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Waste Wood as a Biomass Fuel

Market Information Report

Waste Infrastructure Delivery Programme
April 2008

defra
Department for Environment
Food and Rural Affairs

Department for Environment, Food and Rural Affairs
Nobel House
17 Smith Square
London SW1P 3JR

Tel: 020 7238 6000
Website: www.defra.gov.uk

Information about this publication and copies are available from:

Waste Infrastructure Delivery Programme
Defra
Area 6E, Ergon House,
London
SW1P 2AL

Tel: 0207 238 4290
Email: WIP@defra.gsi.gov.uk

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Glossary

ABPR	Animal By-products Regulations
BERR	Department for Business, Enterprise and Regulatory Reform (previously DTI)
BMW	Biodegradable Municipal Waste
BVPI	Best Value Performance Indicators
CA	Civic Amenity
CHP	Combined Heat and Power
C&I	Commercial and Industrial
C&D	Construction and Demolition
Defra	Department of the Environment, Food and Rural Affairs
DTI	Department of Trade and Industry
EA	Environment Agency
ECA	Enhanced Capital Allowance
EPC	Engineering, Procurement and Construction
EPRL	Energy Power Resources Limited
EU	European Union
Ktpa	Thousand Tonnes Per Annum
LA	Local Authority
LATS	Landfill Allowance Trading Scheme
MSW	Municipal Solid Waste
Mtpa	Million tonnes per annum
NISP	National Industrial Symbiosis Programme
PFI	Private Finance Initiative
PPA	Power Purchase Agreement
SRF	Solid Recovered Fuel
RO	Renewables Obligation
ROC	Renewables Obligation Certificate
Tpa	Tonnes per annum
WID	Waste Incineration Directive
WIDP	Waste Infrastructure Delivery Programme
WRAP	Waste and Resources Action Programme

Executive summary

Wood is one of the oldest fuel sources known to man. Its use is undergoing something of a renaissance, with ever greater awareness of the need to reduce our reliance on fossil fuels in favour of renewable alternatives, as an important element of tackling climate change.

While recycling and energy markets for clean, virgin wood have been growing in recent years, waste wood has been a largely overlooked resource. This is in part due to it often arising as part of a mixed waste stream, with limited availability of facilities for its segregation, and also a result of its predominantly contaminated nature, which often makes recycling impractical. With around 10 million tonnes of waste wood being produced in the UK each year, most of which goes to landfill, this is a great missed opportunity.

The significant carbon and energy benefits of recovering energy from waste wood have been highlighted in a number of recent publications, including the Waste Strategy for England 2007, in which waste wood was identified as one of a number of priority materials for action, the UK Biomass Strategy and the Energy White Paper. Biomass energy generation will have an important role to play in meeting the UK share of the 20% European Union (EU) renewable energy target. It has been estimated that recovering energy from 2 million tonnes of waste wood could generate 2600GWh electricity and save 1.15 million tonnes of carbon dioxide equivalent emissions, with greater benefits available by recovering heat as well as power[1].

With the majority of waste wood arisings being contaminated, the key to realising this potential is greater Waste Incineration Directive (WID) compliant combustion facilities. A number of economic measures exist, and are being strengthened, to divert waste from landfill and, in the case of waste wood, into renewable energy markets. While aggregation points and supply chains for waste wood are in their infancy, these are expected to grow (as they are already doing) with better market knowledge, greater WID compliant combustion capacity with better geographical distribution, and stronger incentives for renewable energy.

The Government announced its plans to band the Renewables Obligation (RO) in May 2007, which will significantly increase support for electricity generated from biomass such as waste wood. Further measures to boost renewable energy generation will be needed to meet the UK share of the EU renewables target. These will flow from the Heat Call for Evidence, published in January 2008, and the work leading up to a UK Renewable Energy Strategy intended for 2009.

[1] Waste Strategy for England 2007

This market information report has been drawn together from a range of published material and with the expert input of a number of producers, aggregators and users of waste wood. The intention is to provide an overview of the current shape of the waste wood market and expected direction of travel, to assist those looking to grow the market for this large and under-utilised renewable energy resource.

1. Introduction

1.1. Background

This report has its genesis in response to recommendation 4 of the Biomass Task Force Report to Government, published in October 2005, as follows:

"The Government should set up a strategic group within the Waste Implementation Programme to take forward the development of wood waste as an energy source. This group should include representation from the Waste and Resources Action Programme (WRAP), given its knowledge of the recycling industry and expertise in industry development."

More recently, waste wood was identified as a priority material for action in the Waste Strategy for England 2007, which outlined the Government's intention to facilitate greater recovery of energy from waste wood.

The purpose of this report is to provide salient market information to progress the development of wood waste as an energy source.

WRAP has been consulted on the wood recycling industry and WRAP reports have been used in research in relation to waste wood arisings. However, the principal focus of WRAP is on recycling rather than treatment in residual waste management facilities. For this reason the majority of the analysis for this report has been performed by the Waste Infrastructure Delivery Programme (WIDP).

1.2. Drivers for change

The UK has been set targets by the EU to divert biodegradable municipal waste from landfill. At the same time, an objective of the Government's Energy Review[2] is to reduce reliance on electricity generation from fossil fuels, which will be assisted by investment in biomass energy recovery facilities[3].

In order to drive behavioural change in waste management, Government has put in place a number of economic measures such as the Landfill Tax escalator and the Landfill Allowance Trading Scheme (LATS). LATS is one of the Government's key measures to reduce the amount of Biodegradable Municipal Waste (BMW) going to landfill and as such will see progressive reductions in the amount of wood that disposal authorities can collectively landfill.

The Landfill Tax escalator applies to all tonnages of active waste sent to landfill and provides a disincentive to dispose of waste to landfill by increasing the cost of landfill relative to alternative disposal methods.

[2] Source: DTI Energy Review (July 2006), Section 5.15

[3] Energy recovery includes plants which produce either electricity, heat or a combination of the two.

In addition to these measures, the Government has made clear its aspirations to deliver greater diversion of waste wood from landfill to reduce carbon impacts of waste management, boost renewable energy generation and contribute to a more diversified fuel chain. These proposals are set out in the Waste Strategy for England 2007[4], UK Biomass Strategy[5] and in the Reform of the Renewables Obligation (RO)[6].

1.3. Methodology

The principal focus of this report is to identify the practical problems of diverting waste wood from landfill from the industry perspective. The industry falls into three broad categories; Producers, Aggregators and Users. Our research has therefore been informed by discussions with industry in these three areas, with a list of contributing organisations included in Appendix 1. Information about the waste wood industry has also been sought from a number of published reports which are listed in Appendix 2.

The key questions that we have sought to address in this report are:

1. Identify the existing economic incentives and disincentives for producers, aggregators and users that affect the disposal of waste wood to landfill.

2. Are there sufficient incentives in place for industry (in the case of Commercial and Industrial (C&I) waste) and Local Authorities (LA) (with regard to Municipal Solid Waste (MSW)) to develop the necessary infrastructure to divert waste wood from landfill?

