A FINAL REPORT BY ENVIROS CONSULTING LIMITED:
SEPTEMBER 2008

BERR

BARRIERS TO RENEWABLE HEAT: EXECUTIVE SUMMARY

Publication title	Barriers to Renewable Heat
CAN	DE1510001
Volume number	Volume 1 of 4
Version	ExecutiveSummaryv1_0
Date	September 2008
File Reference	Executivesummary_V1_0.Doc

Prepared under the management of:

Caroline Doble – Project Manager

Directed, reviewed and approved by:

Mike Bullard – Project Director

Client Address:

BERR
Bay 294
1 Victoria Street
London
SW1H 0ET

Susie Gilbert

Tel 020 7215 5302
Email susie.gilbert@berr.gsi.gov.uk

Enviros Contact Details:

Enviros Consulting Limited
20-23 Greville Street
London
EC1N 8SS

Caroline Doble, Consulting Group Manager

Tel 0207 421 6361
Fax 0207 430 2210
Email caroline.doble@enviros.com

Web www.enviros.com
A Carillion plc company

LIST OF ACRONYMS

AD	Anaerobic Digestion
ASHP	Air Source Heat Pump
BAU	Business As Usual
CHP	Combined Heat and Power
DH	District Heating
GSHP	Ground Source Heat Pump
LA	Local Authority
LFG	Landfill Gas

EXECUTIVE SUMMARY

The Department for Business, Enterprise and Regulatory Reform (BERR) commissioned Enviros Consulting and NERA Consulting to answer the question 'how much renewable heat could be delivered in 2010, 2015 and 2020 under different assumptions on barriers, and at what cost, assuming that financial subsidies are not a barrier?'

The project was conducted in two parts. Part 1 identified and quantified the barriers to the supply of renewable heat in the UK. Part 2 focused on the demand-side and reviewed the barriers from the perspective of heat users. We focussed on the following different categories of renewable heat: biomass, biogas, heat pumps (both ground source and air source) and solar thermal[1].

During the second part of the project we also undertook additional detailed research into the potential for biogas. The findings from Part 1, Part 2 and the biogas research are provided as three separate reports. This executive summary provides an overview of the findings from all three parts of the project.

What is a barrier?

For this project, a barrier is defined as something that prevents the uptake of renewable heat, i.e. a factor that:

- reduces or delays renewable heat capacity being installed; or
- prevents or delays installed capacity running at its optimal output level.

Supply-side barriers are those that prevent a renewable heating system being set up and running how, when and where the customer wants it. In contrast, demand side barriers are those that put a heat user off using renewable heat (either resulting in them using an alternative non-renewable fuel or in deciding not to replace existing heating equipment).

Some issues constitute both supply- and demand-side barriers e.g. planning, which affects a heat user's decision of whether to try biomass heat and which can also delay the completion of a project.

A working assumption for this project is that renewable heat is made cost effective and that financial constraints are overcome. As a result, the barriers identified for this project focus on non-financial issues.

Supply-side barriers identified

Through a review of the literature and based on Enviros' own experience of installing renewable heat projects, we identified a series of barriers to the supply of renewable heat in the UK. We ranked these low, medium or high, based on a series of criteria: the end uses affected; whether a barrier prevents a project going ahead or delays it; whether a barrier stops new capacity being installed or a project from running. 'High' indicates a fundamental barrier to the uptake of renewable heat, either in that it could stop projects going ahead completely or that it affects a large

1 We note that while the last two of these are 'technologies', the first two are collective terms for a range of fuels which can be exploited for heat generation via various technologies. The potential for geothermal is considered small and was excluded from further analysis early in the project (where opportunities for geothermal do exist, we would expect them to be treated consistently with other renewables under any kind of financial incentive).

number of projects/ volume of heat output. The type of barriers identified and their importance varies between different renewable heat categories and may depend on the circumstances of a particular project. Table 1 below provides an overview of the different supply-side barriers that were identified as high for at least one renewable heat category[2].

