A member of
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Jaakko Pöyry Group

POSSIBLE SUPPORT MECHANISMS FOR BIOMASS-GENERATED HEAT

A scoping study for DEFRA

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EXECUTIVE SUMMARY

On paper, there appears to be the potential to meet a significant proportion of the UK's energy requirements from bioenergy – the combustion of plant matter to generate heat and/or power.

To foster the development of this potential, the Government has put in place a number of policy instruments ranging from direct financial aid, through to information programmes. However, to date, the amount of bioenergy development has been disappointing – much less than the Government's expectations.

It is within this context that the Department of Environment, Food and Rural Affairs (DEFRA) has commissioned ILEX to undertake an initial scoping study to examine the issues and options surrounding support mechanisms for the production of heat from biomass sources, also known as bioheat. If significant potential were thought to exist in this area, a further phase of work would then be required to provide more detailed quantitative analysis of feasible options, before more comprehensive proposals could be developed.

The focus of the study is therefore to explore, at a high level:

- whether there is significant potential for the economic use of biomass to supply heat loads;
- what the barriers to the realisation of such potential are; and
- how the Government could address such barriers.

Is there significant potential?

The first part of this study concluded that there was a significant potential for bioheat in the UK. Much of this is already competitive against oil-fired heating, but is largely still uncompetitive against gas. However, if the cost of CO_2 were taken into account, and if the significant cost-reduction potential of both fuel supply and capital equipment were realised as the industry matures, then bioheat would also be cheaper than gas in many cases.

The study revealed many conflicting views as to which biomass resource was cheaper and had greater potential: forestry and agricultural residues, or energy crops. ILEX concluded that both residues and energy crops had a wide spectrum of prices dependent on situation specific conditions. However, the cheapest available resource appeared to be forestry residues. Such a resource, whilst significant, is nonetheless finite. Therefore the most appropriate biomass resource for a particular application will be dependent on the local situation.

What are the barriers to the realisation of such potential?

ILEX identified two main barriers to the realisation of bioheat's potential:

- while bioenergy can be regarded as a mature technology in much of Europe, it is an infant technology in the UK, and currently does not have a critical mass of projects to be self-sustaining in terms of infrastructure, expertise and general public awareness; and
- the price of fossil-fuelled energy generation, and waste disposal, do not currently reflect the 'true' costs to society arising from environmental degradation[1].

What measures could Government undertake to remove such barriers?

To overcome these barriers, the Government needs to tackle the problem on two fronts:

- firstly, the right background conditions need to be created, such that bioheat can develop once the other barriers have been removed; and
- secondly, financial support measures would be needed to:
  - level the playing field when competing against alternative sources of energy and biomass waste disposal routes; and
  - provide support in the short- to medium-term to help the immature industry grow to a critical mass and move down its cost-reduction curve to mature cost levels.

It is ILEX's belief that these measures would need to be implemented together in order to be effective, since each measure on its own is unlikely to be sufficient to overcome the barriers that exist, without the support of the other measures.

The Government is already doing much on both of these fronts. However, there are likely to be opportunities for improvements through better coordination of all the different support elements and better targeting of the support in some areas, as well as introducing new types of support to fill in potential policy gaps.

The specific recommendations that ILEX makes under both of these general headings are as follows:

- Creating the right background conditions for bioheat
  - A series of coordinated measures would need to be undertaken to create the right 'background' conditions for bioheat.

[1] Although the forthcoming EU Emissions Trading Scheme will lead to the development of a carbon price in future, virtually all gas and oil-fired heating installations will fall below the size threshold required for inclusion in the scheme, and hence will not be subject to it.

- Targeted information dissemination
  - It is likely that one of the most cost-effective ways for government to improve the uptake of bioheat would be through a more comprehensive, coordinated and pro-active information and advice programme.
  - Such a program would need to provide information and training, focusing specifically on making key target groups of people (landowners and building managers/specifiers) aware of the potential for biomass.
  - Although it would need central coordination, the local nature of biomass means that local / regional advice centres would be important in such a programme.
- Mobilisation of public authorities
  - Local authorities currently set and implement the planning framework for regions. Their relationship with Regional Development Agencies provides additional opportunities for coordinating economic development with structural planning. As owners of significant amounts of building stock, much of which is suitable for bioheat, there is potential for developing this role further in future.
  - To mobilise this potential resource Government would need to explore practical ways in which building developments that have a significant amount of public involvement could be required to consider bioheat. To further stimulate action, the government could also extend the targets / obligations on public bodies to control their carbon emissions.
  - Both such measures would only work, however, if the relevant decision makers within the public bodies were to be provided with the information and skills to properly assess bioheat. Accordingly, the more extensive information and advice programme outlined previously would play a key part.
- Joined up legislation
  - Bioheat is affected by a great many different pieces of legislation, emanating from a great many government departments and related bodies. To ensure that such legislation does not unduly frustrate the development of bioheat will require close inter-departmental coordination, ideally facilitated by a specific inter-departmental body charged with supporting bioheat's interests.
- Providing financial assistance for bioheat
  - Bioheat is likely to need financial support on two fronts:
    - Research & Development (R&D) and pilot / demonstration funding to help overcome the barriers associated with being an immature technology; and
    - a more commercially oriented financial support regime to overcome barriers associated with environmental costs not being properly reflected in fossil fuel prices and waste disposal options. This support framework could consist of:

  - a major support programme similar to those for electricity in the UK and the continent (e.g. 'feed-in' tariffs, the NFFO, and the Renewables Obligation);
  - reductions in VAT on bioheat capital equipment; and
  - a government-backed loan facility.

None of the above measures are mutually exclusive, and indeed should be regarded as complimentary. If they are properly designed, they should give a more cost-effective return (in terms of MWh of bioheat per £ spent) together, than if they were implemented on there own.

ILEX's specific recommendations for funding are as follows:

- R&D and pilot / demonstration funding
  - There is much good R&D funding. However, much of it is focussed on 'academic' technology issues, and very little on more commercially oriented industrial implementation research.
  - With regards to pilot / demonstration funding, the existing series of measures (bioenergy capital grants, energy crops scheme etc.) largely work well. Without such measures it is ILEX's belief that the future development of bioheat would be largely stifled.
  - However, many individuals within the industry expressed the view that the major programmes are often too prescriptive in the types of bioheat technology they support. In particular:
    - too much money has been specifically set-aside for energy crops compared with that specified for forestry and/or agricultural residues, while some technologies (such as biogas) are specifically excluded; and
    - the capital grants are too geared towards large-scale projects (particularly those with an electricity element).
  - By trying to second-guess what will come forward in this way the government runs the risk of not giving enough to certain technologies, and too much to others (which subsequently will not be called upon).
  - To rectify this potential problem, the government may want to consider making a significant percentage of the available monies available to all bioheat technologies on a first-come, first-served basis. It could still ensure that certain technologies receive some money by reserving a small percentage of the funds for specific technologies.
  - In general, ILEX would recommend that these types of demonstration / pilot funding programmes continue, and they should be complementary to a more significant commercially oriented support regime as outlined below.
- Major commercially oriented support regime
  - Bioheat is sufficiently technologically mature to warrant such a mechanism, and it should be the cornerstone of any set of policy measures to support bioheat. There are a variety of options available for such

support including capital grants, feed-in tariffs, power purchase contract auctions, tax exemptions, and obligations with tradable certificates.

  - Given that all the options would require primary legislation, ILEX recommends that the government focus on the option that appears to be the most effective in terms of delivering significant quantities of renewable energy at least cost. In ILEX's view this would be likely to be some form of obligation mechanism with tradable certificates similar to the existing electricity Renewable Obligation.
  - Because there is no heat market with licensed suppliers on which to place an obligation, using an obligation mechanism to support heat requires enlightened thinking. However, ILEX believes there are no practical barriers to using such a mechanism for the support of bioheat.
  - In brief such an obligation could be placed on gas suppliers (as the main alternative fuel for heating), with potentially additional obligations being placed on heating oil suppliers and electricity suppliers in recognition of the amount of heating their fuels are used to provide.
  - Although such suppliers would have obligations imposed upon them expressed in MWh of gas / electricity / oil supplied, they would purchase obligation certificates from bioheat schemes who are awarded such certificates based on metered MWh of useful heat produced.

- Correcting the VAT imbalance
  - A valuable mechanism could be to reduce the VAT charged on equipment used for bioheat to the same level as the VAT charged on energy consumption. This would give more appropriate price signals in the energy market and lead to a better allocation of resources.
- A government-backed loan facility
  - A specialist, government-backed loan facility specifically for bioenergy (and potentially other renewable technologies) would help overcome a significant barrier in relation to raising finance for bioheat.

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1. INTRODUCTION

1.1 On paper, there appears to be the potential to meet a significant proportion of the UK's energy requirements from bioenergy – the combustion of plant matter to generate heat and/or power.

1.2 To foster the development of this potential, the Government has put in place a number of policy instruments ranging from direct financial aid, through to information programmes. However, to date, the amount of bioenergy development has been disappointing – much less than the Government's expectations.

1.3 The Department of Environment, Food and Rural Affairs (DEFRA), is currently conducting an internal review of the policy instruments for the support of bioenergy with a view to deciding on the type and scale of support to put in place post-2006. As part of this review process, DEFRA has commissioned ILEX to undertake an initial scoping study scoping study to examine the issues and options surrounding support mechanisms for the production of heat from biomass sources, also known as bioheat.

1.4 The focus of the study is therefore to explore, at a high level:

- whether there is significant potential for the economic use of biomass to supply heat loads;
- what the barriers to the realisation of such potential are; and
- how the Government could address such barriers.

1.5 After an initial section of this report that details the main characteristics of bioheat that are pertinent to its development as an energy option, the subsequent three sections address each of the key questions outlined above. The final section of the report draws together all the analysis, and puts forward a set of recommendations for the type of policy support that would be most appropriate for bioheat and how best such measures could be implemented.

1.6 Because bioheat is affected by very many policies from many different government departments, ILEX has examined the policy framework for bioheat in the whole, rather than limit such analysis to policies solely dealing with the 'fuel' side of bioheat.

1.7 This study focuses on the use of biomass to meet heat-only and CHP loads. It does not examine electricity-only generation except to the extent that it impacts on the renewable heat market.

1.8 The study was undertaken through a process of desk research, and extensive interviews with key people in the industry.

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2. KEY CHARACTERISTICS OF BIOMASS-GENERATED HEAT

2.1 The following table indicates the main types of biomass that can be used for bioenergy[2].

Table 1 – Main types of biomass that can be used for bioenergy

Type	Energy Crops		Residues								
Sector	Agricultural		Agricultural			Forestry					
Sub-sector	Arable		Arable	Livestock		Forest by-product		Industry by-product (sawmills, pulp & paper)		Arboricultural arisings	Recycled wood
Biomass	Short-rotation coppicing	Grasses	Straw	Poultry litter	Slurry	Small roundwood	Forest residuals	Sawdust, bark, chips, off-cuts	Black liquor	Timber, branches	Various
Dry / wet	Dry				Wet	Dry			Wet	Dry	
Competing use	Competition for land for arable farming.		Agricultural uses (animal bedding, fertiliser etc.)			Wood panels, pulp, posts	None (Left to rot)	Wood panels, pulp	On-site energy	None (Landfill)	None (Landfill)

2.2 As can be seen, there are a great variety of different potential sources of biomass for bioenergy purposes. It is not the intention of this report to describe in detail the features of these sources and their uses, however, there are a number of characteristics of bioenergy sources and heat applications that have a major bearing on their competitiveness and suitability as a source of energy. Some characteristics are common to all biomass sources and heat applications, whereas others are unique, as discussed below.

Common characteristics of biomass sources

They have low energy and bulk densities;

2.3 Dry biomass typically has an energy density of 20GJ/t. This compares with 27 GJ/t for coal. However, when harvested, biomass typically has a moisture content of 55%, bringing the energy density down to 9 GJ/t.

