERR/NERA, 2008). Other policies exist for which some RES-H technologies may be eligible but for which they are unlikely to receive support in reality. Additionally, some funding has been available through organisations such as the Carbon Trust, though this organisation has a general goal of supporting technologies with potential for carbon reduction and this has meant little attention for RES-H.

The **Community Energy Programme** was initiated in 2001 with the stated aims of promoting schemes to provide heat and/or power to various buildings from the same source and to refurbish obsolete infrastructure and equipment. It expired in 2007. It primarily provided fiscal support in the form of grants for the establishment of district heating in the public sector, though not specifically with the aim of having heating needs met from renewable sources. As noted previously, district heating does not form a significant part of heat provision in the UK so this does represent an effort to initiate change in a new direction. The Programme did also support increased use of biomass for heating purposes, with 16% of available funds going to finance biomass projects. A total of €75M was provided over the six years of the Programme's run, up to its expiry in 2007 on the grounds that funds could be applied to support greater take up of biomass as an energy source more efficiently elsewhere. The programme was funded by the Treasury.

The **Bio-Energy Capital Grants Scheme** was introduced in 2002, also offering grants to support the more efficient use of biomass as a fuel for heating in the commercial, industrial and domestic sectors. The ongoing scheme has seen five funding rounds, and as of 2009, the fifth round[6] provided £12M (€14M) specifically for supporting development of bioenergy exploitation for heating purposes. The five rounds of the scheme have funded projects including the construction of a 44MW wood-fuelled power station in Scotland, a 30MW biomass power plant on north east England, a 2.7MW power / 10MW heat biomass CHP in Northern Ireland, various pellet production projects and more than 100 biomass-fuelled boilers. The programme was initially supported by the Department of Trade and Industry (DTI) alongside the National Lottery's 'Big Opportunity Fund', the second round by the latter only, and the third by the Department for the Environment, Food and Rural Affairs (DEFRA). This round also saw the introduction of competition with grant applicants making obligatory bids, aiming to drive applicants to request the lowest possible fraction of total capital costs in the form of the Scheme's grants. Individual grants were available in the range €37,500-€1.5M from a total available fund of €66M. An additional €3M was made available to support further development of biomass based heating systems from 2006 as part of the UK Government's response to a report on biomass usage by the Biomass Task Force. The Bio-energy Capital Grants Scheme is part of the UK's Environmental Transformation Fund (ETF) which has the goals of advancing demonstration and deployment of low carbon energy sources.

The **Community Renewables Initiative** (CRI) was initially funded to operate from 2002 to 2006 and was introduced essentially as an information programme aiming to drive greater interest and participation in the formation of partnerships at the community level. Support was limited to €3M over the first four years, ranging across the various electrical and heat based renewable sources. Additional funding was secured to extend the initiative into 2007.

[6] Available in England only

The **Clear Skies Initiative** was introduced in 2003, offering grants and acting to provide information to drive greater household and community interest and involvement in renewable energy projects across a range of technologies, including solar thermal and biomass applications. Funds were made available until 2008 though the initiative was effectively superseded by the Low Carbon Building Programme from April 2006. The Clear Skies Initiative made available grants of €750-€7,500 for installation of domestic systems, while community organisations were eligible for grants up to €150,000 for installation.

The Carbon Trust instigated the **Biomass Heat Acceleration Project**[7] in 2005, supported with €7.5M over a five year period of operation, it aims to work with the developers of new and existing biomass generating stations and the key stakeholders of their supply chains and to identify and promulgate best practice. The aim of the Carbon Trust is to be able to establish benchmarks for performance and to identify opportunities for cost reductions in existing and future projects.

The **Bio-Energy Infrastructure Scheme** was funded for the period 2005-2008 as an additional mechanism to stimulate the development of supply chains and markets relevant to the increased use of wood and straw and fuel stuffs. Overseen by DEFRA and with a total budget of €5.25M for its initial three year period of operation, this has been extended to a second round, providing a further £3.5 million over the period 2008-2011. The scheme extends to cover the whole supply chain with support available for elements including harvesting, storage, processing and supply to generating sites the scheme makes funds available to support different elements of the sector, providing different rates to support different elements of the supply chain for biomass producers. Businesses can access 35% of costs associated with training staff and up to 100% for purchase of specialist equipment with a maximum grant of £200,000. (DEFRA 2008a)