3. What are the barriers which are holding back the development of waste wood supply chains?

4. What more (if anything) can be done to stimulate industry and LA to divert waste wood from landfill?

[4] http://www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste07-strategy.pdf (Chapter 4, paragraph 19; Chapter 5, paragraphs 30-31;and page 116 item 32)
[5] http://www.defra.gov.uk/Environment/climatechange/uk/energy/renewablefuel/pdf/ukbiomassstrategy-0507.pdf (page 14, footnote 18; page 15 paragraph 3.6; page 26, paragraphs 4.35 and 4.39; page 38, Annex "A"; page 41; Annex "b" and page 42, Annex "C")
[6] http://www.gnn.gov.uk/environment/mediaDetail.asp?MediaDetailsID=203187&NewsAreaID=360&ClientID=201&LocaleID=2

2. Producers

2.1. Overview

Waste wood arises from a wide variety of sources, in varying quantities and levels of purity. The main three areas in which waste wood arises are, Construction and Demolition (C&D), MSW and C&I. A feature of waste wood arisings, particularly from C&D and MSW, is that both tonnages and sources are unpredictable and materials are often mixed with other types of waste. As such, there is uncertainty over the exact tonnage of waste wood arising in the UK. WRAP estimates that there are 10.6mtpa[7] of waste wood in arising in the UK, as set out in table 2.1.

Table 2.1: Estimate of total wood waste arisings in the UK ('000tpa)

Waste stream	England	Rest of UK	UK
C&D[8]	4,105	935	5,040
MSW (excl furniture)	913	152	1,065
C&I	<unknown>	<unknown>	4,481
Total	**<unknown>**	**<unknown>**	**10,586**

Source: WRAP 'Review of wood waste arisings and management in the UK' (June 2005)

Further details on each waste stream are detailed below, while a more detailed evaluation of UK biomass resource and its potential for energy generation is set out in Annex A of the UK Biomass Strategy. This lists waste wood as the single largest "Dry" Biomass source constituting 31% of total Dry Biomass[9]. However, in terms of carbon savings, dry waste wood has the potential to contribute 45% of carbon savings from all dry materials arising from the substitution of grid electricity and heating oil.

2.2. Municipal waste stream

The two main areas in which waste wood arises in the MSW waste stream are a) household collections, and b) at Civic Amenity (CA) sites. The estimated tonnages of waste wood arising in MSW are set out in table 2.2.

Table 2.2: Estimate of wood waste arisings in MSW ('000tpa)

Waste stream	England	Rest of UK	UK
Household collection	356	62	418
Bulky collections	37	10	47
CA sites	498	74	572
Non household	22	5	27
Total	**913**	**152**	**1,065**

Source: WRAP 'Review of wood waste arisings and management in the UK' (June 2005)

[7] Source: WRAP 'Review of wood waste arisings and management in the UK' (June 2005). Note that an estimate by ERM, as quoted in the Waste Strategy for England 2007, is lower at 7.5 million tonnes.

[8] Note that this figure is an average of the maximum and minimum estimates which, for the UK, are 7.9mtpa and 2.2mtpa respectively.

[9] http://www.defra.gov.uk/Environment/climatechange/uk/energy/renewablefuel/pdf/ukbiomassstrategy-0507.pdf

It is likely to be relatively difficult to segregate waste wood from household collections due to the relatively erratic and unpredictable nature of waste wood arisings as the majority of household waste is food, packaging and paper.

Conversely, waste wood arising at CA sites is likely to be relatively easy to segregate and aggregate. CA sites in close proximity to end markets for waste wood are in some cases already collecting waste wood for energy recovery at existing biomass plants where these are geographically proximate.

2.3. Construction and demolition waste

It is estimated that more than 4mtpa of waste wood arises in the construction and demolition sector in England. Typically construction waste consists of shuttering used in the manufacture of concrete, which is often plywood, containing nails/screws and treated (with chemicals and preservatives) to prolong life. Demolition waste wood is often mixed with other types of demolition waste, such as rubble, reinforcing bars, tiling etc.

Construction and demolition waste is typically disposed of using skips at a cost of between £40 to £150 per tonne. There can be a small financial incentive for building contractors to separate wood waste from other wastes but this tends to be in the region of no more than £20 per tonne, which, given any potential space restrictions at sites, labour costs, skip hire costs is unlikely to be a sufficient incentive to operate separate skips (see section 2.7).

The UK construction industry consists of 250,000 firms[10] ranging from large players with annual turnovers of several £billion to sole traders. The large construction companies have resources, space and internal pressures to ensure that waste wood is minimised. However, due to the difficult nature of segregating waste, smaller companies are less likely to adopt such a robust approach. It is estimated that the large construction companies account for a small proportion of wood waste because they have stricter recycling and re-use policies. It has been suggested, for example, that only 20ktpa of waste wood was from the larger contractors, with the remaining 4,000ktpa from a very large number of relatively small players.

Defra has consulted on the introduction of a requirement for Site Waste Management Plans on construction sites with the view to commencing regulations in April 2008. The Waste Strategy for England 2007 stated that non-statutory guidance to accompany these regulations will highlight beneficial alternatives to landfill for key waste materials, such as wood, and encourage separate collection of such materials at construction and demolition sites.

[10] Source: Department for Business, Enterprise and Regulatory Reform (BERR)

2.4. Commercial and Industrial waste

The main contributors to C&I waste wood are set out in Table 2.3. The C&I sector covers a wide range of activities which means that there is no readily available data for the many sources of waste wood.

Table 2.3: Estimate of waste arising in the commercial and industrial waste streams ('000tpa)

Waste type	Tonnage	Area covered
Furniture manufacture	531	UK
Panelboard manufacture	1,107	UK
Wood products for construction	201	England & Wales
Wood packaging	40	UK
Other industrial wood wastes	2,552	England & Wales
Railway sleepers	26	UK
Utility poles	24	UK
Total	**4,481**	

Source: WRAP 'Review of wood waste arisings and management in the UK' (June 2005)

Large producers of waste wood, such as the panelboard and furniture industry typically have a degree of self sufficiency through established processes for the recovery or reuse of waste materials. For example, a number of companies in the furniture sector operate biomass boilers. These can use in the region of 70ktpa of waste wood to generate heat for the furniture manufacturing process.

The WRAP report did not identify the source of 'other industrial wastes' but stated that 'a large proportion of this is likely to be packaging'. C&I wood waste is likely to be from a range of sectors, including furniture manufacture, panel-board, supermarkets.

2.5. Recovery and disposal routes

The key routes for recovery or disposal of waste wood**,** in their order of priority in the waste hierarchy, are:

- Recycling;
- Energy recovery / incineration; and
- Landfill;

The route taken will be strongly influenced by the grade of the waste wood. There is no industry wide accepted definition of different grades of waste wood but it broadly falls into the following categories:

- **Grade A** – clean wood, relatively homogeneous (hardwood / softwood), very few contaminants (such as fixings, paint, coverings)
- **Mixed grade** – hard wood and softwood mix, including some contaminants such as paint and screws but as a relatively low proportion.

- **Low grade** – processed wood containing contaminants such as panel board, melamine.

The suitability of methods of disposal of unprocessed grades of wood is set out in the table below:

Table 2.4: Suitability of methods of disposal for grades of waste wood

Grade	Landfill	Energy recovery	Recycling
Grade A	High	High	High
Mixed grade	High	Medium	Medium
Low grade	High	Medium	Low

Note that while landfill is highly 'suitable' for disposal of all grades, it is the least desirable option. Energy recovery is classed as medium suitability for lower grades of wood due to the need for cleaning and Waste Incineration Directive (WID) compliance.