Table 1 Overview of supply-side barriers identified and ranked as high for one or more renewable heat categories

Demand-side barrier	Biomass	Biogas	Solar thermal	GSHP	ASHP
Lack of trained personnel: (e.g. engineers and plumbers). The installation and maintenance of new renewable heat plants requires skilled personnel. If there is an insufficient number of trained personnel this will prevent and delay renewable heat uptake.	**H**	M	**H**	**H**	M
Difficulty of retrofit: It may not be as straightforward to fit renewables in existing buildings as it is to fit conventional alternatives. This may both be due to the requirements for the heating system or down to practical considerations (like a lack of space).	M	M	**H**	**H**	M
Availability of reliable fuel supply: Supply-side barriers here include whether or not access to a fuel resource is guaranteed and secondly whether the fuel handling infrastructure is in place to provide that fuel when, where and how the customer needs it.	**H**	**H**	-	M**	-
Lack of awareness/ knowledge: The supply chain may not be fully aware of the potential for renewable heat or of its suitability to particular circumstances. A lack of awareness may result in a lack of R&D and a lack of active players in the market. As a result, end-users may not be able to find the help that they need as easily as they can for conventional heating.	M	**H**	-	-	**H**
Complexity of technology: Where a technology is more complex to install than the conventional heat-only alternative (e.g. in the case of combined heat and power, CHP) this may increase the commissioning times and level of effort required, so making suppliers more reluctant to recommend renewables over other alternatives.	M/**H***	M	M	-	-
District heating (DH) infrastructure: The installation of DH systems requires significant changes to infrastructure which may take a number of years. The size of the pipes used in district heating may restrict their application in very high density areas. Retrospective installation is exceptionally expensive and disruptive.	**H**	**H**	-	-	-

2 A full list of the barriers identified on each of the supply and demand sides is provided in the Part 1 and Part 2 reports respectively.

Demand-side barrier	Biomass	Biogas	Solar thermal	GSHP	ASHP
Air quality: The burning of biomass can raise air quality concerns which impact in two ways (i) biomass boilers may be required to meet stringent emissions standards (affecting fuel and technology choice) and (ii) their use may not be possible at all if it would take air quality standards beyond limits specified in the Clean Air Act.	H	-	-	-	-

Notes: '**H**' High, 'M' Medium, 'L' Low, '-' does not affect category (see paragraph above table for basis of ranking). *For biomass combined heat and power (CHP) in particular. **In terms of access to aquifers.

Demand-side barriers identified

In the second part of the project, we identified and characterised the different barriers from the perspective of heat users. The barriers identified below are drawn from information collated via a literature review, including work by Element Energy on the domestic sector[3], and a small number of telephone interviews[4]. We ranked these barriers using the same criteria established for the supply side. The table below summarises those barriers that were identified as high for one or more renewable heat category. In contrast to the supply side, where some of the barriers that are important for one type of renewable heat are not relevant at all for (some) other categories, the issues on the demand side tend to be common across technologies, although the extent of their impact varies.

Table 2 Overview of demand-side barriers identified and ranked as high for one or more renewable heat categories

Demand-side barrier	Biomass	Biogas	Solar thermal	GSHP	ASHP
Inertia: End users are reluctant to move from a method of heating that they are familiar with. This can be due to concerns around whether the quality of heat supplied will be maintained or due to uncertainty around the costs & practicalities of the alternative options.	H	H	H	H	H
Awareness of renewable heat: There is a lack of awareness of the opportunity to use renewable heat and of its potential benefits amongst end-users, policy makers and installers. If end users are not aware that a technology exists, or that that technology could service their needs, they will not consider installing it.	H	H	H	H	H

3 TNS UK, 2007, The growth potential of microgeneration. Report on qualitative research.

4 In order to supplement the published information and to corroborate the barriers identified, we conducted a short telephone survey. In total 19 respondents were interviewed including users from the commercial, industrial and public sectors. Further details of the organisations contacted are provided in the Part 2 report.