2.4 In addition, biomass is not very dense with a bulk density of 300 kg/m^3 when dry and 150 kg/m^3 when wet. This compares with 800 kg/m^3 for coal.

2.5 Taken together, this makes biomass extremely bulky per GJ with a value of 1.4 gJ/m^3 when wet, compared with 21.6 GJ/m^3 for coal. This has obvious implications for transporting the material requiring significant (and costly) road

[2] Refuse incineration, sewage sludge and landfill gas, whilst strictly speaking can be regarded as biomass, have been excluded from the remit of this study.

haulage infrastructure. It is possible to dry the material. However, cost-effective drying only brings the moisture content down to 20-35%, giving an energy bulk density of 3.3 GJ/m^3.

2.6 The volume and cost of transport means that bioenergy generally needs to be used in installations close to the fuel source (typically within a 25 to 50 miles radius). For bioenergy from animal slurry this requirement is reinforced by the risks of spreading diseases through transporting slurry to different areas of the country.

2.7 On the positive side, however, this requirement for fuel to be sourced locally means that bioheat has strong positive benefits for the local economy, especially rural economies.

2.8 The bulkiness of biomass also has implications for the amount of land needed for on-site fuel storage at the heat-consuming installation, especially when compared with gas heating. This is particularly an issue for domestic heating.

They almost all have competing non-energy uses for their resource.

2.9 Energy crops must compete with other crops for the land. To a lesser extent, agricultural and forestry residues also have competing uses. The future opportunity value of these competing uses must be taken into account when calculating the economics of bioenergy. This adds additional uncertainty to projects.

They are heterogeneous in many characteristics and potential uses

2.10 This is clearly not a 'common' characteristic. However, it is worth pointing out that a lot of the biomass sources cannot easily be mixed and inter-changed.

2.11 Some of this is inherent due to the characteristic of the fuel, e.g. straw cannot easily be mixed with other fuels; nor can sawdust, and wet fuels cannot be mixed. Some of this is due to the choices that are made for the processing of the fuel. Moisture content is one choice fuel suppliers must make. Typically moisture content is in the region 20-35%, although in some cases it is lower and some as high as 50%. The way in which the fuel is processed also creates mixing 'barriers', e.g. woodchips cannot be mixed with pellets.

2.12 All of this can make it hard for policy makers to focus on the particular issues of each technology. It also creates an increased risk that they will try and pick 'winners' among technology options, whereas each of the different options may be appropriate for particular locations / applications.

Specific characteristics of energy crops

They require commitment to the land for 15-20 years

2.13 When compared with other crops this is a significant commitment on behalf of farmers, especially if they do not have a guaranteed purchaser of such crops at a fixed price.

There is a 3 to 4 year lag between initial planting and harvesting the first crop

2.14 This has major cashflow consequences for farmers, and also needs to be borne in mind when trying to develop the infrastructure and markets for such fuels (i.e. developing harvesting and transport infrastructure, and biomass-fuelled heat installations).

They have very different market characteristics to the other crops farmers could grow

2.15 There are no well-established markets as there are for crops such as wheat. Often this means farmers who want to grow energy crops have to get heavily involved in developing such markets. This can represent a significant financial and time commitment that most farmers are not prepared to make.

2.16 In addition, without concrete examples of successful projects, even the most enthusiastic of farmer may be deterred.

They are produced en-masse, have a 6 month harvest window, and are harder to store and handle than forest residues

2.17 A couple of commentators stated that these characteristics meant they were more suitable for (relatively) large-scale power generation projects, rather than the small-scale (100kW-1MW) heat-only applications. They believed that any measures to promote energy crops should therefore focus on the power generation market. If/when an industry is established, there would no-doubt be significant quantities of energy crops going into the heat market as well, but it was not thought that the heat market was a suitable market to stimulate the development of energy crops on its own.

There is an alternative bioenergy use of the land

2.18 In addition to growing energy crops for heat and/or power production, other energy crops can be grown for transport fuels – biodiesel. ILEX has not looked at the economics of biodiesel, but it is worth noting this competing bioenergy use for the land. ILEX also understands that the land commitment for biodiesel is a lot less than the 15-20 years for Short Rotation Coppice and grasses, which may make it more attractive to farmers.

Key characteristics of forestry residues

It is an existing resource

2.19 Whereas energy crops are a new crop requiring dedicated land, forestry residues are being produced at the moment both from managed and unmanaged forests / woodlands. Some of these residues are being used at the moment. However, a great deal is wasted by being dumped in landfill or being left to rot on the land.

2.20 Investing in the infrastructure to collect such resource therefore does not present so much of a risk to residue owners as energy crops do to farmers. In addition, there is already an existing forest contracting industry which can be used to help collect and process forest residues.

2.21 In addition, the opportunity cost of using this fuel is generally becoming cheaper due to the increasing costs of alternative disposal options such as landfill.

It could prove a valuable complement to existing forest product streams

2.22 The forestry industry in the UK is suffering from over-supply and falling world prices for pulp and timber. Bioenergy could prove be a valuable complement to existing product streams to shore up falling revenues.

Key characteristics / issues of the heat 'market'

It is not a single market

2.23 Whereas electricity can be regarded as a single homogenous market, heat is by its very nature a series of thousands of installation-specific 'markets', each with different heat requirements and with the heat price and terms negotiated individually.

There is more of a direct physical relationship between supplier and consumer

2.24 The installation-specific nature of the markets means that there needs to be a much closer relationship between the source of the fuel and the consumer. This is emphasised by the physical nature of the fuel which means that it is not practical to transport it large distances.

The heat market is comprised of many small-scale combustion installations

2.25 Whereas the majority of electricity can be provided by a few large installations, heat must generated close to where it is to be used, requiring many small installations. This exacerbates the transport logistics of fuel supply, and requires fuel suppliers to develop relationships with many more customers.

2.26 This is exacerbated in the UK by the lack of district heating schemes. Such schemes provide the opportunity of centralising and increasing the scale of heat generation.

There is no centralised metering regime

2.27 This poses a problem to governments wishing to introduce output subsidies or supplier obligations as a means of supporting renewable heat.

There is no centralised licensing regime

2.28 Unlike electricity, there is no common licensing regime for the provision of heat. Again, this poses problems on governments wishing to impose obligations on suppliers as a means of supporting renewable heat.

Historically, the UK has had easy access to cheap gas

2.29 This has resulted in most of the heat infrastructure being geared towards gas-fired heat provision. This also creates a lot of social inertia.

2.30 It should be noted that those areas in the country where there is no access to gas (typically rural parts of Scotland and Wales), and heating is provided by the more expensive heating-oil option, are also areas where there are significant amounts of forestry.

Specific issues with respect to combined heat and power

Renewable electricity support is distorting the sizing of CHP schemes

2.31 The fact that renewable electricity receives support through the Renewables Obligation, but renewable heat does not, means that there are incentives for CHP developers to maximise the electricity:heat ratio such that the scheme generates as many electricity ROCs as possible. Such a configuration would lead to a CHP scheme being significantly less efficient than it could be.

2.32 However, ILEX believes that an even bigger issue is the fact that in many more cases, the lack of support for heat means that a biomass CHP scheme is not developed at all.

Biomass CHP is less mature than heat-only biomass boilers

2.33 The technology for heat-only biomass boilers is very mature, and is used extensively throughout much of Europe. However, biomass CHP is much less mature and will probably require more targeted support to help technology development as well as implementation.

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3. POTENTIAL AND COSTS OF BIOENERGY

3.1 This section of the report attempts to give an initial indication as to whether there is significant potential for the economic use of biomass to supply heat loads. There are two aspects to this question: the size of the resource and the cost of exploiting it.

Size of the biomass resource in the UK

3.2 In this section we review the estimates of resource availability for renewable sourced heat production. The sources of fuel considered are:

- agricultural and forestry wastes; and
- energy crops.

3.3 There have been a number of studies estimating the availability of biomass fuels, these include:

- the 'New and Renewable Energy: Prospects in the UK for the 21st Century – Supporting Analysis' – produced by ETSU for the DTI to support the development of the Renewables Obligation;
- 'Woodfuel Resource in Britain', September 2003, written by the Forestry Commission; and
- numerous other regional assessments undertaken by regional authorities and the Forestry Commission.

3.4 These studies reveal that there is a huge potential resource in many areas of the United Kingdom, but that resource availability varies greatly between regions. The potential for using the available resource is equally dependent on the availability of the necessary infrastructure, in particular the availability of chipping machinery, transport and storage. It has been recognised[3] that a realistic assessment of fuel availability needs to be made, perhaps by bringing together the work undertaken in the studies listed above.

Agriculture and forestry wastes

Straw

3.5 Straw is currently being burnt successfully to generate electricity at a 36MW power station at Ely in Cambridgeshire. Straw is a by-product of cereal and oil seed crops grown for food. There is already an established market for a large proportion of the straw produced. Since it is fair to assume that the energy market will not be able to compete with this market on price, then the straw available for heating is only that which is surplus and currently ploughed back into the soil. There is unlikely to be any increase in availability over time, since availability is

[3] Energy from Biofuels – Sustainable Energy Technology Routemap – DTI.

directly related to the amount of land in production. If anything, availability will decrease.

3.6 There is a strong regional difference in straw availability. It is realistic to assume that heating projects would not be considered in areas producing fewer than 200,000 tonnes per year. It is estimated[4] that approximately 5.7 million tonnes could be available each year in regions producing over 200,000 tonnes per year surplus. Over four million tonnes is located in the South East, East Midlands and East Anglia.

Forestry wastes

3.7 The dominant use of woodland in the UK is to provide a timber crop. Production cycles vary from 40-80 years for conifers to 80-120 years for hardwoods. The highest timber values result from producing straight, knot-free stems. This is achieved by planting trees close to each other to stimulate rapid straight growth and thinning them at intervals to maintain maximum growth.

3.8 Wood for fuel can be produced, throughout the year, as a by-product of the harvesting and thinning activities associated with this practice. At present the unwanted branches and tree tops are left in the forest as residues after harvesting, accounting for up to 50% of the above ground biomass.

3.9 Other sources of wood fuel include material from urban and semi-rural tree management, termed arboricultural arisings, much of which is currently landfilled at some significant cost. As landfill costs continue to rise, collection for use as a fuel is likely to become more attractive.

3.10 The use of this resource for energy, particularly for power generation has been investigated at some length, and there have been a number of successful demonstration projects in the UK. In North America, generation from wood is commonplace and there is some 8,000MW of installed capacity. In Scandinavia, wood is routinely used in district heating plant, but rarely for power generation.

3.11 The focus of investigations in the UK has been on the establishment of small-scale generators, typically 5-20MW, or heating systems of less than 1MW, located close to the resource. Proximity to the resource is important because in its raw state wood is bulky, wet, difficult to handle and expensive to transport. This is especially important for heat production since heat cannot be transmitted in the same way as power. Before it can be used as a fuel, it needs to be chipped and dried. Chipped and dried wood is easier and cheaper to transport but requires availability of the infrastructure and equipment at the production location if transport to a heat demand location is to be viable.

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4 New and Renewable Energy: Prospects in the UK for the 21st Century: Supporting Analysis – ETSU R-122.

3.12 The total resource available for use as a fuel was estimated in the ETSU[4] supporting analysis as 1.1 million dry tonnes per year rising to 1.7 million tonnes by 2013. More recent work undertaken by the Forestry Commission confirms this assessment of current availability but forecasts a lower availability in future years. Table 2 summarises the Forestry Commission projections.

Table 2 - Availability of wood fuel estimated by Forestry Commission

Ktonnes/year	Current	2004-2006	2006-2011	2011-2016
Traditional forestry	823	615	630	645
Sawmill co-product	86	86	86	86
Arboricultural arisings	341	670	670	670
Total	1264	1371	1386	1401

Energy Crops

3.13 At present there are no more than 2,000 hectares (ha) planted with energy crops, the vast majority of which were planted to supply the ARBRE[5] project that went into liquidation in the summer of 2002. This is sufficient to supply, at best, 24,000 oven dry tonnes (odt)[6] of wood fuel.