Historically landfill was relatively cheap and benefited from low processing costs as all grades of waste wood (excluding hazardous) could go to landfill. However, landfill tax has increased significantly in recent years (£24 per tonne in 2007/08), and will increase at £8 per tonne from 2008/9 to 2010/11. Furthermore there is a scarcity of landfill in some parts of the UK which means that landfill gate fees are also increasing.

The economics of energy recovery plants is complex and is discussed in more detail in section 4. Energy recovery plants generally require a relatively homogeneous fuel supply, which either has to be high grade or undergo 'cleaning' processes to remove contaminants which may damage the plant or the external environment.

The principal recycling outlets for wood are within the panel board industry, animal bedding, equine surfacing and garden mulches. All recycling outlets require high grades of waste wood, which, as with energy recovery, can be achieved either through front end sorting of wood, or back end cleaning processes (although it is not believed to be cost-effective, if even possible, to remove all contaminants from low grade waste wood).

Unlike energy recovery, the main recycling outlets are unable to use waste wood which has high levels of contaminants, such as plastic coatings and resins. The panel board industry is restricted in the use of processed woods (such as those containing melamine) for the manufacture of panel board, and animal bedding users demand a product free from contaminants.

The Environment Agency (EA) published a technical report and regulatory position statement on waste wood in October 2007, as part of its Waste Protocols Project[11]. The guidance confirms the de-regulation of virgin timber and details how the Agency will continue to regulate clean non-virgin timber and treated timber. It also highlights the wide variety of standards and quality

[11] http://www.environment-agency.gov.uk/subjects/waste/1019330/1334884/1721340/?lang=_e

controls in place within the waste wood industry. However, there is a recognition that it is unrealistic to attempt to decontaminate waste wood that is impregnated with chemical contaminants.

2.6. Economic drivers

Landfill costs are currently around £35 to £45 per tonne and likely to increase in line with landfill tax increases (£8 per tonne from 2008/09 to 2010/11). By 2010/11 landfill gate fees are estimated to be £20 per tonne and landfill tax at £48 per tonne, giving a total estimated landfill cost of ~£70 per tonne. Furthermore, landfill gate fees are likely to increase as landfill becomes more scarce.

Recovery and disposal routes other than landfill are likely to become more attractive where the costs are lower than landfill. High grades of waste wood are currently sought after because there is high demand for clean wood from the panel board industry, as animal bedding, equine uses and garden mulches. The current recovery and disposal costs are set out in table 2.5.

Table 2.5: Current cost of disposal of wood

Grade	Example methods of recovery and disposal	Recovery/Disposal Cost/Income (per tonne)
Grade A	Animal bedding, equestrian use, panel board industry, garden mulches	Potentially income of up to £150
Mixed grade	Processed / sorted for use in panel board industry	Cost of £5 to £30[12]
Low grade	Landfill	Equivalent landfill cost (currently £35 to £45), plus LATS cost if from MSW source

Grade A materials are highly sought after due to the wide range of alternative uses. Lower grades of waste wood can be converted from a disposal cost to an income through processing (cleaning and sorting) – via an Aggregator (see Section 3) - to provide cleaner grades of waste wood. As markets develop for lower grades of waste wood and demand increases the current disposal cost may reduce and potentially could attract income.

LATS is an economic instrument designed to help waste disposal authorities implement the most cost-effective way to make their contribution to the achievement of England's share of UK obligations under the European Landfill Directive (99/31/EC). The directive sets mandatory targets for the reduction of BMW sent to landfill. LATS provides a further incentive for LAs to recycle or re-use waste wood

[12] Source: Letsrecycle.com – Prices at April 2007.

2.7. Typical contractual arrangements

Typically producers enter into relatively short term disposal contracts or one off arrangements for skip hire. The contractual arrangements offer slightly lower disposal prices for segregated waste wood, which will depend on the quality of the wood and level of contamination. Incentives to segregate waste wood can attract a discount of ~£20 per skip (total disposal cost is ~£160, reducing to £140 for segregated wood waste).

2.8. Regulatory drivers

There are relatively few regulatory drivers attached to the recovery and disposal of waste wood.

The Producer Responsibility Obligations set targets to drive greater recycling and recovery of packaging for businesses with a turnover of more than £2m and who handle more than 50 tonnes of packaging per annum. A key element of this is waste wood in the form of pallets.

Implementation of the EU Landfill Directive means that since 30 October 2007 all non-hazardous waste must be pre-treated where it is destined for disposal in landfill. This prior treatment includes any process including sorting (e.g. by extracting recyclables) which alters the characteristics of the waste such as by reducing its volume. It is hoped this requirement in conjunction with others measures adopted under the Waste Strategy for England 2007 will help facilitate greater separation of wood from the residual waste stream.

The competent authorities (the EA or LAs) regulate some aspects of the disposal of waste wood. The EA regulates the disposal of hazardous waste to landfill or incineration. Where the regulations dictate when lower grade waste wood is incinerated it must be done so in a WID compliant facility which may be regulated by the EA or the LAs.

The EA regulates the recovery and disposal of waste including wood so as to prevent harm to human health and the environment. Regulation is generally undertaken through the permitting of the places where waste is recovered or disposed of or through the registration of exemptions from the need for a permit. Where waste wood is incinerated, this must be done so in a permitted incinerator and subject to the additional requirements of the Waste Incineration Directive. Landfill sites are subject to permits and the additional requirements of the Landfill Directive which includes categorising all landfills as inert, non-hazardous or hazardous. Once classified sites may generally only receive waste within their designated category. An exemption is provided for the burning in the open of small quantities of wood arising from demolition at the place where it is produced .

Currently, Government assesses LA waste performance through the suite of Best Value Performance Indicators (BVPIs). Bi-annual compulsory recycling and composting targets for household waste were set for each LA in England. Performance against the targets is measured by adding together their recycling and composting rates under BVPI 82a (household waste the LA

sends for recycling) and 82b (Waste sent by the authority to composting or anaerobic digestion), both of which will include any wood waste processed. There are no targets for energy recovery, which is measured by BVPI 82c, with LAs only able to achieve a score in locations close to installed WID compliant combustion capacity.

From 2008/09, the new national indicator set for LAs and LA partnerships is the only means of measuring national priorities agreed by Government and the only measures on which central government will performance manage outcomes delivered by local government working alone or in partnerships. There are three annual waste indicators:

- Household waste not reused, recycled or composted (kilograms residual waste)
- Household waste recycled and composted (per cent)
- Municipal waste landfilled (per cent)

There will be no mandated targets. Instead, Government Offices will negotiate up to 35 area targets for each Local Area Agreement. Government strongly encourages waste targets where areas are under-performing.

2.9. Future capacity of disposal routes

Capacity for processing of waste wood by recycling is dependent on other industries, such as the panel board industry, and demand for animal bedding, equine uses and garden mulches. The quality of raw material is also critical, with the majority of waste wood being too contaminated for recycling applications. While there may be scope for limited further development of recycling, it appears that this capacity is unlikely to increase significantly in the near future.

Demand for energy recovery from non fossil fuels is likely to increase in the future, as set out in the Government Energy Review. Biomass fuels are expected to play an important role in this regard, as we seek to significantly expand renewable energy generation in the context of the EU 20% renewable energy target.

2.10. Summary and conclusions

The results of this section (Producers) of this report are key to the focus of the following sections of this report. Therefore the summary and conclusions are set out below, which form the basis for the next sections.