Demand-side barrier	Biomass	Biogas	Solar thermal	GSHP	ASHP
Difficulty of retrofit: It is typically more straightforward to install renewable heat in a new building or alongside significant refurbishment. The disruption that retrofitting renewable heat can cause to the existing heating system and the site around it is a barrier to end users deciding to switch to renewables.	**H**	**H**	M/ L	**H**	**H**
Hassle factor: Extra time and effort is often required to use a non-conventional heating system or to switch systems. This additional 'hassle' results from a range of activities, including search, options appraisal, installation and operation. The perception that a renewable heat project may be more resource intensive may put users off choosing it.	**H**	**H**	M	**H**	L
Consumer confidence: In some instances, there is a lack of confidence in renewable heat technologies and in the commercial infrastructure to develop such projects. This is in part due to a small number of successful projects operating in UK and concerns around supply-side constraints. This can make users reluctant to choose renewables.	**H**	**H**	L	M	M
Lack of skilled personnel: Heat users want to be sure that there is a sufficiently well developed skills base that they will be able to obtain help as and when they need it. This could be either upfront, to help choose and install renewable heat, and later once the project is operational. This is particularly important where users do not have experience of renewables themselves and so are reliant on outside help.	**H**	M	**H**	M	M
Resource constraints (fuel supply/ appropriate sites): The feasibility and cost effectiveness of a renewable heat project will vary depending on a range of factors, including the nature of heat demand and the supporting infrastructure at the site. Heat users may not be keen to install renewables if there are resource constraints e.g. if they do not have ready access to fuel or if they do not have adequate space to accommodate the technology.	**H**	M*	L	M	M
Planning: The planning process can both prevent and delay renewable heat projects. End users may be reluctant to engage in a project that will involve planning applications, particularly if they do not have past experience of successful submissions. This is one of the factors that can make a heat user less likely to choose renewables over conventional alternatives.	**H**	M**	L	L	M

Notes: '**H**' High, 'M' Medium, 'L' Low (see paragraph above table for basis of ranking). *Affects Anaerobic digestion (AD). **Affects AD and landfill gas (LFG).

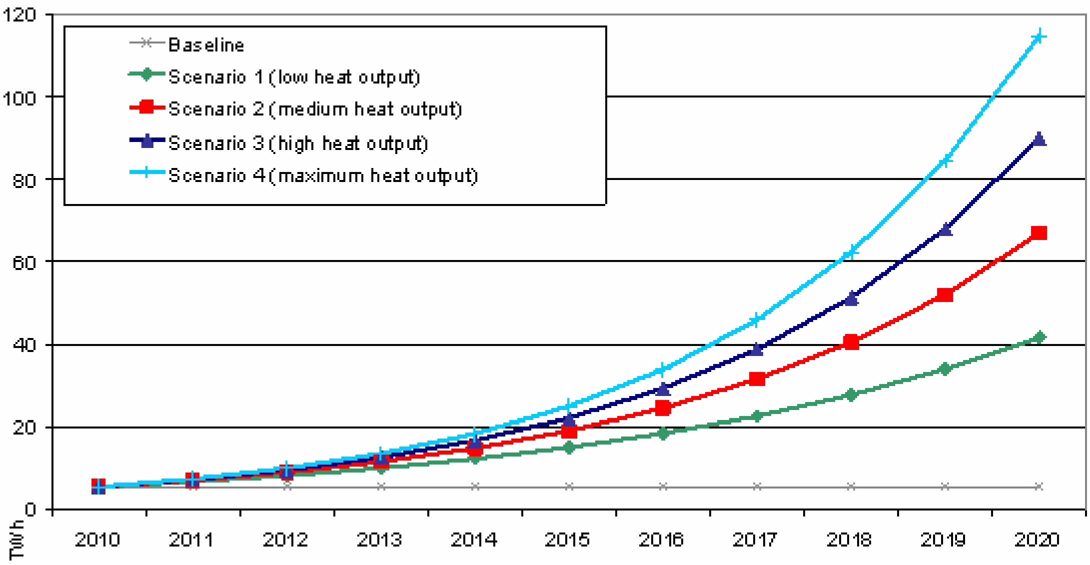
Given these barriers, how much renewable heat could there be in future?