3.14 Several studies have examined the potential for growing energy crops focusing on estimates of the area of land currently used for agriculture that could realistically be switched from food production. The most recent of these studies, 'New and Renewable Energy: Prospects for the 21st Century: Supporting Analysis' by ETSU, suggests that up to one million hectares (ha) of the 18.5 million ha currently under cultivation could be assigned to energy crops by 2010. One million ha could yield 12 million odt of wood fuel. This study was published in 1999; since then, despite the introduction of the eligibility of co-firing for the Renewables Obligation, progress towards this expansion has been negligible.

3.15 In September 2003 the DTI proposed changes to the rules relating to co-firing with the chief objective being to encourage the development of energy crops by

5 ARBRE – Arable Biomass Renewable Energy project supported by the NFFO and THERMIE, located in Eggborough Yorkshire.

6 Oven Dry Tonnes – the price of fuel wood is generally expressed in units of oven dry tonnes (odt) which assumes zero moisture content. Wood fuel has varying moisture content dependent on, length of time after harvesting, storage facilities and whether any drying has been undertaken. Wet wood is heavier than dry wood so prices are adjusted for moisture content and expressed using odt as a consistent unit.

creating a temporary market within the fossil fuelled power generation sector. Should this policy prove successful the growth of energy crops could be substantial. Once eligibility for co-firing to the Renewable Obligation expires in 2016, the energy crops developed to meet the co-firing demand could be available for the heat market. We have examined the potential effect of these proposed changes to the rules[7] on the availability of energy crops and conclude that by 2016 up to an additional 400,000tonnes could be available for heating and power generation.

Cost of the biomass resource in the UK

3.16 ILEX spoke to a number of different individuals regarding the costs of bioheat, and got a wide range of responses.

Fuel costs

3.17 The greatest variation in responses was in relation to the cost of the fuel.

3.18 With respect to biomass derived from forestry/woodland residues, delivered fuel costs ranging from £28-£90/odt and more were quoted.

3.19 With respect to biomass derived from energy crops, delivered fuel costs in the range £40-£70/odt, were quoted.

3.20 What this indicates is not that incorrect costs are being quoted, but that the cost of biomass fuel is very *situation specific*. Some of the key drivers that dictate the cost of fuel include:

- For forestry-derived fuel, how the biomass occurs is critical . If it is a co-product from an existing forestry process, or a waste product (e.g. from tree surgery or saw mills), then the cost can be very cheap. If it needs to be harvested specifically from woodland, then the costs can increase significantly.
- The cost of the competing use for the resource.
  - For forestry residues the competing use is chipboard or pulp & paper manufacturer. Facing such competition can push the cost of forestry residues up to £50-£80/odt.
  - For energy crops the competing use is the use of the land. ILEX was quoted a cost of £45/odt for energy crops for them to be economic when compared against a £65/tonne cost of winter wheat. Currently winter wheat is priced at £80/tonne (which presumably increases the cost of energy crops to £55/odt).
  - Forestry and agricultural residues that are currently disposed into landfill will face a declining bioenergy cost as the cost of landfill increases.

[7] Assessment of proposed changes to the rules relating to Co-firing – ILEX report for the DTI August 2003.

- The amount of fuel delivered. Economies of scale exist such that the cost of harvesting, processing and delivery all fall for larger quantities of biomass. This holds true for energy crops and forestry/woodland resource.

3.21 The general conclusion that ILEX draws from all this information is that the cheapest biomass fuel currently available is from forestry/woodland residues. Whilst this very cheap resource is finite, it is nonetheless a major resource that is significantly greater than the existing market for bioenergy.

3.22 The exploitation of such a resource would also help develop the infrastructure and experience necessary for the industry to reach a self-sustaining critical mass.

3.23 This is not to say that energy crops are too expensive. In many parts of the country, energy crops appear to be more cost-effective than most of the available woodland resource.

3.24 What is clear is that both energy crops and forestry / woodland residues have the potential for cost reductions. For energy crops a figure of 10% reduction (approx. £5/odt) in 3 years was quoted based on improvements in technique and economies of scale. For forestry residues a cost-reduction potential of £5/odt was quoted based on reduced chipping and overhead costs arsing from a more extensive and established infrastructure.

Boiler costs

3.25 With respect to the capital costs of the biomass boiler equipment, there was less variation in responses from individuals, although there is a clear range of prices based on the size of the equipment.

3.26 For a 150kW boiler the cost of a wood-fuelled boiler would be approximately £150/kW. For a greater than 1MW boiler the cost would fall to £60/kW.

3.27 As with fuel costs, there was a strong belief that costs could reduce considerably if biomass became a more established industry. Buying boilers in bulk from manufacturers could give a 5-10% reduction in costs. The opportunities from reduced installation costs potentially represent an even greater cost saving of 10-15%[8]. Overall, there is an opportunity to reduce the capital costs of the biomass boilers by some 25%.

Comparison with fossil-fuel alternatives

3.28 In common with most renewable technologies, bioheat generally has higher capital costs than the fossil-fuelled alternatives, and lower fuel costs.

[8] The fact that there are very few accredited design engineers, installers and maintenance people adds significant costs to bioheat developers as they need to constantly reinvent the wheel in terms of explaining what the technology entails and training people.

3.29 However, one of the key issues with bioheat boilers is that most of the companies we spoke to who developed and installed biomass boilers said that they should not be regarded as replacements for oil or gas boilers. They said there would still be a need for a back-up oil or gas-fired boiler, sized to meet the peak heat load for two reasons:

- In case of the biomass boiler not being available. This is either due to it breaking down (there are more things to go wrong with a biomass boiler), or due to the fuel supply being interrupted (e.g. if snow resulted in lorries not being able to deliver the fuel).
- The biomass boiler is most efficient running baseload. A back-up boiler would therefore be used to meet peaks and/or cover times of very low demand.

3.30 Therefore, the economics of whether to install a biomass boiler means that the comparison should be between the relative fuel and efficiency costs *plus the capital* costs of the biomass boiler. In calculating the capital costs on a p/kWh basis, the load factor of the boiler will need to be taken into account. A high load factor means a lower p/kWh capital cost.

4. REVIEW OF BARRIERS TO BIOENERGY

4.1 This section of the report examines the barriers that exist to realising the potential of biomass-generated heat. There are two main types of barrier to the realisation of biomass-generated heat's full economic potential in the UK:

- the market prices for fossil-fuelled heat, and for biomass waste disposal options, currently do not properly reflect their 'true' cost to society; and
- in the UK, bioenergy is a relatively immature technology.

4.2 There are many other *difficulties* associated with the characteristics of bioenergy as detailed in Section 2 previously (e.g. having to compete with alternative uses of the resource, the bulky nature of the fuel, the small-scale diverse nature of the heat 'market' etc.). However, these are intrinsic characteristics of bioenergy that must be taken into account, not a barrier per se.

4.3 Accordingly, this section only explores the two features identified above as being 'barriers'.

Market prices not properly reflecting 'true' costs

Environmental cost of fossil fuels

4.4 The principal costs that are not properly reflected in market prices are the environmental costs of using fossil fuels. Accordingly, bioenergy and other renewable sources of fuels, are competing on an uneven playing field.

4.5 New legislation is due to come in force that will go some way to rectify this situation. The EU Emissions Trading Scheme (EU ETS), which is due to come into force on 1 January 2005, will result in a cost emerging for CO_2 which will need to be factored into the production and pricing decisions of all large installations that emit CO_2. Similarly, from 2008, large combustion plant will face a cost of emitting sulphur, NO_x and particulates through the European Large Combustion Plant Directive (LCPD).

4.6 Whether the £/tonne cost of emissions that emerges from such schemes are a 'true' reflection of their environmental damage is a contentious point. However, if they are, then emissions will have been factored in for many larger plants.

4.7 The legislation however excludes small-scale plant. For the EU ETS, the threshold size is 20MWth, and for the LCPD it is 50MWth. Accordingly, renewable plant that is competing against small-scale fossil plant will still therefore be at a disadvantage.

4.8 This is only a problem for heat not electricity. This is because electricity is a single market where prices are set by large-scale fossil-fuelled plant that will face the costs imposed by the EU ETS and the LCPD. For the supply of heat, on the

other hand, the market price is set by the cheapest means of heating each installation *on an installation-specific basis*. Only some of the largest industrial processes have heat loads greater than 20MWth. Thus, for example, the cost of CO_2 will not need to be factored into the cost of burning oil to meet a 2MW peak heat load on a site.

Fuel diversity costs

4.9 If the UK moves to becoming heavily dependent on just one fuel source – i.e. gas – there may also be diversity value attached to alternative fuels[9]. However, at the present moment the UK enjoys a very diverse fuel mix and, even if it moved to being more dependent on just one type of fuel, it is extremely hard to attach a monetary value to diversity.

4.10 Despite the difficulty of attaching a monetary value, reducing dependence on a single fuel source is clearly desirable, especially if that fuel is located in politically unstable parts of the world. This has been recognised by the European Commission that has goals for improving fuel supply security.

Cost of waste disposal

4.11 Finally, with regards to residues, the cost of waste disposal through landfill and/or incineration has historically not included the full cost of pollution and land-use.

4.12 This situation is gradually being rectified through the landfill tax[10], and increasingly strict legislation from the Environment Agency relating to the disposal of agricultural residues to prevent groundwater pollution and the like. In addition, the government is imposing increasingly strict recycling targets on local authorities.

4.13 These measures are starting to have a significant positive influence on the use of agricultural and forestry residues for bioenergy.

Bioenergy is an immature technology in the UK

4.14 In some respects bioenergy can be regarded as a mature technology. In several European countries (e.g. Scandinavia and Austria), biomass is used extensively for the provision of heat and power, and the associated harvesting and combustion technologies are 'mature' in the sense that future major cost reductions are unlikely.

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9 The huge steps Denmark has made in developing an indigenous renewable energy industry were initially driven by a desire to reduce their dependence on imported sources of energy following the OPEC oil shocks. The environmental drivers behind such developments only happened later.

10 By 2004/5 the landfill tax will have reached a level of 15 £/t. The intention is to increase this tax by at least 3 £/t every year until it reaches 35 £/t.

4.15 However, in the UK bioenergy is a 'new' technology with extremely few projects on the ground. This lack of existing infrastructure and societal knowledge / experience is a significant barrier in itself. As with many new technologies, a critical mass of projects needs to be successfully operating in order to provide a sustainable pool of knowledge, fuel, equipment, and customers. Once such a critical mass is in place, the industry has the capability to grow to reach its natural level, plus enjoy considerable cost reductions through economies of scale and series.

4.16 The challenge for government in trying to encourage the development of such a critical mass is that it needs to act on two different fronts:

- firstly, it needs to encourage the potential producers of the biomass fuel to make the necessary investments to do just that; and
- secondly, it needs to encourage the development of biomass-fired heat producing installations that will act as the market for this fuel.

4.17 This represents a dilemma. Installers will not commit to the installation of biomass-fuelled heating plant unless they are happy that there is sufficiently secure fuel supply, but growers will not commit to making the investments in their crops unless they are sure there is a sufficiently well established market for it.

4.18 Solving this dilemma and achieving a critical mass of projects represents the biggest challenge for government wishing to develop the bioenergy heat industry in the UK.

4.19 In doing so, the government must also address the characteristics of bioenergy already outlined in Section 2 which exacerbate this problem.

4.20 It should also be appreciated that, whilst the use of forestry residues for bioenergy is mature in many European countries, energy crops and biogas are 'new' technologies in all European countries and thus face a steep learning curve for their implementation.

Mis-aligned incentives for building developers and building occupiers

4.21 One problem arising from the fact that biomass has not reached a critical mass is that many of those who make the decisions regarding what type of heating-installation to fit in a building (design engineers, architects etc.) are not aware of the bioheat options.

4.22 Even if they are, there is currently very little incentive for them to consider bioheat. Indeed, there is a disincentive in that they will need to purchase capital equipment that costs more, and which (to them) is an unknown quantity compared with the conventional alternatives (i.e. gas heating). This is despite the fact that bioheat may prove more cost-effective in many situations.