- Energy recovery and recycling are the main alternatives to sending waste wood to landfill;
- Recycling outlets currently require higher grades of waste wood than energy recovery;
- Recycling outlets are well developed and there is limited scope for a significant increase in recycling due to dependence on output from

other industries and the contaminated nature of most waste wood; and

- Energy recovery is the most likely method of diverting additional waste wood from landfill.

3. Aggregators

3.1. Overview

The main sites for aggregating waste wood are LA CA sites or at private sector sites such as transfer stations. Aggregators offer varying degrees of processing (sorting inputs at the front end or removal of contaminants during processing) and certification of waste wood.

There are a relatively large number of small private sector waste wood aggregators (many of whom are members of the Wood Recyclers Association[13]) who are predominantly focused on aggregating high grades of waste wood. Typically the focus of aggregators is on recovery of pallets or packaging, provision of materials for chipboard manufacture, chipping for animal bedding, equestrian use or garden mulches. Demand from recyclers is for high grade materials, so there are a relatively low number of aggregators focused on low grade waste wood.

LAs are responsible for the operation of CA sites, where waste is delivered by either individuals (without a charge), or as trade waste (with a charge to cover disposal costs). Skips are usually provided for mixed waste wood. High grades can be recycled and, where the markets exist low grades can be sent (for a cost) to energy recovery or other industrial users where these are geographically proximate.

3.2. Typical contractual arrangements

For aggregators, waste wood input contractual arrangements are as per producers' output arrangements which are described in section 2.7.

Aggregators' output contractual arrangements vary according to the nature of the outlet. Typically the supply of materials to recyclers tend to be on a 'spot basis', with no penalties for failure to supply. Residues to landfill will also be on a spot basis, but it is unlikely that materials are accepted by aggregators without a clear secondary use.

Larger aggregators have developed arrangements to supply waste wood as a biomass fuel which include typical 'take or pay' contract provisions, including:

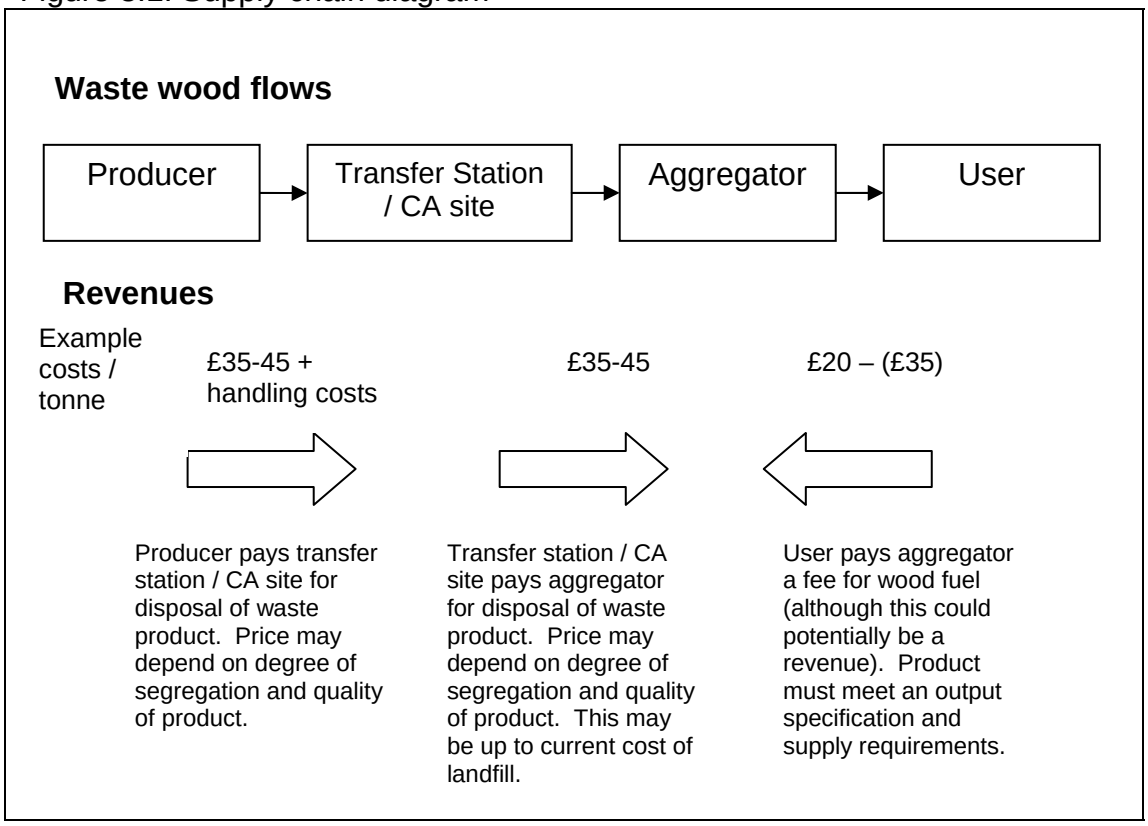
- A fuel cost is paid by users for high quality, guaranteed supply of clean or contaminated wood;
- Long term contract with users (~10years);
- Certificate of compliance with output specification (provided by a third party);
- Price sharing arrangements linked to the moisture content;
- Penalties paid by aggregator for non-supply;
- Penalties paid by user for non-acceptance; and

[13] http://www.woodrecyclers.org

- Prices index linked to the Retail Prices Index / landfill tax and fuel cost.

A typical supply chain diagram is set out below:

Figure 3.1: Supply chain diagram



3.3. Economic incentives

Input tonnages

Aggregators are able to generate revenues on input tonnages where alternative disposal routes have a cost, such as landfill. These revenues vary according to the grade of material and are set out in table 4.5.

Output tonnages

Aggregators are able to generate revenues on output tonnages for high grades of wood and processed low grades of wood. Low grades of waste wood which cannot be processed are not aggregated as they go to landfill, which attracts a disposal cost.

There are relatively strong financial incentives for aggregators to collect and process the high grades of waste wood, due to the relatively high demand for such materials from recyclers and increasingly from biomass energy generators.

There is very low demand for low grades of waste wood from recyclers so aggregators are only incentivised to collect low grades of waste where

alternative disposal routes exist, for example close to WID compliant biomass plants.

Aggregators are able to derive revenues from the supply of low grades of waste wood to biomass plants where they meet certain contractual requirements (as set out in section 3.2). In order to meet the requirements, a relatively high level of processing tends to be required by the aggregator.

Contract rates for the supply of waste wood to biomass plants are determined on a plant specific basis due to the low number of biomass plants in the UK which accept waste wood. It is understood that biomass plants are prepared to pay a fuel cost for processed waste wood. This is discussed in more detail in section 4.6.

3.4. Aggregator profiles

Typically aggregators tend to be relatively small, handling between 50ktpa to 100ktpa of waste wood per year. The main outlets for such companies are recovered pallets, animal bedding, equestrian surfaces, garden mulches as well as providing high grades of wood to the panel board industry.

There are some waste wood aggregators who supply wood (not necessarily waste wood) to the biomass industry, some examples of which are set out in table 3.1.