As the starting point for this project we used information from BERR for the baseline, business as usual (BAU), projection of heat output. This assumes that renewable heat remains constant at 5TWh per year until 2020. We have then used three different scenarios for increased renewable heat uptake, based on assumptions for renewable heat output in 2020 also provided by BERR. They are:

- Scenario 1: 6.5% of final energy demand for heat from renewables;
- Scenario 2: 10.5% of final energy demand for heat from renewables; and
- Scenario 3: 14.1% of final energy demand for heat from renewables.

All three of these scenarios require a considerable increase in renewable heat output on baseline levels (illustrated in Figure 1 below[5]). One of the fundamental assumptions underlying these projections is that renewable heat is made cost effective and that financial barriers are overcome (as noted above, this is a working assumption throughout this project). We have considered which of the barriers identified above would need to be overcome to deliver each output scenario and quantified the costs of doing so.

Figure 1 Renewable heat scenarios



Source: BERR data manipulated by Enviros

BERR also requested that Enviros consider whether it would be possible to achieve levels of renewable heat output beyond those defined by the most challenging scenario (Scenario 3). We therefore constructed a fourth scenario (also shown in the chart above), which represents Enviros' view of the maximum potential for renewable heat output. The resulting range of heat output in the four scenarios widens over time, from 15TWh to 25TWh in 2015 as compared to from 42TWh to 115TWh in 2020.

What types of renewables would deliver that heat output?

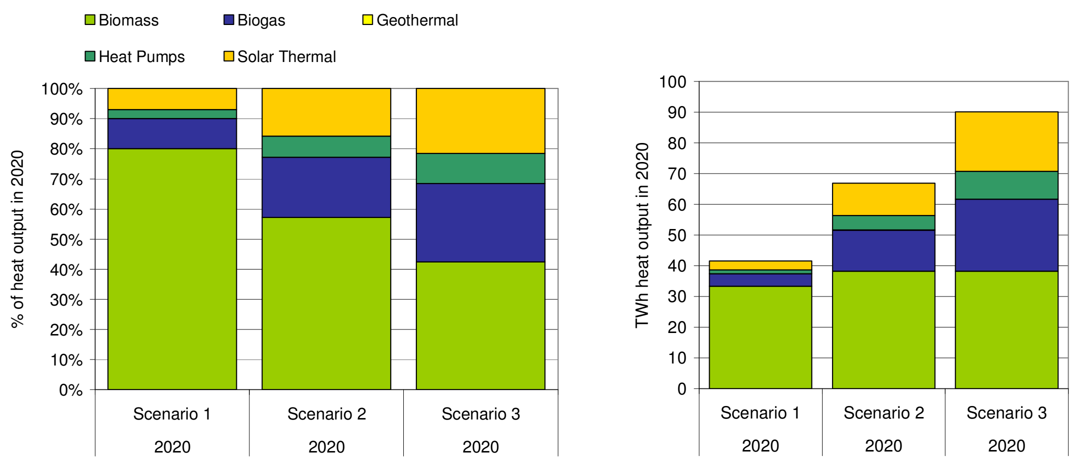
In order to develop projections of how these levels of heat output could be met, output projections for each category of renewables were first analysed bottom-up,

5 In developing the heat output profile to 2020, we have assumed that it would not be possible to implement and see the benefits of any new policies to deliver increased renewable output before 2010. This is due to the time necessary to design and implement any policy support and to the resulting time lag to develop projects or to implement the changes to existing projects that would result from that support.

based on our view of likely growth rates for each technology once different barriers have been overcome. For biomass and biogas, the availability of fuels and feed-stocks was also taken into account[6]. These projections were then sense checked against the total volume of heat projected from the other technologies, to ensure that the total level of heat demand expected under the scenario was met and also that the relative contribution of different technologies appeared appropriate given the scenario assumptions.