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5. POSSIBLE SUPPORT MECHANISMS

5.1 This section of the report considers how the Government could potentially remove the barriers to the development of bioheat. There are a variety of options that could be taken by governments wishing to support particular technologies. These can be grouped as follows:

- R&D and pilot / demonstration funding;
- major commercially oriented financial support regimes;
- other financial support;
  - loan facilities;
  - reduced VAT on capital equipment;
- taxes on fossil-fuel derived energy;
- non-specific incentives;
  - legislation limiting emissions and/or waste disposal;
  - building legislation;
  - planning guidelines;
  - obligations on public bodies; and
- information and advice programmes.

5.2 This section of the report examines each of these various support mechanisms (and the various sub-options within them), and attempts to evaluate their suitability for use as stimulants to the development of bioheat in the UK.

R&D and demonstration / pilot funding

Research & Development funding

5.3 R&D funding is appropriate not just for very immature technologies, but also specific aspects of technologies that are regarded as more mature.

5.4 The UK government currently funds R&D into biomass-generated heat through a number of programs, and it is expected that the new National Energy Research Centre will have biomass research within its remit. The new National Non-Food Crops Centre is also expected to play an important role.

5.5 However, a common criticism of the UK's approach to such R&D to-date is that it is too heavily focussed on academic pre-commercial technology/engineering research, and that far too little attention is paid to the issues surrounding technology implementation. Given that one of the biggest issues in relation to bioenergy is in relation to getting all the various elements of the supply chain in place and working together (growing, harvesting, processing, transporting, generating), this relative lack of a commercial focus to such R&D is unhelpful.

5.6 Many people interviewed in the course of this study also felt that too much emphasis is placed on only supporting novel technologies, and that much valuable research could be undertaken on technologies that are closer to being commercially viable.

5.7 Some European research institutes were cited as being good examples of 'high quality, commercially oriented, contract research institutes'[11], including the German Fraunhofer Institutes and the Danish dk-Teknik.

Support for pilots & demonstration projects

5.8 For a technology such as bioenergy which requires the development of many different elements in a supply chain, it is vitally important to develop a number of good quality pilot / demonstration projects. Not only do they enable many valuable lessons to be learnt which can be disseminated throughout the industry, but more importantly they provide tangible examples to people considering entering the industry that such technologies are viable and not unduly 'risky'.

5.9 This is particularly important for bioheat where two important groups need to be persuaded to get involved, neither of whom have any real 'need' to get involved:

- farmers who must be persuaded to make the considerable investment and long-term commitment to growing energy crops; and
- heat consumers who must be persuaded to make the investment in biomass heating infrastructure – in many cases replacing existing oil or gas-fired infrastructure.

5.10 The way in which suitable projects are selected to act as demonstration/pilot projects is crucial. Much criticism has been levelled at the way in which the ARBRE project was selected for support under the Non-Fossil Fuel Obligation. One of the reasons it was selected was because the technology it used was deemed more novel than that used in other projects.

5.11 However, the subsequent failure of this flagship project, largely due to the experimental nature of its technology, has caused very real damage to the prospects for bioenergy in the UK through the signals it sends to those thinking of getting involved in the industry, particularly farmers.

5.12 Because one of the biggest challenges is getting all the different aspects of the biomass supply chain working together, ILEX feels it would be valuable to have more demonstration projects supported that are focussed on getting the fuel supply infrastructure working, and which use boiler/generator technology that is more tried and tested.

[11] 'Biomass Mission to Austria and Denmark', report to Advantage West Midlands, March 2003.

5.13 The current main support instruments for bioheat[12] are at the pilot/demonstration stage. Largely they appear to work well and are generally viewed favourably by those in the industry. However, there have been some criticisms levelled at them:

- They are too prescriptive in the technologies that they support. In particular, many people (including those that are 'impartial') feel too great an emphasis is placed on energy crops, and not enough support is earmarked for other forms of biomass (forestry residues, solid agricultural residues, anaerobic digestion).
  - One option to address this is, for a given pot of available money, to allocate a certain percentage (perhaps the majority) to be available to all bioheat technologies on a first-come-first-served basis. The remaining funds could then be reserved for particular technologies to ensure they get some money.
- The split in support between different elements (fuel growing, fuel infrastructure, and boiler/generator technology) means projects have to fill in too much paperwork to apply for all the different elements. It also increases the risks for projects in that they may not get funding for one element of the project.

Major, commercially oriented financial support regimes

5.14 Many countries around the world have chosen to develop some form of large-scale financial aid regimes to support renewable energy. The intention of such schemes is to provide financial support to technologies that are close to commercialisation and have a large potential, but need support because they face barriers (i.e. market prices not fully reflecting the true cost of alternatives, and/or the industry needing support to grow to the 'critical mass' level needed to be self-sustaining).

5.15 Such policy mechanisms are different to those for providing support for demonstration / pilot projects in that they have much greater focus on:

- achieving the most cost-effective spend in terms of £/MWh of energy supported; and
- delivering targets for significant growth of a renewable energy technology.

5.16 At the moment bioheat in the UK has no large-scale financial assistance regime. The support it does have is of the demonstration kind as outlined in the previous section.

5.17 However, ILEX believes that bioheat has progressed sufficiently in terms of technological maturity, and has sufficiently large potential, to warrant such a

[12] The Bioenergy Capital Grants Scheme for the support of boiler technology, the Energy Crops Scheme for the support of developing energy crops, and the Energy Crops Infrastructure Support Scheme to support the harvesting, processing and transport of biomass (including forestry and energy crops) to end-users.

support mechanism. Indeed, without such a mechanism, bioheat is likely to continue to languish at the demonstration stage of its development.

Design options

5.18 When designing any such mechanism (whether it be for bioheat or other technologies), governments have a number of choices regarding implementation:

- capital *or* output-based;
- subsidies *or* tax-breaks;
- competitive selection *or* open eligibility;
- same support for all *or* differential support between technologies; and
- taxpayer *or* energy ratepayer funded.

Capital or output-based

5.19 Financial assistance can either be given to projects up-front in the form of capital-related assistance, or it can be given throughout all or some of the life of the project through output-related assistance. There are pros and cons to both approaches.

5.20 Capital support has the advantage that projects typically have to raise less debt finance, which often proves a stumbling block to getting off the ground. However, capital support has the disadvantage that money may be spent on projects that do not subsequently perform well (a well-documented problem in the early days of Californian support for wind projects), plus the long-term revenue stream of the project is subject to uncertainty.

5.21 Output-based support has the advantage of giving greater long-term revenue certainty to projects, plus governments will only be supporting projects that work (i.e. if a project only produces half the expected amount of energy, it will only receive half the level of support). However, it has the disadvantage for bioheat in that it requires a centralised market framework for the collection of metering data in order to implement cost-effectively – something that the heat 'market' does not have.

5.22 This may not be a fundamental problem for bioheat given that heat metering is increasingly common. However, it would require the development of a centralised system for the gathering of data.

5.23 In general, the relative pros and cons mean that capital-based support is typically most appropriate for technologies at the early stages of technology development (and as such is most appropriate for R&D and demonstration/pilot support), whereas output-based support is most appropriate for more mature technologies.

Subsidies or tax-breaks

5.24 Financial assistance can be given to projects either in the form of subsidies or tax-breaks. Both subsidies and tax-breaks can be used for capital or output-related support.

5.25 From a cashflow point of view, there is often relatively little difference between the two approaches and can thus be regarded as being equivalent in the level of support. Sometimes, however, tax breaks can give different levels of support to two identical projects due to the fact that they only benefit companies that are profitable. Thus, if one company is in profit it can take advantage of tax-breaks from investing in a project straight-away, whilst another company that is loss-making will have the benefit deferred until such time as it is in profit[13].

5.26 From a national economy point of view, there is also little difference between subsidies and tax-breaks – at the end of the day, taxpayers or electricity/gas ratepayers are the ones who pay for the support, irrespective of the method. Politically, however, there is often a difference in terms of how easy it is to implement a support mechanism – funding comes out of different departments, and subsidies are often a lot more visible than tax-breaks.

5.27 One drawback of tax breaks is that it is inherently much harder to design such a mechanism to achieve specific goals in terms of MWh of a particular renewable energy technology.

5.28 A tax break mechanism also needs to be carefully designed such that it does not unduly support existing projects and/or imported renewable energy from other countries (as was the experience with the Dutch scheme). Imported heat is not an issue for bioenergy, but imported fuel (such as pellets) may well be.

Competitive selection or open eligibility

5.29 The means by which governments ration such support can have a major impact on the 'success' of the mechanism.

5.30 One option is for governments to require projects to take part in a competitive tendering process based on strict selection criteria, usually cost. The main advantage of this approach is that it gives governments absolute certainty regarding the upper-limit of total financial assistance they will be giving. In addition, for programmes with limited budgets governments may like to have greater control over how such funds are spent.

[13] The bad experience in California of financial support not leading to 'good' projects was due to the tax-break nature of the support whereby companies benefited so much from the capital tax break, that the performance of the wind turbine was almost of secondary importance.

5.31 Another potential advantage of this is that it rewards only the most cost-competitive projects, thereby resulting in lower support costs per unit of energy and encouraging the development of lower cost technologies.

5.32 However, experience with such selection-based mechanisms (e.g. the NFFO in the UK) has highlighted a number of significant problems:

- Often contracts are awarded to projects that subsequently fail to come to fruition due to other problems (e.g. obtaining planning consents or finance). This inevitably results in monies being denied from other projects which might have been more likely to go ahead.
- It creates significant uncertainty for developers who may have to devote a significant amount of time and effort on a proposal without the guarantee that they will actually be selected to receive support. For a technology such as biomass-generated heat where there is a need to persuade farmers and consumers who do not actually 'need' to get involved to become involved, this uncertainty would act as a major barrier. This uncertainty is also a major barrier to the development of an indigenous renewable technology manufacturing sector.
- The emphasis on cost sometimes has unforeseen outcomes. It sometimes results in untried technologies being selected which, on paper, appear cheaper but which run a greater risk of running into problems. For wind, the NFFO also created an incentive for developers only to go for the windiest sites, which often were in the most sensitive planning areas.

5.33 The alternative to competitive selection is for the government to specify that any project that comes forward and meets certain criteria will receive support. The best example of this approach is the so-called feed-in tariffs for renewable electricity in operation in Germany. The main advantage of this approach is that it creates certainty for developers which, for an immature technology, are one of the most important factors for its development.

5.34 The main disadvantage is that, if the support level is wrong, it can lead to too much being spent to support renewables with windfall gains to some renewable developers. Clearly, to try and prevent such situations occurring a government would need to undertake careful study as to what is the appropriate level to set such support before starting the support programme. However, there is often the incentive for renewable producers to exaggerate the costs of their technology when negotiating the level of a feed-in tariff.

Same support for all or differential support between technologies

5.35 For simplicity's sake the government may decide to award the same level of support to every technology (biomass, wind etc.). However, this runs the risk of paying too much for one technology, and too little for another.

5.36 The alternative is to pay different amounts to different technologies. Given that one of the aims of such support is to help kick-start immature technologies, and that all technologies will be at different levels of maturity, it would be easy to

justify such a decision, and in some cases is definitely appropriate. Inevitably, however, differentiating between technologies adds complexity to the scheme, and can make it more politically contentious.

5.37 A good compromise is often to have a core element of the support scheme which does not differentiate between technologies, with additional support for certain technologies (possibly from demonstration / pilot funding).

Taxpayer or *energy ratepayer funded*

5.38 This is largely a political question – often it is more contentious to take money from general tax revenues than to add a cost to consumers' energy bills.

5.39 There may, however, be an economic efficiency benefit from requiring energy ratepayers to fund such mechanisms given that it goes some way to 'internalising' the costs of pollution that the renewable support mechanisms are largely designed to tackle.