Table 3.1: Wood supplied to the biomass industry

Supplied to	Fuel	Annual tonnage
Slough Heat &Power and Steven's Croft	Waste wood	130,000
Steven's Croft	Coppice / willow	40,000
Wilton 10	Waste wood	80,000
Slough Heat &Power	Coppice / woodland	unknown
Wilton 10	Willow	80,000
Wilton 10	Forestry	50,000
EDF – West Burton and Cottam	Forestry	60,000

3.5. Regulatory factors

Aggregators are carrying out waste recovery (or disposal) activities. They will therefore need the benefit of the appropriate permit to handle and store waste wood unless they can benefit from one of the exemptions[14]. All those handling waste are subject to the Duty of Care and may also be required to register as waste carriers.

[14] http://www.environment-agency.gov.uk/subjects/waste/1416460/?version=1&lang=_e

4. Users

4.1. Overview

As discussed in section 2.5, good markets exist for the relatively high grades of waste wood and forestry, to the extent that users will pay for such materials. There are very limited markets for low grades of waste wood, due to relatively low demand for such materials, reflecting its unsuitability for recycling, and the shortage of WID compliant combustion capacity. The price for lower grades of waste wood is typically close to the alternative costs of disposal to landfill.

4.2. Biomass plants

Clean wood and waste wood can be used as a biomass fuel as follows:-

- In existing infrastructure which run on fossil fuels (generally co-fired but subject to the implementation of the "neutrality for waste" provisions proposed by the RO Banding Review in the case of waste wood);
- As a replacement for, or co-fired with other types of biomass; and
- In specifically constructed wood fuelled biomass plants.

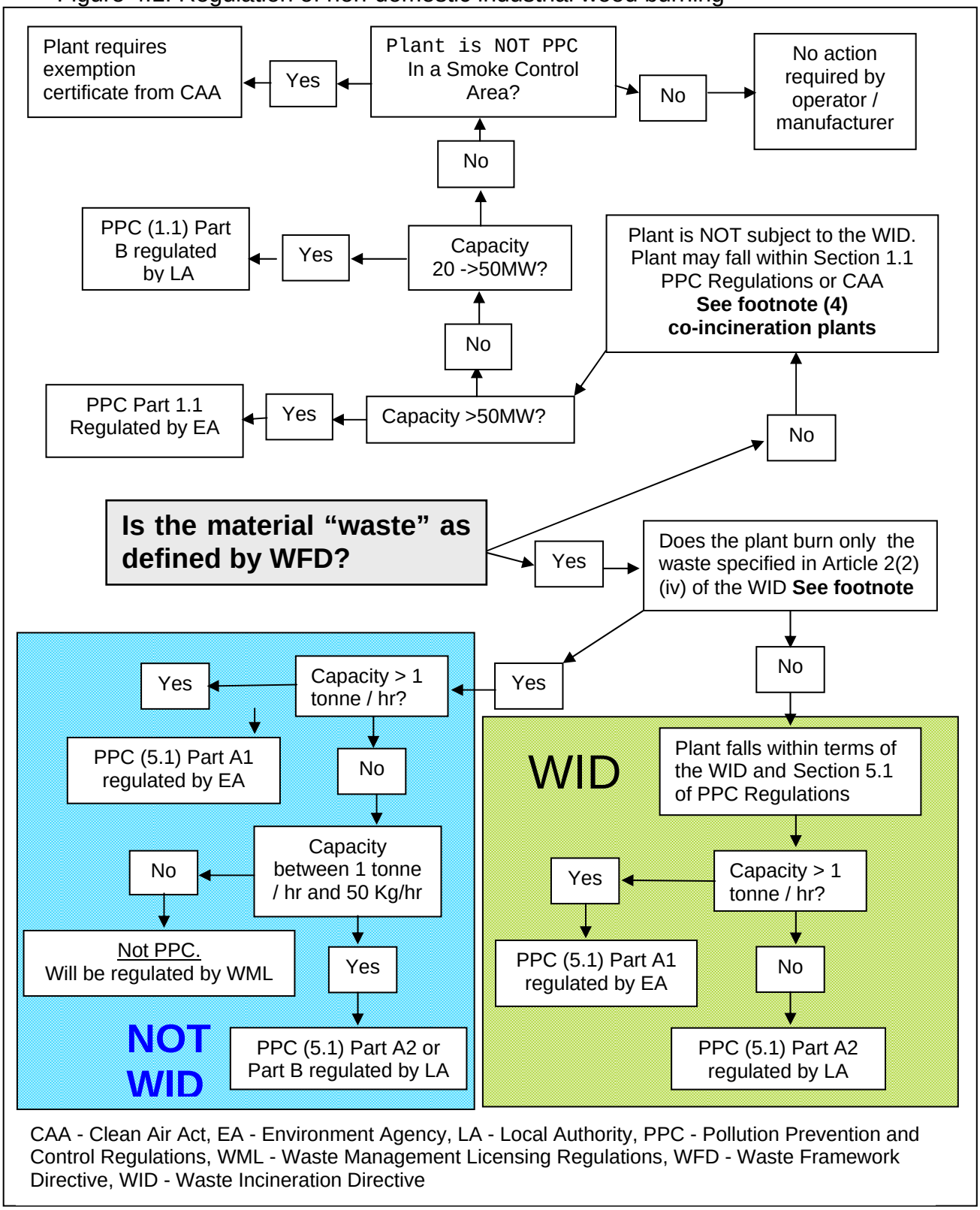
However, it is important to note that if lower grade waste wood is to be used as a biomass fuel, the plant must be WID compliant. Figure 4.1 outlines how industrial wood burning facilities are regulated[15].

England has 105 WID compliant incineration plants (as at September 2006 - see Appendix 3) which range in size from ~1ktpa up to 550ktpa. It is unlikely that existing WID compliant plants could be used to materially divert existing waste wood from landfill because MSW, Animal By-products Regulations (ABPR), paper, sewage and clinical plants are likely to have designated fuel sources so there is unlikely to be spare capacity at the plants. Furthermore, incineration plants are designed to accommodate fuel of a certain calorific value, a change to the fuel would require a change to the firing diagram of the plant.

Of England's operational WID compliant plants only one plant is known to accept waste wood (Slough Heat and Power), with three further plants currently under construction or commissioning in the UK, (Shotton, Stephen's Croft and Wilton 10).

[15] Air and Environment Quality Division, Defra

Figure 4.1: Regulation of non-domestic industrial wood burning



CAA - Clean Air Act, EA - Environment Agency, LA - Local Authority, PPC - Pollution Prevention and Control Regulations, WML - Waste Management Licensing Regulations, WFD - Waste Framework Directive, WID - Waste Incineration Directive

1. This means: "Wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood-preservatives or coatings which includes in particular construction and demolition waste" ((Article 2(2) iv WID).
2. Plants may burn combinations of wastes falling under Article 2(2) e.g., cork waste or vegetable waste from agriculture and remain outside the terms of the WID.
3. The incineration of any "hazardous waste" will fall under PPC (5.1) Part A1 be regulated by the EA .
4. Plants whose main purpose is the generation of energy or materials may also burn waste and these will be regulated as co-incinerators and fall within the WID, typically these plants may include: electricity generating plants or cement manufacturers' power plants (Sections 1.1 & 3.1 respectively).

4.2.2. Co-firing

There is a large capacity of existing infrastructure in the UK which use fossil fuels (such as coal) as a fuel source. Existing power stations co-fire clean biomass products, including wood with coal to generate energy. Coal currently contributes approximately 30GW of the UK's energy capacity, but the UK now is a net importer of coal which has a cost of approximately £25/tonne. An example of this is Drax, where approximately 2.5%[16] of the fuel supply is biomass, and Didcot which accepts approximately 20ktpa of bio-energy crops[17].