The **Low Carbon Buildings Programme** (LCBP) was introduced from April 2006 as replacement for the Clear Skies Initiative and other renewable energy support schemes. Managed by the Carbon Trust in conjunction with the DTI its stated aims include provision of a more holistic approach to reducing carbon emissions from buildings, to assist in the wider demonstration of microgeneration and to assess ongoing cost changes in microgeneration technologies and to raise awareness of the potential for the use of microgeneration in buildings. The first phase of the LCBP was intended to run for three years with £30M of funding, split into two funding streams, the first

7 See http://www.carbontrust.co.uk/technology/technologyaccelerator/biomass.htm for further information

stream supporting householders and community organisations, the second stream supporting medium and large microgeneration projects by public bodies, and 'not for profit' and commercial organisations. The LCBP made grants available at different rates for different technologies, expressed as a fraction of the total capital costs, and with different limits dependent on the stream. In regard of domestic installation, support was available for solar thermal hot water systems and ground source heat pumps at up to 30% of capital costs, but with a limit of €600 for solar water heating and of €1,800 for ground source heat pumps. Wood pellet heaters were supported with grants of up to 20% of costs with a limit of €900 while wood-fired boiler systems were eligible for up to €2,250 with a 30% limit. Total available funding for phase 2 saw £12M go to microgeneration technologies other than solar photovoltaic panels. In the second stream, support for larger projects was available up to €45,000 with a limit of 50% of capital costs. Funding was only available where the applicant could demonstrate that energy efficiency measures had already been put in place at the site to be supported. The funds which were intended to support three years of installation in the domestic stream were allotted within the first six months, indicating high demand, though it could also be argued that this demonstrates (i) that the grants available per domestic project were set too high and (ii) that the government significantly underestimated demand. An additional £6.2M was made available to bridge the gap until phase 2 could be initiated from January 2007. Funding availability was altered in phase 2 such that funds were available in monthly tranches to try to avoid the problem of early exhaustion of funds. Continued high demand from the domestic sector in the initial months however, saw funds repeatedly depleted in the first hours of each month leading to the temporary suspension of funding after March 2008 but was reopened and is currently available until April 2009 (CHECK this is up to date). Funding for public institutions is available until April 2010. To be eligible for grants consumers had to purchase only approved technology and only from approved 'Framework Suppliers', with approval overseen by the government's Microgeneration Certification Scheme (MCS)[8]. This proved to be somewhat contentious in the earlier stages of the process as poorly directed advertising of the need for approval and of the approval process meant many companies where effectively excluded from the process and thus from the subsidised market.

The **Energy Crops Scheme** was announced in 2007 with the intention of complementing the Bioenergy Capital Grants Scheme via provision of financial support to encourage farmers to grow perennial energy crops.

As already noted, in addition to these instruments aimed specifically at RES-H, there are other instruments which may have implications for delivering RES-H. The Carbon

8 See http://www.microgenerationcertification.org/ for further information.

Trust has been mentioned in a number of places. The Carbon Trust is a private company, limited by guarantee. It was established by the UK Government in 2001 with the aim of acting as a financier of new technology in the environmental sector. The goal of providing support in this way is to allow the Trust to respond to flexibly to opportunities to develop ‘green’ technology. Effectively it is a lender of last resort in support of technologies which offer potential for both financial return and ‘carbon return’. As of March 31st 2007 the Carbon Trust had five subsidiary companies all aimed at enabling development and deployment of low carbon technologies. As well as offering financial support, the Trust has also been given responsibility for oversight of various government backed programmes, such as the Biomass Heat Acceleration Project and the Low Carbon Buildings Programme. This responsibility extends to oversight of the Enhanced Capital Allowances, a programme of tax credits which allow companies to claim 100% of first year tax allowances against taxable profits for specified energy saving technologies. Various RES-H technologies are eligible in this system, including ground source ands air source heat pumps and solar thermal systems.

The **Renewables Obligation** (RO) is the UK’s central mechanism for the financial support of renewable electricity sources. It does not provide any support directly for heat production from renewable sources but since it does support electrical production from biomass, CHP systems are subsidised, with implications for the rate of deployment. Proposed changes to the RO mean that biomass fired CHP will receive higher subsidies than is the case for other forms of renewable electrical generation (BERR/NERA, 2008). Clearly, the application of this form of support for electrical generation using biomass will also drive competition for biomass resource.