The resulting projections for renewable heat output by category of renewables are shown in the figure below. It shows that in all scenarios, the majority of renewable heat comes from biomass, followed by biogas, solar thermal and heat pumps (a combination of ground and air source).

Figure 2 Output mix in 2020



Source: BERR and Enviros.

Role of biogas

Biogas feedstock is available from the anaerobic digestion of wastes and energy crops, sewage treatment and landfill gas. There is a range of ways that this can be exploited to produce renewable energy, including for electricity- or heat-only generation and for combined heat and power. This energy generated can be used on-site if the biogas feedstock is co-located with energy consumption, or distributed for use off-site, e.g. using district heating.

At the request of BERR, we researched the potential role of biogas in particular detail during the second part of this project. We considered whether alternative exploitation options, such as the upgrade of biogas to bio-methane for injection into the gas grid and distributing the heat using hot water pipes, could be beneficial. The analysis took into account the technical feasibility of the options, their cost and the amount of additional renewable heat that they might deliver.

The level of biogas use illustrated in Scenario 3 above represents our view of the maximum potential heat output from biogas by 2020. It is built on extremely strong

6 Biomass: for the purposes of this project it is assumed that a total of total fuel input for biomass does not exceed 44TWh (158PJ) biomass fuel available for heat generation. In addition to considering the availability of biomass fuels, we also considered the available infrastructure to deliver these to users. Biogas: in the second part of this project we undertook a detailed review of the availability of biogas in the UK. Our findings are summarised later in this document and are detailed in the separate biogas report.

assumptions for the level of feedstock available for renewable heat including: 100% of sewage arisings; a gradual shift from CHP to heat use for landfill gas; approximately one third of theoretical food waste arisings; and energy crops grown on 157,000ha of land. The analysis concluded that although different exploitation routes could deliver an increased level of heat output, this would be at the expense of a reduction in the amount of electricity generated (and so would result in an increase in carbon emissions)[7].

What types of customer would use that heat?

In developing these projections, we also considered the types of heat users (industrial, commercial, public or domestic) that would consume the renewable heat. In the first part of this project, we drew on current information about the relative uptake of different technologies amongst different types of end users and assumed that these shares remain constant over time.

This is a simplifying assumption. The nature of heat demand varies considerably between end-users for a wide range of reasons[8]. In addition, different end users have different levels of willingness to switch to renewables i.e. they are affected by barriers like a lack of interest and inertia to differing degrees. These considerations affect the feasibility of substituting fossil fuels with renewables in particular user groups.