However existing co-fired plants are not WID compliant so they will not be able to accept lower grade waste wood. The EA has indicated that it is permissible to convert one unit of, say, a 2000MW coal fired power station to WID co-firing compliance but the investment required is significant.

Currently there is a disincentive to co-fire waste with either coal (when co-fired with biomass) or pure biomass, as the co-firing of waste results in the loss of Renewables Obligation Certificates (ROC) for all qualifying biomass fuels used at the plant for that month. This does not apply to waste, including waste wood whose biomass energy content is over 90%, which is classed as biomass under the RO. Reform of the RO[18] (May 2007) included proposals to make the RO neutral to solid recovered fuel, which would address this disincentive. The RO is discussed further in section 4.6.2.

4.2.3. Replacement of other biomass fuels

The existing biomass plants (from non waste wood fuel sources) in the UK are shown in table 4.1. It may be attractive for existing UK biomass plants to accept waste wood as a biomass fuel, given the risks associated with overdependence on a single fuel source. Single fuel plants are exposed to the risk that fuel sources may disappear, for example, during the avian flu crises in Suffolk in early 2007. However in order to accept lower grade waste wood, existing infrastructure will need to be WID compliant and the economic incentives will need to be preferable to the alternative fuel sources.

[16] Source: Drax response to the RO review (December 2006)
[17] Source: UK Energy Research Atlas. Report by Prof Gail Taylor (Sept 06)
[18] http://www.berr.gov.uk/files/file39497.pdf

Table 4.1: Installed large UK biomass plants (non wood fuel)

Name	Parent	Location	Tonnage	Fuel	Electricity output	Operational
Thetford	EPRL	Norfolk	420,000	Poultry litter	38.5MW	1999
Westfield	EPRL	Scotland	110,000	Chicken litter / feathers	9.8MW	2001
Eye	EPRL	Suffolk	160,000	Poultry litter / feathers / horse bedding	12.7MW	1992
Glandford	EPRL	Lincolnshire	89,000	ABPR / other	13.5MW	1993
Ely	EPRL	East Anglia	200,000	Straw	38MW	1996

All plants in the table, with the exception of Ely, are WID compliant and may accept a small amount of waste wood. However, the ash output from these plants is currently used as a fertiliser so cannot accept high tonnages of waste wood due to potential contamination of this product.

4.2.4. Wood fuelled biomass infrastructure

The existing wood fuelled biomass plants in the UK are either large plants, typically 20MW – 40MW producing only electricity or heat or a combination (Combined Heat and Power - CHP), and smaller installations typically up to 3MW, which generally produce heat only.

Key issues in the determination of plant size are as follows:

- Heat offtake is difficult above a certain size. Plants which produce in excess of 3MW may find it difficult to find an offtake for heat as the range for heat is typically 1-2km.
- Development costs and grid connection costs are high, with the latter potentially costing up to £500,000. A plant must be sufficiently large to benefit from the economies of scale.
- Proximity to fuel – larger plants will require a larger catchment area for wood fuel, which becomes less economical the further they are located from a plant.
- Fuel security – there is a higher risk associated with the availability of larger tonnages of wood fuel.

Existing large wood fuelled biomass plants in UK are set out in table 4.2.

Table 4.2: Installed (or under construction / commissioning) large wood fired biomass plants in the UK

Name	Parent	Location	Tonnage	Electricity output	Supplier	CHP
Wilton 10	Sembcorp	Teeside	300,000	42MW	Greenenergy / UK Wood Recycling	Yes
Slough Heat and Power	Slough Estates	Slough	300,000	35MW	Thames Valley Biofuels	Yes
Poyry	UPM (Shotton Paper Mill)	Shotton, Wales	300,000	20MW	Shotton Paper Mill	Yes
Steven's Croft	E.ON	Lockerbie	220,000	44MW	A W Jenkinson	No

Additional large scale wood fuelled plants under development are set out in table 4.3.

Table 4.3: Potential / Planned large wood fired biomass plants in the UK

Name	Parent	Location	Tonnage	Electricity output	Status
Western Wood Energy / Western Bioenergy	ECO 2	Port Talbot	160,000	13.8MW	Construction commenced Oct 2006
Prenergy Power	Prenergy	Port Talbot	3,000,000	350MW	No planning
Winkleigh Biomass Electricity Generator	Peninsula Power	RAF Winkleigh , North Devon	70,000	23MW	No planning
Hartshill	PDM group	Midlands	Unknown	1.5MW	Planning obtained

There are several relatively small biomass plants in the UK, such as Kielder Village district heating scheme and those operated by the furniture industry. These schemes typically range from 300KW up to 2MW and usually generate heat, but not electricity due to the prohibitively high costs of obtaining a grid connection. Such schemes are common where there is a relatively secure fuel supply, such as forestry or high grade waste from an industrial process. It is unlikely that smaller existing plants are WID compliant due to the high fixed costs of retro-fitting WID compliance.

4.3. Features of biomass wood fuel

Typically fuel is from a combination of sources. There are a number of considerations in biomass fuel selection, as follows:

- Fuel cost;
- Calorific Value / Moisture content;
- Security of supply;
- Biomass content; and
- Contaminants;

Fuel cost is key to the economics of an energy facility. This is discussed further in section 4.6.

Fuel cost must be considered in conjunction with the ability to generate energy from the fuel. Different wood fuels result in different energy output. In wood, energy output is closely linked to moisture content. Waste wood generally has a lower moisture content (18-25%), and from this perspective it is generally preferable to forestry and biomass crops (~40%).

Security of supply is a fundamental concern to investors in biomass projects. In this respect forestry and biomass crops may be preferable to waste wood as they are available under long term contracts. Contracted for tonnages and composition of forestry and biomass crops are likely to be more predictable over the long term than the supply of waste wood.

On the other hand, demand for forestry biomass crops is increasing and this will affect the availability and price of these materials in future.

Biomass energy content is critical in obtaining ROCs, which is, in turn, fundamental to the economics of a biomass project. Forestry and biomass crops have a biomass content close to 100%, whereas low grades of waste wood may have a biomass energy content as low as 80%. This is below the biomass threshold in the RO, which would tend to preclude using waste wood as a sole fuel source, although in practice this will depend on the level of contamination of waste wood streams. Some current projects use a blend of forestry, fuel crops and waste wood (in a ratio of 60:40) to achieve the overall 90% biomass energy content required to obtain ROCs. In consequence, Aggregator functions are likely to involve a fuel mixing capability requiring large covered spaces in which wood of varying qualities can be co-mingled.

Non–combustible contaminants such as nails and grit may cause additional wear to biomass facilities and will add to the disposal costs of ash. In this respect forestry is likely to contain lower levels of contaminants than waste wood. Waste wood can be processed to remove contaminants, for example, UK Wood Recycling plant at Wilton includes processes to remove such materials.

Table 4.4: Summary of features of waste wood and other wood fuel sources

	Waste wood	Forestry / biomass crops
Fuel cost	Low	High
Moisture content	Low	High
Security of supply	Medium	High
Biomass content	Medium	High
Contaminants	High	Low

4.4. Regulatory factors

Biomass plants and co-fired plants which accept wastes as fuel must comply with the Waste Incineration Directive, except for clean waste wood which is exempt[19]. The aim of WID is to minimise the impact of negative environmental effects on the environment and human health resulting from emissions to air, soil, surface and ground water from the incineration and co-incineration of waste.