The **EU Emissions Trading Scheme**, the **Climate Change Levy** and the **Carbon Reduction Commitment** are additional mechanisms impacting on the UK system which may all produce more attractive conditions for RES-H by making the alternatives more expensive. The Climate Change Levy is a levy on all fossil fuel use by all commercial entities without a specific exemption, applied via gas and electricity consumption. Renewable generation is exempted. A recent document suggests the levy is equivalent to a carbon tax of £10/tonne, but noted that this was not enough to overcome the cost disadvantage of most RES-H systems alone (BERR/NERA, 2008). The Carbon Reduction Commitment is a cap-and-trade mechanism

The **Carbon Emissions Reduction Target (CERT)**, is an obligation on electricity supply companies with over 50,000 customers to reduce the emissions of domestic energy consumers by an amount specified by the UK Government. Effectively the third phase of the **Energy Efficiency Commitment (EEC)** the CERT changed the emphasis from energy reduction to carbon emission reduction, it requires the utilities to invest in energy efficiency and home improvements including microgeneration RES-E and RES-H to achieve an overall lifetime reduction of 154 MtC by 2011. The Government proposed in 2009 that this figure should be raised by 20% to 185 MtC by 2011. Securing the initial target has been estimated to require investment of £2.8billion by the utilities, this will obviously rise if the 20% increase in required emissions comes into force, as looks likely. (DECC 2009a) However it should be noted that in its current form the amended CERT is forecast to support only a few thousand additional microgeneration units including RES-H technologies. (DECC 2009c)

It is apparent that many of these policy instruments focus on the development of biomass as an energy source reflecting that this is the main source of RES-H in the UK, is regarded as being a potentially significant contributor to RES-E generation and is somewhat more complex in regard of the supply chain necessary for its long term development, and thus in need of a wider ranging support framework.

6 Current Status of Renewable Energy Sources of Cooling in the UK

Little consideration has been given to the development of renewable cooling in the UK. There is little record of Government departments having given consideration to the development of policy, even to the extent of developing specific aims or consideration of potential. There are no targets relating to the support of RES-C and no policies specific to their use though it may be possible that some more general policies relating to support of environmental technologies might allow bids relating to RES-C technologies. The general absence of cooling in the debate over renewable energy policy is perhaps typified by the total absence of consideration in the Renewable Energy Strategy Consultation document issued by the UK Government (BERR, 2008b) in September 2008. The concept of renewable cooling has been raised in some other recent publications however. Cooling was mentioned in passing in the 2007 Energy White Paper (DTI, 2007b) and more notably in the Heat Call for Evidence published in January 2008 (BERR, 2008a). It does not appear that any effort has been made to assess the potential for RES-C in the UK or the attendant costs.

There are a few examples of installed projects which have applied RES-C technology in the UK, though these are limited, and it does not appear that any attempt at collating the total amount of capacity has been made; it is likely that this figure is very low however. It does not appear that any work has been carried out to assess the UK potential for the application of RES-C technology into the future.

There are only a handful of significant projects employing RES-C technologies to have been constructed in the UK. On its completion in 2006, the new headquarters of the Gloucester police force claimed the largest geothermal heating and cooling system to be installed in the UK at that point, with a cooling capacity of 860kW and a heating capacity of 640kW. This was improved upon by a new north Kent police building in 2007, claiming a new UK high of 1,3MW of cooling and 0,5MW of heating capacity. Applications on this scale remain the exception rather than the rule however.

7 Ongoing Legislative, Regulatory and Market Changes

Heating

Since 2007 the UK Government has produced or sponsored the production of a number of documents relating to RES-H; this can be linked directly to the EU level agreement to aim for an Europe wide target of 20% renewables by 2020 and the corresponding figure of 15% of UK energy consumption to come from renewables by that year. Little activity took place before the March 2007 agreement between European leaders. The May 2007 Energy White Paper emphasised the need to address energy use for heating as a key element of achieving the 2020 targets and can be seen as a precursor to the production of a number of UK Government documents relating to the future development of renewable heat policy.

Documents published since the White Paper include an assessment of the business case for renewable heat (DEFRA/BERR, 2007a), an assessment of possible mechanisms for supporting the deployment of renewable heat (DEFRA/BERR, 2007b) supported by a qualitative evaluation of the financial instruments in the UK context (BERR/NERA, 2008). The Heat Call for Evidence in January 2008 produced a document aiming to set out an “understanding of the opportunities and prospects for renewable heat and some of the barriers that prevent the greater use of renewable heat” (BERR, 2008a). This was followed by the May 2008 issue of ‘Barriers to Renewable Heat Part 1: Supply Side’, and perhaps most significantly by the inclusion of a heat chapter in the Renewable Energy Strategy Consultation document of June 2008 (BERR 2008b), the overarching document initiating consultation on a wide array of renewable energy policies. The RES Consultation document set a notional target range for renewable heat for 11-14% of all heat demand to be supplied by RES-H by 2020. Since heat demand accounts for almost 50% of both energy use and of carbon emissions this reflects a major element of long term UK goals within the EU. Achieving the 15% by 2020 target would require the 14% figure for heat be achieved along with 10% targets for renewable transport fuels and a target in excess of 30% for renewable electricity. These targets can all be regarded as highly ambitious.