Description of the main 'composite' support mechanisms

5.40 All of the above options have been combined into composite mechanisms which fall into five main categories. They are described briefly below, along with commentary as to any practical difficulties associated with their use for supporting bioheat.

Capital grants (with or without competitive selection)

5.41 Renewable energy generators receive capital support. This is the only real mechanism where, for bioheat, support can directly be given to companies 'upstream' in the fuel supply chain (i.e. growers, harvesters, processors etc). All other mechanisms support the renewable energy generator who can then, in turn, pay higher amounts for biomass fuel.

Tax exemptions

5.42 Energy suppliers are exempt from paying standard energy taxes if they purchase the energy from a renewable source. This enables them to pay more for the renewable energy than they would otherwise be able to do.

5.43 The EU Emissions Trading Scheme (EU ETS) will introduce a cost of CO_2 which effectively acts like a tax, and which renewable generators will be exempt from. However, as set out in paragraphs 4.5ff, it will impose a cost of CO_2 on very few fossil heat generators. One way to rectify this would be to impose a CO_2 tax paid by all fossil fuels (which could be claimed back for those installations covered by the EU ETS). ILEX believes this has much merit. However, this would be a major piece of legislation, and one which does not appear likely in the short to medium term. A more realistic option (and which would have the same effect) could be for the government to evolve the climate change levy.

5.44 Increasing the rate of VAT on energy (gas, oil and electricity) from the current 5% level to the standard 17.5% level would also have a similar effect. Again, however, this would be highly politically contentious in terms of the impact it would have on vulnerable members of society (the elderly and fuel poor).

Feed-in tariffs

5.45 A central purchasing authority agrees to purchase energy at a fixed rate from plant that meets certain criteria. The central authority will on-sell that energy (either to final consumers or to a central market). Feed-in tariffs are typically guaranteed for a minimum length of time (5 plus years), and can easily be differentiated between types of technology. Typically, feed-in tariffs are funded by a levy on energy ratepayers.

5.46 From bioheat's point of view, the requirement for the central purchasing authority to on-sell the energy could be problematic as there is no central market for heat – rather hundreds of thousands of individual heat customers.

5.47 Because of this, it would probably not be practicable to pay for all the heat generated at a fixed price. Rather the schemes would qualify for a set subsidy, and sell the heat to the end-use customer rather than a central authority.

5.48 This reduces the certainty to heat generators in terms of the revenue streams they are likely to receive in the future, because the heat revenues may change due to changes in market conditions (e.g. a rise in gas prices). To counteract this, it would be possible to link the subsidy payment to some form of index (e.g. gas prices).

5.49 Another aspect of this scheme is that it would require heat metering to be installed on all sites that receive such support, plus the development of a central meter data collection framework. However, the cost of heat metering maybe relatively low (depending on the size of the scheme), but the development of a central heat metering framework would have to be the subject of further study.

Power purchase contracts with competitive selection

5.50 This is similar to feed-in tariffs except that contracts are typically awarded which guarantee payment for longer periods of time (10+ years), and the processes for awarding such contracts is a competitive one, often completed in annual 'rounds'. Typically the premium payments are funded by a levy on energy rate payers.

5.51 It is easy to differentiate payments (and the total amount of support) between technologies (witness the Non Fossil Fuel Obligation). Also, the annual rounds mean that it is possible to pay a different rate to projects of the same technology which receive contracts in different rounds.

5.52 As with feed-in tariffs, the energy is purchased by a central purchasing authority, and requires a central metering framework. This gives rise to the same set of problems (and potential solutions) for bioheat.

Obligations with tradable certificates

5.53 Such a mechanism is the most recent addition to the 'family' of renewable energy support mechanisms, and works as follows:

- Energy suppliers are obliged to procure a certain proportion of their energy from renewable sources. Typically such obligations are expressed as a percentage of supply and grow over time.
- Suppliers meet such obligations by purchasing 'green' certificates (expressed in MWh) from renewable generators, which they can then redeem at the end of the year. The value of such certificates is driven by the penalty payments suppliers must make if they do not purchase enough certificates and the laws of supply and demand (if certificates are scarce relative to the obligation, the value will be high compared to a situation where certificates are plentiful). For the UK electricity Renewables Obligation this is achieved by 'recycling' the penalty payments to holders of certificates pro-rata to their holdings.
- Renewable generators capture such value through negotiations for the sale of certificates to suppliers. The cost of purchasing such certificates and any penalty payments is levied on energy consumers.
- Renewable generators are issued certificates from a central authority based on their metered output of energy.

5.54 It is possible to differentiate between technologies by either setting different percentage targets for different technologies, or awarding a differing number of certificates per MWh generated to different technologies.

5.55 With regards to bioheat, an obligation approach has so far been regarded as impracticable for two reasons:

- firstly, there is no centrally-administered metering regime for the measurement of heat. However, as previously described for feed-in tariffs, it could be straightforward to introduce such a regime for those installations that wish to qualify for earning certificates; and
- secondly, there is no central licensing regime through which an obligation could be imposed on heat suppliers. The local and site-specific nature of heat means that developing such a licensing regime would probably be impractical.

5.56 This latter problem may appear insurmountable. However, ILEX believes that with enlightened thinking, the renewables obligation could be extended to cover heat relatively simply.

5.57 The first question relates to who the Obligation would fall on. Heat suppliers are clearly a not appropriate due to there being no centralised licensing regime for heat, or genuine heat 'market' against which an obligation could be set. However, there is no practical reason why suppliers of electricity or gas should not be obligated to purchase a certain percentage of ROCs from heat generators. This is because one of the most radical elements of an obligation approach is that *'green' certificates can be traded independently of the power*.

5.58 This concept enables all suppliers of electricity to share the cost of supporting renewable energy equally, irrespective of where they are located in the country, and enables renewable generators to be located in areas of the country where they are most cost-effective and sell their power locally.

5.59 This principle of trading 'greenness' separately from energy means that there is no practical reason why a supplier of electricity, say, should not be able to purchase certificates of greenness from a heat generator, and use them to offset against their electricity obligations. In theory, therefore, it should be simple to extend the current electricity renewables obligation in the UK to include heat. In practise, there are some issues that will need to be considered. These are outlined in detail in Annex A.

Comparing the main 'composite' funding mechanisms

5.60 The two main criteria that should drive any government's selection of type of support mechanism are:

- cost; and
- investor certainty.

5.61 With regards to ***cost***, the government needs to create a system that minimises the cost per MWh supported, plus control the total amount of support provided. In this respect, ILEX has subjectively ranked the options in descending order of attractiveness:

- Supplier obligations with tradable certificates
  - The key feature is that if a lot of renewable energy comes forward and/or the other revenue streams to renewable projects rise (e.g. from a rise in fossil fuel prices, or the introduction of other support measures such as VAT reductions on bioenergy capital equipment), then the value of certificates will fall, resulting in a corresponding fall in the amount of money going to renewable generators.
  - Secondly, the amount of support that consumers must pay is capped at the level of the penalty payment multiplied by the size of the obligation.
  - Another advantage of such an approach is that the burden of selection of renewable projects to be supported moves from government to industry.
  - The one disadvantage of this approach is that if the government sets an unrealistically high obligation, then too much money on a per MWh basis will go to those selected projects. In this respect, targeted measures at creating the right 'background' conditions for bioheat could help reduce the amount of money spent on a per MWh basis under an obligation mechanism.
- Energy purchase contracts with a competitive selection procedure.
  - The competitive selection process allows the amount of total support given to be strictly limited.
  - The other main claimed advantage is that the competitive selection procedure is meant to drive prices down. However, the experience from

the NFFO was that in many cases developers felt pressured to drive prices down to unrealistic levels with the result that contracts were awarded to projects that never materialised. This had a major detrimental impact on the NFFO's effectiveness at bringing forward the desired levels of renewable energy.

  - The fact that the NFFO was conducted over annual rounds meant that as the technology matured, contracts with lower costs could be awarded.
  - One further advantage of NFFO was that the Non-Fossil Purchasing Agency purchased the electricity and thus obtained the rights to sell it on into the wholesale market. If the wholesale price then rose, the revenues were used to offset the cost to consumers. However, as previously mentioned, this would not be practicable for heat.
- Feed-in tariffs with open eligibility:
  - One drawback is that if the level is set too high, generators will enjoy windfall profits.
  - Similarly, the open-ended nature of the support means that the scale of support (and eventual costs to consumers) may grow larger than expected.
  - In addition, feed-in tariffs for heat suffer from the same problem as outlined for fixed price contracts in that it is not practicable for the purchasing authority to on-sell the heat.
- Capital grants with a competitive selection procedure:
  - This suffers from the same pros and cons of competitive selection as already described.
  - In addition, one problem with capital grants is that they can be awarded to schemes that go ahead but perform badly, giving a high cost per MWh of heat.
  - Also, if future conditions mean that energy prices rise (and bioheat projects consequently need less support), there is no means of recovering the money already awarded to these projects.
- Capital grants with open eligibility:
  - These are the least attractive option.

5.62 Investor Certainty is, from the point of view of developers, one of the most important features of any support mechanism. Unless developers (and banks) are confident that the government is committed to a technology for the long-term they will not invest at the level required. This is especially the case for energy crops where farmers must commit the land for 15-20 years.

5.63 In this respect ILEX has again subjectively ranked the various options in descending order of attractiveness:

- Feed-in tariffs with open eligibility (and a minimum commitment of 10 years).
  - However, if the problems with on-selling heat outlined previously mean that support is limited to 'extra' payments in addition to revenues earned from selling the heat to the end consumer, the certainty benefit

significantly reduces. This could be partly counter-acted by indexing the level of such payments to a basket of factors that drive the price of heat (e.g. the cost of gas).

- A supplier obligation mechanism coupled with tradable certificates. (provided that the obligation is for a sufficiently long period of time 10-15 years)
  - One particularly attractive feature of this option is that if the amount of renewable energy coming forward falls short of the target, the price of the certificates will rise accordingly to send the appropriate price signal to developers.
- Capital grants with open eligibility
  - The uncertainty regarding future energy revenue streams adds a degree of uncertainty.
- Fixed price and term energy purchase contracts (coupled with a competitive selection process).
  - For this option the uncertainty that the competitive selection process creates can be a major drawback.
  - In addition this may suffer from the same problems as feed-in tariffs with regards to the purchasing authority on-selling the heat.
- Capital grants with a competitive selection process.
  - This is the most uncertain option.

5.64 Based on the above criteria, ILEX believes an obligation-type mechanism could be the most suitable for the long-term, commercially-focussed support of bioheat.

5.65 Bioheat is mature enough for such support to be suitable. It provides the right price signals to the industry and it does not rely on the government trying to pick winners. Such a mechanism is also likely to be the most cost effective in terms of £/MWh supported.

5.66 It is also especially compatible with additional support mechanisms that may be necessary for particular bioheat technologies. If additional support is received leading to more projects being developed, the cost per MWh of support given via an obligation will fall.

Other financial support measures

5.67 In addition to a major commercially focussed support mechanism, it may be desirable to have other financial support mechanisms. Rather than projects receiving 'double support' and windfall profits, such mechanisms can lead to a more cost effective overall level of support for the industry.

Renewable loan facility

5.68 In common with most renewable technologies, bioheat is a fairly capital intensive technology. Thus, typically the capital costs of the equipment tend to be

significantly higher than the fossil-fuelled alternatives, whilst the operating costs are lower.

5.69 This capital structure creates a greater requirement for up-front funding, much of which will need to come from debt. In many cases this poses a barrier for renewable projects as most banks are wary of such investments. Such wariness largely stems from the untested (in the banks' eyes) nature of the technology, although part of it is due to the large losses that banks have made in a number of energy-sector investments over the last few years.

5.70 For bioheat projects, an additional barrier is that the projects are typically much smaller than renewable electricity projects. In many cases this makes them too small for the specialist renewable energy branches of banks to bother about.