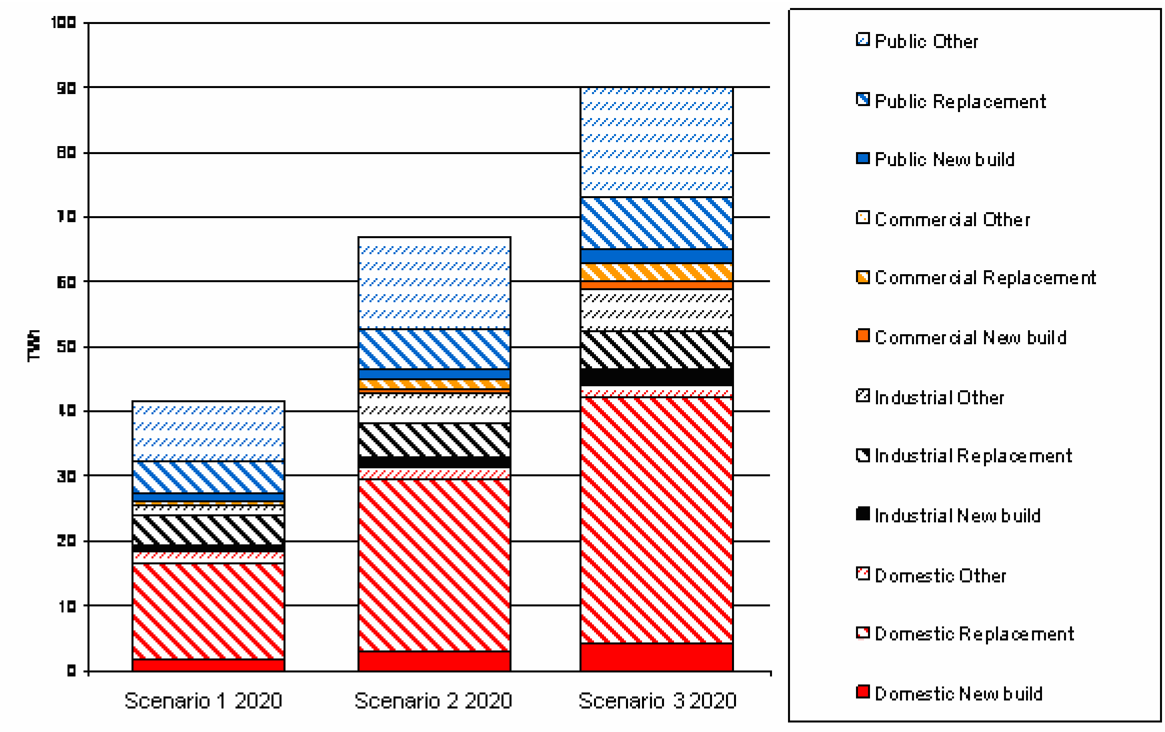
We therefore reviewed the scenarios that resulted in the second part of this project which focussed on the demand-side. We took as a starting point that the most straightforward segments to target would be new build and replacement, since the barriers to uptake are lowest where a new heating system needs to be installed[9]. We then compared the levels of uptake that the scenarios developed in Part 1 would require against the rate of new build/ replacement and where other types of site would need to install renewables to meet the targets. The results of this analysis are shown in shown in Figure 3 below.

7 Our assumption under Scenario 3 is that the biogas feedstock is used for CHP and district heating. The most feasible and cost effective alternative identified was that the biogas is used for direct industrial use or gas grid injection instead. If this were the case, heat output could increase from 23.4TWh in Scenario 3 to 27.8TWh by 2020, an increase of 4.4 TWh (19%). This would result in a decrease in renewable electricity generation of 2.6TWh. Assuming an electricity emissions factor of 0.43kgCO2/kWh, this results in a reduced the carbon benefit of around 292ktCO2/yr by 2020.

8 e.g. heat use, building size, building type, building age.

9 It may also be possible to target these users via property developers and (private or public sector) landlords rather than at the individual user level.

Figure 3 Heat consumption by end user group



In particular, we note that:

- The projections rely on a relatively high level of uptake of renewable heat amongst new build/ replacement installations, substantially higher than we see today. In our view this would be achievable driven by a gradual rate of increase over ten years; however, a step change from current levels over a shorter time frame may not be possible (or at least, may be more costly to achieve).

- The scenarios developed require a larger proportion of heat demand in the public sector to be serviced by renewables than is the case for the other sectors (domestic, commercial and industrial). There are arguments in favour of this e.g. if the public sector is expected to play an exemplary role. However, based on our analysis, a stronger argument might be that (some of) the demand attributed to these users might come from a different source. Other sources could include social housing (classified as 'domestic' rather than 'public' in the demand analysis).