The UK’s Renewable Energy Strategy consultation document represented the initiation of a process to adopt both a central policy instrument to support renewable heat and potentially additional other efforts designed to overcome or remove barriers to the development of increased deployment of renewable heat.

The Renewable Energy Strategy consultation document posited a number of policy measures which could support RES-H, these are;

- financial support for installation (grants, soft loans)
- A ‘bonus’ or ‘incentive’ paid to all RES-H generators per unit of energy generated, effectively a form of support not dissimilar to a feed-in tariff but specific to the support of RES-H

- An "obligation requiring that a predetermined share of heat used in the UK is generated from renewable sources" (effectively a quota mechanism, though not a strictly accurate description)
- The use of cap and trade emissions, or some form of energy taxation, on conventional heating sources, thus rendering them comparatively more costly.

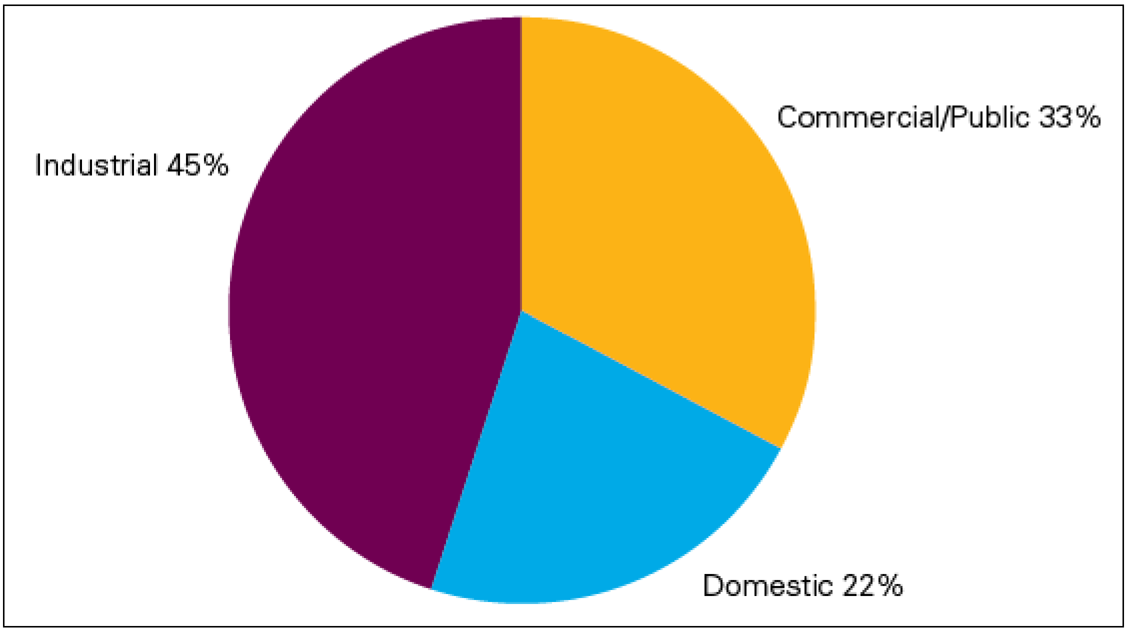
The UK Government then sprang something of a surprise in November of 2008 with the late inclusion in the 2008 Energy Act, among other RE policy initiatives, of a new policy instrument to support RES-H, the Renewable Heat Incentive (RHI). The amendment to the Act laid down the basis of the instrument, effectively that it would offer a fixed price for the generation of renewable heat without going into any further detail as to how it would be applied, what value it would have or any other significant parameters. It placed a legal obligation on the Secretary of Sate with responsibility for the environment to establish how the implementation of the instrument would apply in practice. It is currently expected that the relative complexity of the application of such a mechanism means that it is unlikely to be clear exactly how it will run until at least the latter half of 2010,

July of 2009 saw the release of the Government's Renewable Energy Strategy document based on the earlier consultation (DECC 2009b). The strategy forms one third of the UK's overall strategy on carbon reduction and sets out the Government's intentions to meet the UK's renewable target of 15% by 2020. It cuts down the previously stated 11-14% range for RES-H as a fraction of total heat consumption and sets a UK specific target of 12% of heat to come from RES-H by 2020. The main tool for achieving this was reaffirmed as the RHI with the first phase of the consultation concerning the RHI is scheduled to begin in late 2009. (DECC 2009b) and a projected start date of April 2011 for the instrument to begin to provide financial support.