The requirements of the WID have been developed to reflect the ability of modern incineration plants to achieve high standards of emission control more effectively.

The additional cost of WID compliance in a new plant is much less than the cost of retro-fitting WID compliance to an existing facility.

Facilities which handle waste are likely to fall within the terms of the Pollution Prevention and Control Regulations under which they will be required to hold an operating permit.

4.5. Typical contractual arrangements

The most efficient financial structure for a biomass waste to energy plant is likely to be a project financing arrangement. As such, the contractual arrangements must ensure that sufficient risk is transferred to third parties in order to attract external finance. Commercial arrangements are likely to be complex, with the key contracts being as follows:

- High quality fuel supply arrangements;
- Long term electricity off-take agreements – Power Purchase Agreement (PPA);
- CHP off-take contracts;
- Fixed price turnkey Engineering, Procurement and Construction (EPC) contract; and
- Operating subcontracts.

[19] Source: WID http://www.defra.gov.uk/environment/ppc/envagency/pubs/pdf/wid-guidance-edition3.pdf

Fuel Supply

Security of fuel supply is a fundamental concern of banks and equity providers to a waste wood biomass facility. Key issues of concern to funders are as follows:

- Fuel supply counterparty of good financial standing
- Certainty of long term fuel supply;
- Price and volume certainty; and
- Ability to hedge contractual arrangements (e.g. electricity offtake).

An optimum fuel supply arrangement is a long term, fixed price, take-or-pay waste supply agreement, for a significant proportion of the plant capacity, with a counterparty of significant financial standing. The waste supply agreement is likely to have terms such that, in the event that the supplier breached its fuel supply obligations, liquidated damages would be payable to compensate the facility for any loss of revenues (i.e. electricity and heat supply and any loss of revenues which may be payable for receiving fuel).

Currently, there are not many such counterparties in the waste wood market who are able to offer a robust waste wood supply agreement. The consequence of this is that biomass plants are funded using a diverse fuel supply which can offer a higher degree of certainty, such as managed forestry and fuel crops (e.g. miscanthus grass). An example of this is ECO2 which has entered into a long term supply agreement. Such ‘anchor’ contracts can be supplemented by a large number of small fuel supply contracts.

There are a small number of suitable counterparties to a supply agreement who may have access to large quantities of waste wood such as furniture manufacturers, large construction companies and waste management companies. There is evidence that these type of entities are looking into biomass plants: we are aware that a prominent retailer has installed a 2MW biomass unit in a distribution centre in Doncaster which uses packaging waste and a major civils contractor has developed an 18ktpa biomass plant in the Netherlands to dispose of construction waste.

As the market for clean wood tightens, plants with WID compliance will be able to source contaminated waste wood at lower cost – and other materials commanding a gate fee – thereby providing a choice of business models.

Power Purchase Agreements

PPAs are often used to underpin the funding for energy plants. An electricity company commits to purchase the electricity generated by a plant for a fixed price over a long term period (usually up to 15 years).

It should be noted that fuel shortages will also lead to loss of electricity revenues. This emphasises the importance of having a secure fuel supply.

CHP off-take contract

CHP offtake contracts will depend on the local demand for heat. Often demand for heat will play a key role in determination of a suitable site for a CHP plant. Due to the relatively high level of investment in CHP infrastructure long term off-take contracts for both electricity and heat takers will be required, ideally with counterparties with strong credit ratings.

EPC and operations subcontracts

Typically a biomass plant will be constructed by owner operators or by smaller developers using an EPC contract with an established constructor or a series of co-ordinated contracts for equipment and Civils.

4.6. Economic incentives

The economics of waste wood biomass plants are extremely complex. Some of the key considerations are as follows:

- Fuel specification and cost;
- ROCS;
- Size of plant;
- Nature of off-take agreements for electricity and heat;
- Enhanced Capital Allowances (ECA) (for good quality CHP)
- Government capital grants for bio-energy[20]

4.6.1. Fuel cost

There are a range of biomass fuels which have different features and costs. These are discussed in section 4.3. Table 4.5 sets out the costs / gate fees, calorific values and ROC eligibility for different types of biomass fuels and fossil fuels.

[20] http://www.defra.gov.uk/farm/crops/industrial/energy/capital-grants.htm

Table 4.5: Biomass and fossil fuel costs / gate fees, calorific value, ROC eligibility and WID requirement

Source	Cost / (Gate Fee) per tonne	Calorific Value (MJ/kg)	ROC eligible	WID required
Coal	£25[21]	35[22]	No	No
Forestry	£15 to £22[23]	15-19	Yes	No
Willow	Not known		Yes	No
Miscanthus grass	Not known	17-19[24]	Yes	No
Poultry litter	£10[25]	13.5[26]	Yes	Yes
Straw	£35[27]	14.8[28]	Yes	No
Unprocessed mixed wood	(£5) to (£30)[29]	16[30]	If biomass content >90%*	Yes
Processed low grade wood	Unknown – anecdotal evidence suggests that is a cost to user		If biomass content >90%*	Yes
Theoretical max C&I gate fee	£(44) increasing to £(68) in 2010/11[31]		If biomass content >90%*	
Theoretical max MSW gate fee	£(194) increasing to £(218) in 2010/11[32]		If biomass content >90%	
Solid Recovered Fuel (SRF)	£(40) – (50)	11-15	If biomass content >90%*	Yes

* see also Section 4.6.2 below

Using waste wood as a fuel source is likely to result in lower fuel costs (potentially resulting in revenues) compared to other forms of biomass and fossil fuels. The economic incentives to use waste wood as a biomass fuel

[21] Source: Annex B of the Energy Review
[22] Source: Kaye and Laby
[23] Source: Forestry Commission
[24] Source: DTI Energy from Biomass (Jan 1999) - http://www.berr.gov.uk/files/file14939.pdf
[25] Source: Parliament Publications and Records (Jan 04): http://www.publications.parliament.uk/pa/ld200304/ldselect/ldsctech/126/12618.htm
[26] Source: DTI Energy from Biomass (Jan 1999) - http://www.berr.gov.uk/files/file14939.pdf
[27] Source: Parliament Publications and Records (Jan 04): http://www.publications.parliament.uk/pa/ld200304/ldselect/ldsctech/126/12618.htm
[28] Source: DTI Energy from Biomass (Jan 1999) - http://www.berr.gov.uk/files/file14939.pdf
[29] Source: Letsrecycle.com – Prices at April 2007.
[30] Source: Scion Research, assumes moisture content of ~15%
[31] Assuming high demand and prices are set according to the cost of alternative disposal. This assumes a landfill gate fee of £20 and landfill tax of £24, rising to £48 in 2010/11.
[32] Assuming high demand and prices are set according to the cost of alternative disposal. This assumes a landfill gate fee of £20 and landfill tax of £24, rising to £48 in 2010/11 and LATS penalties at £150 per tonne.

source are likely to increase as landfill tax increases and LATS targets become more challenging; and in the event of a tightening of the clean wood supply market.

Waste wood is likely to have a higher calorific value than forestry and willow because of its lower moisture content, but this is lower than that of coal. The calorific value of waste wood is similar to that of miscanthus and straw.

Waste wood will only attract ROCs if the biomass energy content (of the waste wood alone, or when blended with another biomass fuel) is in excess of 90%. This is discussed in more detail in section 4.6.2.