Actions to overcome the barriers

Delivering the levels of heat output described in the scenarios above requires that renewables are cost effective and that (some of) the supply- and demand-side barriers to renewable heat are overcome. The sooner the barriers are overcome, the greater the likelihood that these target levels of heat output be achieved. The actions that the scenarios assume are addressed are summarised below.

- Ensuring that renewable heat, including retrofit installations (which may require additional time, effort or more complicated systems), are cost effective.

- Additional fuel handling capacity for biomass to alleviate supply infrastructure bottlenecks.

- Increasing the number qualified personnel able to install and operate renewable heat. This would involve training e.g. for installers of biomass, solar heating engineers and bore hole engineers (for GSHP).
- For all types of user, additional resources (time or money) to compensate for the added 'hassle' of fitting renewables (for search, options appraisal, installation and operation) as compared to the fossil fuel alternative.
- Marketing campaigns targeted at the domestic and non-domestic (i.e. industry, commercial and public) sectors. Their purpose would be to raise awareness of, and increase confidence in, renewable heat options for the domestic sector.
- For the domestic sector, providing examples of different types of renewable heat in practice e.g. by setting up exemplar households that can be visited, to demonstrate renewables in practice in the domestic sector.
- Training and awareness raising for planning officers to ensure that biomass air quality issues are dealt with appropriately.
- For the domestic sector, help with the planning process e.g. through the provision and dissemination of exemplar planning guidance documentation and a telephone helpline to help achieve successful applications.
- For the non-domestic sector, planning assistance in the form of expert support to bring experience of similar projects and a thorough understanding of the process to bear.
- Support to maximise the potential for biogas, including towards the costs of biogas plant upgrades and the development of the heat distribution infrastructure.
- If the higher level of uptake of biogas seen in Scenario 3 is required, awareness raising about the supply and demand side around the potential for energy crops.
- Awareness raising around the potential for district heating e.g. a website and public sector training for its application.

There is already a considerable amount of activity underway in some of these areas. These actions should build on the work of bodies like the Carbon Trust, Energy Savings Trust and the Regional Development Agencies.

Costs of overcoming the barriers

We have estimated the cost of overcoming both the supply- and demand-side barriers in order to deliver the levels of heat required under the different scenarios. To do this we have built on published data where possible but in many instances it has been necessary to make an estimate based on market intelligence and Enviros experience.

The tables below summarise the estimated costs incurred between 2010 and 2020 to overcome different types of barrier[10].

10 Discounted back to 2008 money using a discount rate of 3.5%. Tables sum the cost stream from 2010 to 2015.

Table 3 Overview of costs to overcome barriers

Supply side **Barrier overcome**	**Scenario 1** **£m**	**Scenario 2** **£m**	**Scenario 3** **£m**
Fuel supply (Biomass)	25.2	29.7	30.0
Lack of skilled installers (Biomass)	20.7	25.6	23.5
Air quality (Biomass)	2.5	4.2	6.5
Lack of solar engineers (Solar Thermal)	5.7	40.4	90.4
Lack of heating engineers (Solar Thermal)	0.0	66.2	238.6
Lack of solar design engineers (Solar Thermal)	0.0	0.1	0.1
Costs to retrofit solar (Solar Thermal)	232.0	1,806.7	5,433.1
Lack of borehole drillers for GSHP (Heat Pumps)	0.4	2.2	4.6
Lack of GSHP design engineers (Heat Pumps)	0.0	0.2	0.5
Costs to retrofit GSHP (Heat Pumps)	23.6	85.7	505.5
Cost for ASHP awareness raising (Heat Pumps)	0.2	0.2	0.2
Cost of upgrading and distributing heat from LFG plant	0.0	802.7	3,656.2
Cost of upgrading and distributing heat from sewage gas plant	80.5	279.2	603.8
Incentive to use energy crops (Biogas)	0.0	0.0	54.5
All supply side barriers	**391.0**	**3,142.9**	**10,647.3**