5.71 For energy service companies in particular, who develop and operate a project on behalf of the heat user, raising debt finance can be a significant barrier, especially for those with small balance sheets. In some cases, the only way in which such projects can raise finance from banks is through the development of complex contract structures which put the risk back on the heat user who are often perceived to be better credit risks (e.g. hospitals). Not only does this add development costs to the project, in some cases it may be a barrier to the project going ahead altogether.

5.72 To overcome this, a government-backed loan facility that specialised in bioenergy projects would be of significant benefit. The benefits which such a facility could bring would be:

- simplified loan authorisation process; and
- longer length loans (7 to 10 years instead of the 5 year term that most banks currently favour).

Reduced VAT on capital equipment

5.73 VAT is one area in the UK where the current regime can arguably be giving the wrong economic signals. The consumption of energy is subject to VAT at 5%, whereas the installation of equipment such as bioenergy-boilers is subject to VAT at 17.5%.

5.74 There is a clear case for reducing the level of VAT on such equipment to the same level as VAT charged on the consumption of energy. There is also a precedent through certain types of energy saving or 'green' energy producing equipment (e.g. photo-voltaic panels) already benefiting from reduced levels of VAT.

Non-specific incentives

5.75 Due to the nature of bioheat, very many other policies affect its development. Such policies may promote, or even unintentionally frustrate, the development of bioheat.

Legislation limiting waste disposal and/or emissions

5.76 Two policies that are having a strong positive impact on the development of bioheat are those relating to the use of landfill as a waste disposal option, and recycling.

5.77 Under current landfill legislation, a tax is imposed on landfill. By 2004/5 the landfill tax will have reached a level of 15 £/t. The intention is to increase this tax by at least 3 £/t every year until it reaches 35 £/t.

5.78 The legislation relating to recycling requires local authorities to recycle an increasing proportion of their waste rather than incinerate it or send it to landfill.

5.79 Both policies are increasing the costs of disposing of forestry, agricultural and commercial waste. This is giving rise to a ready source of biomass material, in the form of arboricultural arisings[14] and pallets in particular, for whom the cost of disposal is becoming 'too high' and where bioenergy is an increasingly attractive option.

5.80 Another set of policies that are having an impact is those relating to the disposal of agricultural residues on land as administered by the Environment Agency. Those relating to animal slurries in particular are restricting the disposal options available to farmers due to concerns regarding ground water pollution and public health. Anaerobic digestion for bioenergy represents a useful option for farmers in this respect as it 'conditions' the slurry, destroying a lot of the harmful elements.

5.81 At the moment these policies are favourable to bioenergy. It is up to government to ensure that any revisions do not unnecessarily frustrate future developments. In addition, government may wish to capitalise on such positive policy interactions by pro-actively approaching companies / authorities / farmers that are currently having to deal with such wastes to make them aware of the potential for bioenergy.

Planning guidelines and building regulations

5.82 The local government structural plans and the related land-use planning guidelines are extremely important for a technology such as bioheat. This is largely due to the significant road transport element of bioenergy, and its local nature.

5.83 Central government needs to ensure that the guidance it issues to local government in these areas is appropriate for bioheat and minimises the risk of bioheat projects falling foul of 'NIMBY' – motivated objections.

5.84 A stronger level of support may be to use building regulations to make the heating option more heavily weighted in favour of biomass. For example, a presumption

[14] Wood and branches from tree surgery etc.

in favour of biomass unless it can be proven that the alternatives (gas- or oil-fired heating) are more cost-effective. This has been a powerful tool in Austria to promote the development of bioheat.

5.85 However, at the moment, such prescriptive methods are likely to be practicable (or even desirable). What could be done is to ensure that the building regulations treat bioheat as 'mainstream'. Part of this could be achieved by moving towards a greater focus on carbon-efficiency of buildings rather than the more usual energy-efficiency focus of building regulations.

Placing obligations / targets on public bodies

5.86 Where there may be another opportunity to use an obligation approach towards the promotion of bioheat would be through publicly-owned buildings. Central and local government own a significant amount of building stock, much of which is eminently suitable for bioenergy heating (hospitals, schools, prisons, leisure centres, government offices etc.). In addition, local government is often closely involved in the development of new housing stock.

An obligation to 'take bioheat seriously'

5.87 A relatively simple obligation would be to require all developments (new infrastructure or refurbishments) involving publicly-owned buildings, or which have a large degree of public involvement, to have to actively consider bioheat and district heating as a heating option. In effect, they would have to prove that bioheat and/or district heating was not appropriate for such projects.

5.88 Clearly to be effective such an obligation approach would need to be pragmatic in how such 'proof' should be provided and who to. It would not be desirable for such a scheme to be responsible for any delays in development processes.

5.89 It would also require much better information provision to those individuals responsible for specifying the heating solutions for public buildings (architects, design engineers, buildings officers etc.). They cannot be expected to consider bioheat if they are not given the information to do so.

5.90 However, given that one of the major barriers to the development of bioheat is lack of awareness of its possibilities, this potentially simple policy would go a long way towards raising the levels of awareness.

An obligation to take action

5.91 A different obligation would be to require public bodies to actually *meet* certain targets with respect to energy provision. ILEX does not believe it would be appropriate to place bioheat-specific targets on public bodies due to the fact that the potential for bioheat is different in different parts of the country.

5.92 Instead, broader obligations on energy usage (e.g. carbon targets) would be more appropriate, as bioheat should naturally fall out of such obligations *where it was appropriate.*

5.93 ILEX understands that many public bodies already have such targets in place. For example, hospitals have a target to reduce carbon emissions, as does some local government.

5.94 One of the main problems with such targets, however, is that they are perceived not to have any teeth. For example, one individual expressed the view that the target on hospitals to reduce their carbon emissions was 'meaningless' because hospital managers faced no consequences of not meeting the targets, and thus tended to ignore it.

5.95 Despite this, ILEX believes such targets are useful as they help raise awareness of low-carbon alternatives that, if coupled with good information dissemination regimes, can lead to significant amounts of action being taken. What typically happens is that particularly dynamic individuals first take action in a few public authorities around the country. After this 'pioneer' phase, other public bodies can more easily follow the examples set, plus it is easier for government to set more mandatory targets.

5.96 Without the targets existing in the first place, the dynamic individuals would not have been empowered to take the actions that others subsequently follow.

Information and advice

5.97 Whilst on the face of it, bioheat may seem a simple concept, in reality it requires the development of a relatively complex supply chain involving many different parties, the use of specialist equipment, and the requirement to work within many different legislative frameworks (energy, land-use planning, and environment). This supply chain is much more complex than all other renewable technologies.

5.98 This complexity, coupled with the lack of awareness of bioheat amongst those individuals responsible for deciding what technology to use for meeting a heat load, is one of the biggest barriers to overcome.

5.99 To rectify this, one of the most cost-effective uses of public money is likely to be to develop a more effective approach towards information dissemination relating to bioheat. To be effective, such information provision would need to be:

- *Comprehensive*. There are many different aspects of bioheat, all of which need to work together. Therefore any information provision should be 'one-stop-shop' in nature both in terms of the type of people it caters for (growers, industry bi-product creators, distributors, end-users, architects, design engineers, installers, boiler maintainers etc.), and the type of information provided (technical advice, training, legislative framework, subsidy regimes etc.).

  In addition to providing information, ideally the advice providers should be able to provide more interactive support such as commenting on proposals, introducing different parts of the supply chain to each other, and helping apply for grants.

- *Coordinated.* There is a reasonable amount of advice activity already underway around the country. However, a number of people commented that there is duplication of effort and resource in many cases that could be reduced through better coordination. In addition, the advice structures for disseminating the ongoing lessons learned from projects are often ad-hoc (or non-existent).
- *Pro-active*. The key decision makers are those deciding what heat technology to install to meet a heat load. As far as they are concerned, they already have an economic existing solution available (gas or oil-fired heating), and will not waste time looking for alternatives. A vital first step is in getting them to even *consider* bioheat as an option. As such, a pro-active approach to raising awareness and skills amongst such professionals is essential. Similarly, pro-actively raising awareness and skill levels amongst the other elements of the supply chain is important.

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6. CONCLUSIONS & RECOMMENDED ACTION PLAN

6.1 ILEX believes there is the potential for a significant proportion of the UK's heating needs to be met *economically* from biomass sources. However, at the moment there are two major barriers to bioheat's potential being realised:

- Bioenergy is an infant technology in the UK, and currently does not have a critical mass of projects to be self-sustaining in terms of infrastructure, expertise and general public awareness.
- The price of fossil-fuelled energy generation, and waste disposal, do not currently reflect the 'true' costs to society arising from environmental degradation.

6.2 To overcome these barriers, the government needs to put in place a coherent set of measures to tackle the problem on two fronts:

- firstly it needs to create the right background conditions such that bioheat can develop once the other barriers have been removed.
- secondly, it needs to put in place financial support measures to:
  - level the playing field when competing against alternative sources of energy and biomass waste disposal routes; and
  - provide support in the short- to medium-term to help the immature industry grow to a critical mass and move down its cost-reduction curve to mature cost levels.

6.3 The two measures are not 'either / or'. They must be implemented together otherwise any such support will fail.

6.4 The government is already doing much on both of these fronts. However, there are opportunities for improvements through better coordination of all the different support elements, better targeting of the support in some areas, and introducing new types of support to fill some gaps.

6.5 The remainder of this section details specific recommendations that could be undertaken under these two main headings.

Creating the right background conditions for bioheat

6.6 Bioheat, more than almost any other energy technology, suffers from major difficulties in establishing a critical mass where it can be self-sustaining. These difficulties stem from the inherent characteristics of bioheat as outlined in Section 2 of this report. In summary, though, there is a dilemma:

- Heat consumers will not invest in bioenergy boilers to create the demand for biomass fuel unless they are sure there is a reasonably secure supply of such fuel. However, the suppliers of such fuel will not make the necessary investments in growing, harvesting, processing and transporting the fuel unless they are sure that there is a reasonably firm demand.

- This situation is exacerbated by the fact that a relatively complex supply infrastructure needs to be developed to link the various participants (growers, processors, transporters and consumers), and that there are many different sources of biomass fuel.

6.7 There is no one single solution to breaking this cycle. Rather a series of coordinated measures need to be undertaken to create the right 'background' conditions for bioheat:

- spreading the word
- mobilise public authorities; and
- joined up legislation

Spreading the word

6.8 Ignorance, apathy and lack of skills are one of the biggest barriers to the realisation of bioheat's potential.

6.9 Accordingly, as set out in paragraphs 5.97ff, one of the most cost-effective ways for government to improve the uptake of bioheat would be through a more comprehensive, coordinated and pro-active information and advice programme.

6.10 Due to the integrated nature of bioheat it would need to be 'one stop shop' in nature dealing with all aspects of bioheat (fuel supply, heat boilers, technology, commercial, grants, planning etc.). As well as giving information, such a programme should be responsible for training key people involved in the industry (design engineers, boiler maintenance people etc.), as well as pro-actively making key groups of people (landowners, building managers and specifiers etc.) aware of the potential of bioheat.

6.11 Due to the inherently local nature of bioheat, local advice centres will need to play a crucial role, especially in the pro-active aspect of advice giving. A central advisory body would need to facilitate and coordinate the actions of local centres.

Mobilise public authorities

6.12 Public authorities are crucial to the successful development of bioheat on two fronts.

6.13 Firstly, they play an extremely important role in terms of creating the right conditions for local and regional technology developments through measures such as the structural plans, and the land-use planning framework. This can be leveraged even more through coordination with the Regional Development Agencies in terms of their Regional Economic Strategies and the strategic funds they have available.

6.14 Largely the existing framework seems to be working well through appropriate guidance from central government. However, as with all aspects of local government, some regions are better than other due to more dynamic individuals

being involved. Government should build on such local successes by using a coordinated approach to disseminating the lessons learned.

6.15 The second crucial role for public authorities in respect of bioheat stems from the fact that they own a significant amount of building stock, much of which has heat-load characteristics that are ideal for bioheat (schools, hospitals, prisons, swimming pools etc.)

6.16 Apart from a few examples (again the result of a few motivated individuals), very little has been done on the bioheat front for such building stock.