The RE Strategy document also announced that the Government would be working to remove barriers to the wider deployment of RES-H at both small and large-scale, and to promote their greater uptake. The document suggested the majority of RES-H would be in the areas of biomass, solar thermal, ground source and air source heat pumps and biogas. A number of consultations are currently in process or are scheduled to be undertaken in the near future and these will have implications for the delivery of policy relating to RES-H. Notable among these are the 'Heat and Energy Saving Strategy' consultation which is currently underway.

The Government has drawn up a number of scenarios as to where the increase in RES_H deployment will come from in 2020, the breakdown in the lead scenario employed in the RE Strategy document is shown in Figure X below.

Figure 7: Illustrative sector contributions to renewable heat in 2020 in the lead scenario



Source: DECC 2009b

Cooling

Absent from the RE Strategy document was any commitment to introduce policy instruments to support increased deployment of renewable cooling in the UK. Cooling is mentioned only in passing in the document, though there is some possibility that some form of policy may be considered in the Heat Energy Saving Strategy, another area upon which the UK Government is currently consulting (DEC/CLG 2009). The Government does acknowledge in the RE Strategy document that it will need to introduce guarantees of origin for both RES-H and RES-C in order to comply with its obligations under the 2009 Renewables Directive. (DECC 2009b)

Housing

The UK Government is committed to the introduction of policy to introduce regulations requiring new buildings to meet a standard that it has labelled ‘zero carbon’ and which will apply in the domestic and non-domestic sectors. It is currently undertaking a consultation as to how this might be more precisely defined. The consultation document was issued in December 2008 (DEFRA 2008b), with responses collated in July 2009. The consultation document proposes a number of different ways in which a new building might qualify as Zero Carbon and some of these allow for the installation of microgeneration RES. The use of biomass CHP, biomass heat, solar hot water heating systems and ground source heat pumps are specifically named as technologies which might be applied in combination with high levels of energy efficiency in order to achieve the zero carbon rating. The introduction of this standard may have implications for the levels of demand for RES-H technologies in both domestic and non-domestic new build, though this will be dependent on the final definition issued by the Government, the particular interface of each technology with a highly efficient building both from a technical and economic perspective.

8 Conclusion

The UK, as with most other EU Member States, has done little beyond the small-scale application of grants to support the development of RES-H or RES-C. The EU wide adoption of a 20% target for renewables by 2020, and the UK's own 15% target seems to have driven the realisation at the level of the UK Government that this will only be possible with the large-scale penetration of RES-H alongside RES-E and renewable transport options. This has led to the initiation of a process to identify both policy options for support of RES-H, and to identify what other initiatives might facilitate the regulatory, societal and other changes which will make high levels of penetration possible.

The legal adoption of a bonus mechanism, known as the Renewable Heat Incentive (RHI) for the support of RES-H in the 2008 Energy Act represents a significant break with the UK's historical preference for competition based mechanisms, though as noted above, the operational details of the mechanism are likely to be announced at some time in late 2010 or in 2011 and thus it is not yet clear how some of the problems apparent in this application will be dealt with. It has previously been suggested that a bonus mechanism following the lines of those applied to support RES-E in many EU Member States would not be appropriate to support small-scale RES-H delivery. The RES-E tariff typically sees a fixed sum paid per unit of energy generated. Applying this to heat will imply more complexity and the Government is aware of this and expected to investigate how his might be addressed in that time. The generic problems of applying a bonus mechanism to RES-H have been outlined elsewhere as part of the 'RES-H Policy" project (Connor, Bürger et al 2009) Particular issues likely to be relevant may include:

- Minimisation of the costs of efficiently providing large volumes of subsidy to large numbers of small scale generators, this links to;
- the basis for any process of consolidation of generated output to minimise costs and at the same time to ensure accurate linking of generator output to subsidy availability
- the application of standards to try to ensure subsidy does not lead to installation of low quality equipment. It can be assumed that this will link into the provisions for standardisation relating to micro-generation in the current draft of the new renewables directive

The 2009 Renewable Energy Strategy document makes it clear that the Government will be taking additional action to identify and address any further barriers to the expanded deployment of RES-H, though it has not fully clarified what all of these barriers might be or lay down specific strategies for dealing with them as yet. Obvious barriers such as issues relating to planning consent are unlikely to be easily dealt with. The RE Strategy document lays down an extended list of the consultations, associated publications and other steps it will be taking in the policy development process in the coming years. This whole process of developing RES-H policy may prove to be a slow one, given the hugely ambitious target and the rapid expansion needed to reach it.

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