Demand side **Barrier overcome**	**Scenario 1** **£m**	**Scenario 2** **£m**	**Scenario 3** **£m**
Awareness & confidence: marketing campaign	30.0	49.9	62.0
Awareness & confidence: exemplar installations	0.0	7.0	23.3
Awareness & confidence: marketing campaign	13.8	22.9	28.5
Planning: helpline to provide guidance	1.4	2.7	3.1
Planning: guidance (example planning applications)	0.3	0.4	0.5
Planning: expert support	104.7	796.0	2970.2
Hassle factor: time cost for search	271.9	941.6	1686.7
Hassle factor: time cost for installation	194.8	643.8	1140.6
Hassle factor: time cost for operation	0.0	289.6	630.3
Hassle factor: time cost for search	348.7	1325.1	2472.1
Hassle factor: time cost for installation	139.8	530.5	989.3
Hassle factor: time cost for operation	0.0	7.9	17.1
District heating: website and public sector training	0.0	0.0	0.5
All demand side barriers	**1105.4**	**4617.4**	**10024.3**

For details of cost calculations refer to the demand and supply reports that accompany this document.

Uncertainties around the cost estimates

The cost estimates provided above depend on the assumptions made, particularly on the assumptions around: the levels of heat output achieved (and the number of units/ users it is assumed are required to deliver that output); the actions identified to overcome the barriers; and the effectiveness of those actions.

We have not undertaken any statistical analysis to establish where within the range of possible outcomes these cost estimates fall. However, in our view, they are likely to be on the low side. For instance, we assume that new installers work on the technologies for which they have trained 100% of the time. In fact, it is possible that they only work on a particular technology for a proportion of the time and therefore a larger number of individuals would require training to deliver the capacity required.

In addition, we have not explicitly quantified costs to overcome 'behavioural' barriers (e.g. inertia or a lack of interest) that could leave end users reluctant to invest in renewable heat even if it is the more cost effective option. This is because we have assumed that in these scenarios this barrier is addressed by targeting the 'best' end-users first[11].

This is not to understate the importance of behaviour on the uptake of renewable heat. It may be that even in the face of more complete information, a cost effective project and other non-financial benefits that accrue to using renewable heat[12] an end user still chooses not to invest in renewables. This type of behaviour has been witnessed around the uptake of energy efficiency measures, for instance. The potential for this impact has been taken into account to some extent in the analysis by assuming that even in the 'best' sectors 100% penetration would not be achieved. However, one of the uncertainties around this analysis is the extent to which end-users can be relied on to make the decision an appraisal of the costs and benefits considered for this project leads us to expect. With this in mind, different uptake rates have been applied to different demand segments.

It is also important to note the inherent uncertainty in assessing the impact that any policy could have. An additional risk to the delivery of the types of support described here is that the environment in which heat users are making decisions changes over time. These changes could affect the nature and cost of the renewable heat options available, the characteristics of an end-user's heat demand and so the impact that different barriers have on uptake. In some instances these factors may work together to make renewable heat a more attractive option, but in others the impact may be to slow or even prevent uptake.

We would also emphasise that all of the analysis in this project relies on the premise that renewable heat is made cost effective via some kind of financial incentive. This is a strong assumption which underpins the analysis and is essential if the increased levels of uptake required are to be delivered. We are of the view that for any of the output levels described by the scenarios to be delivered in 2020 it is necessary for there also to be some long term market signal in place i.e. binding targets for renewable heat (rather than just for renewable energy).

11 i.e. those with the greatest propensity to use renewable heat and those whose demand needs are optimally met by renewable heat

12 e.g. for organisations there are potentially benefits in terms of corporate social responsibility (CSR) benefits, carbon footprint reductions (which can help regulatory compliance e.g. with emissions trading schemes) and stakeholder engagement (i.e. with consumers, customers, staff and investors).