6.17 Largely this is due to lack of awareness by the building managers / design engineers of the potential or costs of bioheat. However, it is also due to a lack of clear incentives for them to seriously consider bioheat.

6.18 Accordingly ILEX recommends that the government tries to mobilise the considerable resource that is represented by public building stock on two fronts:

- explore ways in which any building developments (refurbishments or new build) of public buildings, or developments with strong public involvement (e.g. community housing), are *required* to seriously consider bioheat and/or district heating as an option. (In effect, such developments would have to *prove* that bioheat is not the best option before deciding for a gas or oil-fired heating option); and
- extend existing obligations / targets on public bodies to reduce their carbon emissions.

6.19 Such measures will only work if the government at the same time provides local authorities with the information they require to examine the options for, and hopefully implement, bioheat. Accordingly, the comprehensive information and advice regime detailed previously will be crucial to the successful mobilisation of public authorities.

6.20 It should be noted that the government should have willing allies in local authorities for such measures given that bioheat has strong positive benefits for the local economy.

Joined up legislation

6.21 Bioheat is affected by very many different policies, directly or indirectly including:

- specific support regimes for biomass fuels and/or bioheat combustion facilities and/or district heating;
- renewable electricity legislation;
- energy taxation;
- national and European farming legislation;
- forestry legislation;

- environmental legislation relating to emissions (from combustion plant, and disposal of agricultural wastes);
- planning legislation;
- recycling legislation;
- landfill legislation; and
- building regulations, etc.

6.22 These policies emanate from many different central government departments (e.g. DEFRA, DTI, Treasury, ODPM, Scottish and Welsh assemblies) and/or their semi-autonomous agencies (e.g. Forestry Commission, Environment Agency, etc.)

6.23 To ensure that these policies do not frustrate the development of bioheat (and ideally promote its development) will require some form of inter-departmental coordination, possibly from a specific body.

6.24 ILEX understands that there is significant inter-departmental cooperation on a number of matters, some of which impact on bioheat (directly or indirectly). However, there is no inter-departmental organisation charged with promoting the development of biomass energy covering all its different aspects (fuel and end use).

6.25 ILEX would strongly recommend the creation of such a body, potentially as part of a larger inter-departmental body charged with facilitating the development of all renewable energy, not just biomass. Such a body would be an important element of a more effective information and advice programme as outlined earlier.

Providing financial assistance for bioheat

6.26 Bioheat needs financial support on two fronts:

- R&D and pilot / demonstration funding to help overcome the barriers associated with being an immature technology; and
- a more commercially oriented financial support regime to overcome barriers associated with environmental costs not being properly reflected in fossil fuel prices and waste disposal options. This support framework should consist of:
  - a major support programme similar to those for electricity in the UK and the continent (e.g. 'feed-in' tariffs, the NFFO, and the Renewables Obligation);
  - reducing VAT on bioheat capital equipment; and
  - a government-backed loan facility.

6.27 None of the above measures are mutually exclusive, and indeed should be regarded as complimentary. If they are properly designed, they should give a more cost-effective return (in terms of MWh of bioheat per £ spent) together, than if they were implemented on there own.

R&D and pilot / demonstration funding

6.28 Whilst there is much good R&D funding in the UK, the main criticism with regards to existing bioheat R&D funding in this area is that it is too focussed on the novel technology side of things, and that not enough attention is paid to more commercially-focussed R&D looking at some of the more practical aspects of implementing the bioheat supply chain.

6.29 With regards to pilot / demonstration funding, the existing series of measures (as set out in Annex C) largely work well[15]. Without such measures it is ILEX's belief that the future development of bioheat would be largely stifled.

6.30 However, many individuals in the industry expressed the view to ILEX that the major programmes are too prescriptive in the types of bioheat technology they support. In particular:

- too much money has been specifically set-aside for energy crops compared with that specified for forestry and/or agricultural residues. And some technologies (such as biogas) are specifically excluded; and
- the capital grants are too geared towards large-scale projects (particularly those with an electricity element).

6.31 By trying to second-guess what will come forward in this way the government runs the risk of not giving enough to certain technologies, and too much to others (which subsequently will not be called upon).

6.32 To rectify this potential problem, the government may want to consider making a significant percentage of the available monies available to all bioheat technologies on a first-come, first-served basis. It could still ensure that certain technologies receive some money by reserving a small percentage of the funds for specific technologies.

6.33 In general, ILEX would recommend that these types of demonstration / pilot funding programmes continue, but should be complementary to a more significant commercially oriented support regime as outlined below.

Major commercially oriented support regime

6.34 This should be the cornerstone of any set of policy measures to support bioheat. As set out in Section 5, there are a variety of options available for such support including capital grants, feed-in tariffs, power purchase contract auctions, tax exemptions, and obligations with tradable certificates.

6.35 Given that all the options would require primary legislation to support bioheat, ILEX recommends that the government focus on the option which appears to be the most effective in terms of delivering significant quantities of renewable energy

[15] Not withstanding the European Commission delay on giving the go-ahead for the infrastructure support scheme.

at least cost. In ILEX's view this would be some form of obligation mechanism with tradable certificates similar to the existing electricity Renewable Obligation.

6.36 Because there is no heat market involving licensed suppliers (on which to place an obligation), using such an obligation mechanism to support heat requires enlightened thinking. However, as set out in Annex A, ILEX believes there are no practical barriers to using such a mechanism for the support of bioheat.

6.37 In brief, though, such an obligation would ideally be placed on gas suppliers (as the main alternative fuel for heating), with potentially additional obligations being placed on heating oil suppliers and electricity suppliers in recognition of the amount of heating their fuels are used to provide.

6.38 Although such suppliers would have obligations imposed upon them expressed in MWh of gas / electricity / oil supplied, they would purchase obligation certificates from bioheat schemes who are awarded such certificates based on metered MWh of useful heat produced.

Correcting the VAT imbalance

6.39 A valuable mechanism would be to reduce the VAT charged on equipment used for bioheat to the same level as the VAT charged on energy consumption. This would give more appropriate price signals in the energy market and lead to a better allocation of resources.

6.40 One advantage of this type of support is that it need not be just applied to bioheat boilers. It could also be applied to the harvesting and processing equipment associated for biomass.

6.41 This would not necessarily result in schemes receiving more money than they need if additional support to bioheat were provided via an obligation mechanism with tradable certificates. This is because the lower VAT regime would bring forward more bioheat schemes as the economics of such schemes will have improved. The increased number of schemes will consequently lower the price of any heat ROCs.

A government-backed loan facility

6.42 A specialist, government-backed loan facility specifically for bioenergy (and potentially other renewable technologies) would help overcome a significant barrier in relation to raising finance for bioheat.

Moving forward

6.43 If the UK government decides to take any or all of these recommendations forward, much work would need to be done before they could be implemented.

6.44 Given that many of the recommendations would need to be implemented by, or have significant involvement from, departments other than DEFRA, the

development of an inter-departmental 'champion' for bioheat would be of great benefit. Such a body would then be able to coordinate:

- the development of an effective information and advice regime; and
- future legislation and actions by all departments that would impact on bioheat.

6.45 In addition, ILEX would strongly recommend exploring the issues and options in relation to an obligation mechanism with tradable certificates for bioheat.

6.46 Another piece of work that ILEX believes would be valuable is drawing together the large body of existing work on the potentials and costs of the various forms of bioheat. It should give government a better idea of the potential of bioheat (including the rate at which it could grow and its costs), which is essential before putting in place a major support mechanism. In addition, it should provide useful information which could be disseminated to the rest of the industry.

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ANNEX A – PRACTICAL IMPLICATIONS OF INCLUDING HEAT GENERATORS WITHIN AN ENERGY OBLIGATION

A.1 As set out in paragraphs 5.53ff, there is no practical reason why an obligation mechanism with tradable certificates could not be used to support bioheat.

A.2 The lack of existing centralised metering framework is an issue. The practicality and costs of establishing would need further study.

A.3 The lack of a homogenous heat 'market' with a centralised supplier licensing regime can also be overcome. Rather than obligate heat suppliers, there is no practical reason why suppliers of electricity or gas should not be obligated to purchase a certain percentage of ROCs from heat generators, which they can then redeem against an obligation expressed in terms of MWh of electricity or gas supply. This is because one of the most radical elements of an obligation approach is that *'green' certificates can be traded independently of the power*.

A.4 This concept enables all energy suppliers to share the cost of supporting renewable energy equally, irrespective of where they are located in the country, and enables renewable generators to be located in areas of the country where they are most cost-effective and sell their power locally.

A.5 This principle of trading 'greenness' separately from energy means that there is no practical reason why a supplier of electricity, say, should not be able to purchase certificates of greenness from a heat generator, and use them to offset against their electricity obligations. In theory, therefore, it should be simple to extend the current electricity renewables obligation in the UK to include heat. In practise, there are some issues that will need to be considered as set out below:

- A ROC 'exchange rate' may need to be developed.
  - The unit of measurement for ROCs are MWh, reflecting the fact that the renewable electricity is displacing fossil electricity. However, the 'greenness' of a MWh of renewable electricity may be different to a MWh of renewable heat. This is because renewable electricity generators are typically displacing relatively carbon-inefficient technologies (i.e. coal-fired power stations of low efficiency), whereas renewable heat boilers are more likely to be displacing relatively carbon-efficient technologies (i.e. gas-fired, high efficiency boilers).
  - Accordingly, it may be appropriate to specify that 1 ROC is equivalent to 2.5MWh of renewable heat, say and only 1MWh of renewable electricity.
- A centralised metering framework for heat will need to be developed.
  - Heat meters that can be remotely interrogated are relatively inexpensive. Only those heat-installations wishing to earn ROCs will need to install a meter.

  - The biggest issue will be in developing the framework for collecting the metered data and issuing the ROCs. However, using the existing electricity ROC infrastructure may not be too problematic.
- A separate percentage obligation on electricity suppliers may need to be developed specifically to cover heat.
  - If electricity suppliers can purchase heat ROCs to offset against their obligations this will automatically exert a downward pressure on the price of ROCs (there will be increased supply with no change in demand). Clearly, renewable electricity generators will rightly feel aggrieved, as the basis on which they have invested in renewable energy will have changed.
  - To rectify this, the level of the obligation will need to be increased (e.g. say from 15.4% in 2015 to 17.4%). However, even then the price of ROCs will be different (possibly higher or lower) to what they would have been under the old 15.4%, electricity-only ROC regime.
  - The 'best' solution would be to introduce a separate heat obligation on electricity suppliers (e.g. 2% of their electricity supplied must be covered by ROCs purchased from heat generators). This will mean that the price of electricity ROCs will not be impacted in any way, and a separate price for heat ROCs will emerge.
- Is it 'fair' that electricity consumers should pay to support heat?
  - The issue of who pays for supporting a technology is clearly (and rightly) politically contentious. It could be argued that electricity suppliers (and their customers) who are not involved in the heat market should not have to pick up the bill for changing the actions of heat suppliers.
  - This argument has some merit, although it should be pointed out that some 50% of domestic electric consumption is for heating purposes.
  - Given that primary legislation would be required anyway, it would probably be more appropriate to place an obligation on the suppliers of gas and heating oil, which are the main alternatives to biomass for heating fuel. Including electricity suppliers for part of the obligation may be appropriate because of the amount of electric heating used by domestic customers.
- What happens if the obligation is set too low or too high?
  - The financial support to renewables stems from the value of the ROCs that they can sell to suppliers. This, in turn, is a function of the penalty price and the amount of renewable energy that comes forward compared to the target level.
  - If the target is too low, there will be a significant amount of renewable projects coming forward compared with the target level such that the value of ROCs will be very low.
  - If the target is unrealistically high (e.g. set at a level which the industry physically could not deliver due to the time delay in getting a sufficient number of projects up and running), the value of ROCs will be too high, and customers will end up paying too much for supporting renewables.

ANNEX B – CO-FIRING AND THE RENEWABLES OBLIGATION

B.1 There is considerable debate as to whether allowing co-firing of biomass with coal in large power stations is a 'good' or 'bad' thing from the point of view of developing a sustainable bioenergy industry in the UK.

B.2 One school of thought is that burning biomass in coal-stations will help develop the biomass fuel supply infrastructure, with the additional benefit of displacing coal-fired generation (and thus lower CO_2 emissions)[16].

B.3 The other point of view is that the large coal-fired power stations will take a lot of the available cheap biomass, thereby increasing the cost of biomass to small heat installations and frustrating its development

B.4 The reality appears to be a mix of the two views. A large proportion of the biomass resource in the UK is not suitable for combustion in power stations without the owners of such stations investing significant sums in order to handle such material – something that they appear loath to do. As such, this biomass market is not adversely affected by co-firing (nor is it really helped).

B.5 However, there is some biomass (particularly sawdust) which is suitable for power stations and which is being used. This is clearly raising the cost of such biomass for other potential users. However, it is also developing a supply infrastructure for such biomass, and it is likely that the majority of this biomass would not be used for bioheat purposes if it were not co-fired, at least for many years. In this respect, it is probably a good thing.

B.6 If the aim of co-firing is partly to develop a biomass supply infrastructure which can then be used to foster the bioheat market, then probably one of the most important aspects is the rate at which biomass co-firing *declines*. Such a decline will be due to progressively reduced eligibility of such plant to earn ROCs, and as an inevitable reduction in coal-fired plant's operation due to increasingly tight sulphur constraints and (potentially) a high cost of CO_2.

B.7 If such a decline is gradual, it will enable the bioheat market to grow and pick-up the biomass that used to go to co-firing. If there is no decline, then it will clearly have a detrimental impact on the development of bioheat installations. Likewise, if there is a very sudden decline, it could have a detrimental impact on biomass fuel suppliers.

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16 Previous work ILEX has undertaken for the DTI indicates that co-firing does in fact result in coal being displaced by biomass rather than gas (as might have been the case had burning biomass to earn ROCs changed the relative positions of coal-fired plant and CCGTs).

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ANNEX C – EXISTING SUPPORT PROGRAMMES AND PUBLIC BODIES INVOLVED WITH BIOHEAT

Support programmes

C.1 There are a variety of different support programmes that are of relevance to bioheat. The nature of the support is largely of the kind appropriate for demonstration / pilot schemes. Listed below are the main support programmes that ILEX is aware of.

Support for heating installations

Bioenergy Capital Grants scheme

C.2 This scheme, administered by the DTI, provides capital grants towards the installation of biomass-fuelled heat and/or power generation units. £66m was made available. The focus is predominantly on electricity and CHP applications, although some is available for heat-only projects.

Clear Skies / Scottish Community and Householders Initiative

C.3 The £10m Clear Skies initiative provides grants and advice to homeowners and communities wishing to install renewable technologies to provide heat and/or power. It is funded by the DTI and administered by BRE. It covers England, Wales and N. Ireland.

C.4 The Scottish equivalent is the Scottish Community and Householders Initiative, worth £3.7m over the three years till 2006. It is funded by the Scottish Executive and administered jointly by the Energy Savings Trust and Highland and Islands Enterprise.

Carbon Trust RD&D funding

C.5 The Carbon Trust runs an RD&D funding programme where grants are available for projects which are innovative and demonstrate a clear reduction in carbon emissions. Last year it spent £5m.

Carbon Trust Carbon finance

C.6 The carbon trust additionally will make equity investments in more mature projects that can demonstrate carbon reductions. Bioheat falls under this category.

Enhanced Capital Allowances (ECAs)

C.7 Capital allowances on plant and machinery are generally given at 25% a year on a reducing balance basis. However, with ECAs, businesses can write off 100% of the cost of energy saving equipment against their taxable profits within the first

year of investment. Businesses claim the allowance on their income tax or corporation tax returns.

C.8 Boilers, including biomass-fuelled boilers, are covered by the scheme.

Community Energy Programme

C.9 A £50m funding programme to develop community/district heating schemes. It has development grants and capital grants. Run by the Energy Savings Trust.

Support for the development of fuel supply infrastructure

The England Rural Development Programme (ERDP)

C.10 The EU Rural Development Regulation (Council Regulation (EC) No. 1257/1999) provides EU Member States with the opportunity to protect and improve the countryside and to encourage sustainable enterprise and thriving rural communities.

C.11 The England Rural Development Programme (ERDP) sets out how the UK Government is using the EU Rural Development Regulation (RDR) in England. It provides a framework for the operation of ten schemes which aim to protect the environment and support the rural economy and communities:

- Energy Crops;
- Environmentally Sensitive Areas;
- Farm Woodland Premium;
- Hill Farm Allowance;
- Organic Farming;
- Countryside Stewardship;
- Processing and Marketing Grant;
- Rural Enterprise;
- Vocational Training; and
- Woodland Grant.

C.12 Projects are supported under these schemes through a combination of national and EU funds.

C.13 Parallel arrangements have been made in Wales, Scotland and Northern Ireland under their respective rural development programmes.

Energy Crops Scheme

C.14 This is run by DEFRA in partnership with the Forestry Commission as part of the England Rural Development Programme. It is worth £29m during the period 2000 to 2006. It provides establishment grants of between £1,600 to £920/ha for energy crops, and grants covering up to 50% of the costs of establishing producer groups for short-rotation coppice.

Energy Crops Infrastructure Support Scheme

C.15 This is intended to provide grants to help the development of the infrastructure required to harvest, store and supply biomass to energy end-users. It is worth £3.5m to be spent by 2006. However, it is currently held up due to having to seek State Aid approval from the European Commission.

C.16 It does not cover SRC as this is covered by the Energy Crops Scheme.

Woodland Grant Scheme / Scottish Forestry Grant Scheme

C.17 Administered by the Forestry Commission, the WGS gives grants to create new woodlands and manage existing woodlands. It is open to all owners of woodland. It is part of the England Rural Development Programme.

Farm Woodland Premium Scheme

C.18 Also administered by the Forestry Commission, the FWPS is designed to encourage the creation of new woodlands on farms and can only be received in conjunction with the Woodland Grant Scheme. Whilst the WGS offers grants towards the establishment or maintenance of woodland, the FWPS offers annual payments to compensate for agricultural income foregone. Annual payments are made for either 10 or 15 years depending on the type of trees planted and how they will be managed. It is only available to farmers. It is part of the England Rural Development Programme.

Common Agricultural Policy (CAP)

C.19 From 1 Jan 2005 there will be some support for energy crops under CAP whereby farmers will receive a €45/ha production subsidy. However there is a 1.5m ha ceiling across the EU. If this is exceeded, the €45/ha support will be reduced pro-rata.

C.20 Land for which the CAP energy crops subsidy is claimed is not available to receive set-aside payments. Set-aside land, however, can be used to grow energy crops.

Other support

Climate Change Levy

C.21 Although not a direct support to bioheat, the CCL does increase the cost of alternative fuels (albeit by a relatively small amount). Under the CCL, suppliers of gas and coal must charge an additional 0.15p/kWh, and electricity suppliers must charge an additional 0.43p/kWh.

Renewables Obligation

C.22 Whilst this obligation, in its current form, is only concerned with the support of renewable electricity, it is likely to have a significant impact on bioheat through its influence on the development of the biomass fuel supply chain. The DTI is

responsible for administering the scheme. The obligation requires electricity suppliers to meet 3% of their supplies from renewable sources for 2002/3, rising to 15% by 2015.

Community Renewables Initiative

C.23 This is a £1m programme funded by the Countryside Agency to stimulate community-based partnerships. It has supported 10 groups around to country to help promote renewable within their communities by providing information and acting as facilitation facility.

Public bodies

C.24 A great many different public bodies influence the development of bioheat. This section lists some them, and the nature of their influence, to illustrate the need for good coordination to ensure that the actions of one do not unnecessarily frustrate the development of bioheat. The list is not exhaustive, especially in relation to the very many smaller organisations that are involved in bioheat.

Central government

DEFRA

C.25 Main department to directly affect the production of potential sources of biomass fuel, through developing legislation that will regulate and support farmers and forest owners.

C.26 Other key bioheat-related areas are environmental through legislation that will increase the cost of burning fossil fuels, and increase the cost of disposing of organic wastes.

Department of Trade and Industry (DTI)

C.27 Main department responsible for energy policy. Responsible for legislation that will regulate and support generators of electricity and heat, including those from renewable sources.

Treasury

C.28 Responsible for the budgets of all other departments. Treasury approval required for all measures such as CO_2 taxes, VAT exemptions, etc.

Office of the Deputy Prime Minister (ODPM)

C.29 Responsible for the planning framework in which local authorities must operate, including setting guidelines for the development of renewable energy. Also responsible for building regulations (which could influence the development of bioheat boilers).

Other departments

C.30 Several departments (or their subsidiary bodies) own significant amounts of the publicly-owned building stock that is not owned by local authorities. Much of this has heat profiles that are eminently suitable for bioheat (e.g. prisons, hospitals). In addition, many of these bodies have carbon-reduction targets (e.g. hospitals).

Local government

C.31 Local government plays an important role in terms of developing the structure and local plans that set the planning framework for new developments such as renewable energy.

C.32 In addition, local government is also a significant owner of building stock, much of which has heat profiles that are suitable for bioheat (e.g. leisure centres, government offices, schools.). Most local government also has targets for CO_2 reduction and/or renewables implementation.

Government agencies

C.33 There are many agencies that are either totally or partly funded by money from central and/or local government that will have an influence on bioheat.

Carbon Trust

C.34 Provides funding and advice for business on low-carbon technologies and projects. Provides capital grants, and also administers the Enhanced Capital Allowances Scheme.

Energy Savings Trust

C.35 Similar to the carbon trust, but with more of a focus on energy-saving projects, plus offers more advice to households. More recently they have increased their scope to include advice and some grants for renewable energy.

Energy Efficiency / Renewable Energy Advice Centres

C.36 The Energy Efficiency Advice Centres are a network of centres across the country that provide advice to local households and businesses relating to energy efficiency – i.e. the measures they can take, and the grants that are available.

C.37 More recently, a number of these centres have set up Renewable Energy Advice Centres that offer a similar type of advice but focussed on renewable energy.

Regional Development Agencies

C.38 These bodies were set up in 1999 to provide leadership for regional economic development as well as to supply targeted funding. Each of the nine RDAs must produce an economic development strategy which will set the framework for subsequent investments. Renewable energy is one area of their focus.

Forestry Commission

C.39 Main government department responsible for developing and implementing policy relating to forestry in the UK. The Forestry Commission is also the single largest owner of forestry in the UK.

Environment Agency

C.40 Main agency responsible for implementing, and helping develop, legislation relating to the release of pollutants into the environment. Particularly relevant to increasing the costs of fossil fuels, and the costs and options for disposal of certain agricultural residues. Also has an impact relating to regulations limiting emissions from biomass plant.

Countryside Agency

C.41 Funded by DEFRA. Aims to promote rural life. Has some grants available for rural projects such as those available under the Community Renewables Initiative.

Buildings Research Establishment

C.42 Government-funded research establishment. Administers the Clear Skies grant scheme.

National Non-Food Crops Centre

C.43 Recently created body to provide the central focus for research into non-food crops including energy crops. Disseminates information, plus funds some research.

National Energy Research Centre

C.44 Recently created body to provide the central focus for research into heat and power generation technologies.

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Quality Control Check Sheet

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Director: Stephen Andrews	Date: 03 June 2004
Project Manager: Rhian Bisson	Date: 03 June 2004
Author: Rhian Bisson & Mary Miller	Date: 03 June 2004
Administrator: Wendy Warrick	Date: 03 June 2004

ILEX Energy Consulting
King Charles House
Park End Street
Oxford, OX1 1JD
UK

Tel: +44 (0)1865 722660
Fax: +44 (0)1865 722988
E-mail: energy.consult@ilexenergy.com
www.ilexenergy.com
www.ewe.ch

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