4.6.2. Renewables Obligation

ROCs for waste as a biomass fuel

ROCs are available to biomass plants which use fuels from a renewable fuel source where the biomass energy content is greater than 90%, as well as for the electricity generated from the biomass energy content of waste when used in a combustion plant with Good Quality CHP or when manufactured into a fuel by means of plant and equipment using advanced conversion technologies.

Low grade waste wood may have a biomass energy content as low as 80%, but this will be variable. That would be too low on its own to meet the biomass level (90%) in the RO. In order to obtain ROCs, existing biomass plants have used a blend of forestry and energy crops, which have a biodegradable content of ~100%, together with waste wood in the ratio 60:40.

Banding the RO

The Government's Energy White Paper (May 2007) proposed to introduce a banded RO to target support to those renewable technologies that need it most. Whereas currently all technologies receive 1 ROC per MWh of renewable electricity, under the new proposals dedicated biomass plant (those using fuels over 90% biomass in content) with CHP will receive 2 ROCs per MWh, with plant generating electricity only being awarded 1.5 ROCs per MWh. These changes are not expected until 2009 at the earliest, but will offer a significant further boost to efficient energy recovery from biomass fuels including waste wood.

ROCs for co-fired biomass

Reform of the RO[33] recognises that power stations may use a combination of feedstocks[34] and proposes that ROCs would be available for eligible biomass which is co-fired with fossil fuels alongside SRF. This would improve the current situation in which ROCs are not available to any renewable fuels used in a plant in the same month where waste is accepted as a fuel. This acts as a

[33] http://www.berr.gov.uk/files/file39497.pdf (paragraphs 6.29 to 6.31)
[34] Reform of the RO, paragraph 3.8

disincentive for plants with an eligible biomass ROC business to accept waste fuels on site. This is particularly the case for coal fired generators where the fuel mix is less than 90% biomass. This will not mean that the biomass content of SRF will attract ROCs, except where used in Good Quality CHP or when manufactured into a fuel by means of plant and equipment using advanced conversion technologies.

In order to claim ROCs, users must demonstrate the biomass energy content of the fuel supply in accordance with Ofgem's fuel measurement and sampling procedures. This is a relatively onerous process, which may result in significant additional costs. BERR's response[35] to Reform of the Renewables Obligation recognised the difficulties encountered by generators in this area and set out the Government's intention to facilitate more flexibility in demonstrating biomass energy content.

The above proposals should be viewed in the context of the Themba Technology report[36] on sustainability which illustrated that the carbon balance for co-firing is positive.

4.6.3. Size of plant

The potential to benefit from economies of scale is likely to be significant due to high project development costs and grid connection costs.

4.6.4. Nature of off-take agreements for electricity and heat

Electricity and heat off-take agreements will result in revenues. Grid connections may be expensive, so are only justified for larger plants, but heat offtake agreements are limited by the range of CHP (1-2km) which means that offtake agreements are difficult.

4.6.5. Enhanced capital allowances

ECAs are available for biomass plants which include Good Quality CHP[37].

4.6.6. Capital grants

Defra's Bio-energy Capital Grants Scheme supports the installation of biomass-fuelled heat and combined heat and power projects in the industrial, commercial and community sectors. The third round of the scheme has made available over £11m to projects over the period 2006-07 to 2008-09. Waste biomass-fuelled plants not subject to WID are eligible under the scheme.

[35] http://www.berr.gov.uk/files/file43545.pdf
[36] http://www.berr.gov.uk/files/file34448.pdf
[37] http://www.eca.gov.uk/etl

5. Analysis of barriers

5.1. Producers

The current barriers to producers segregating waste wood are:

- Lack of financial or regulatory incentives; and
- Lack of facilities to segregate and/or burn.

There are no statutory obligations for either LAs or the private sector to separate waste wood for recovery, although this activity is encouraged by measures such as landfill tax, LATS and recycling targets.

Figure 5.1 sets out the location of WID compliant wood combustion capacity in the UK.

Figure 5.1: Map of UK Wood Biomass Plants

There is a lack of infrastructure available (for segregation of waste wood from the residual waste stream) to the commercial sector outside of LA CA sites.

The private sector is not specifically incentivised to provide collection or aggregation facilities for waste wood. The landfill pre-treatment requirements should help, although they are not material specific, and there is low demand for low grades of waste wood to be segregated.

Private sector sites typically have a minimum tonnage charge (of 3 tonnes) for the use of landfill facilities or transfer stations.

5.2. Aggregators

Aggregators are likely to respond to the demand for secondary use products. Currently, there is low demand for low grades of waste wood so very few aggregators are focused on its collection and supply. However, where demand exists, there appears to be relatively strong economic incentives to aggregate waste wood and low barriers to entry for aggregators to develop supply chains.

LA CA sites are regarded as good aggregation points for the collection and segregation of waste, both from individuals and from small businesses. Collecting additional commercial wood waste and diverting it from landfill helps a Waste Disposal Authority's LATS position.

Without access to CA sites there are limited alternatives for small businesses. Businesses are likely to use large scale landfill sites or transfer stations which do not have any provisions for segregation of waste.

5.3. Users

There is currently a relatively low demand for low grades of waste wood. Demand for low grade waste wood could be increased through the introduction of WID compliant incineration capacity in England. The main barriers to the installation of WID compliant biomass capacity are:

- Economics;
- Sites and planning;
- Fuel supply; and
- Knowledge.

The existence of biomass plant which accept waste wood illustrates that, under certain situations, these plants are economically viable. Key problem areas for biomass plants are a) compliance with the RO (biomass content must be in excess of 90%), b) achieving offtake for heat (important for revenues and obtaining ECAs), c) low cost, fixed price, long term fuel supply contracts and d) the costs of providing evidence of compliance with the RO.

What is the basis for this assertion? How long did the plant which already exist take to get planning consent, and do their promoters feel that it was "problematic"? Better to present factual information if available. Land use

planning is often problematic in the construction of biomass infrastructure, particularly given that business planning timeframes are usually shorter than the likely delivery timescale for such infrastructure.

Certainty on availability of fuel of suitable quality and price are key factors in economic viability of a biomass plant. In order to comply with the RO, a plant which uses waste wood as a fuel source may also need to use virgin biomass to increase the average biomass content. Currently there is high demand for such material (e.g. from the furniture and panel board industry) which has recently led to increased wood prices. Whilst demand for low grade waste wood remains low and landfill tax increases, there is likely to be relatively high availability for low grades of waste wood.

Existing UK biomass plants have been initiated by companies with different backgrounds, as follows:

Slough Heat and Power – acquired by Scottish and Southern Energy with effect from 1 January 2008;
Wilton 10 – owned by a diversified industrial company;
Steven's Croft – owned by and electricity producer; and
Shotton – owned by a paper mill.

The current waste wood biomass market is immature and there is a lack of appropriate sponsors. Projects currently under development are generally being led by renewable energy companies. It is unclear which of these developers, if any, will lead on the delivery of future projects. If WID compliant biomass infrastructure is to be installed, it is likely to be most efficiently delivered by those who have experience in developing such projects. Many of the potential users (i.e. intensive energy users) do not see electricity or heat generation as part of their core operations, whereas electricity companies may not be focussed on electricity generation from waste as it falls outside of their core expertise and waste management contractors are principally focussed on the MSW market.

6. Remedies

6.1. Producers

Incentives for producers to segregate waste will increase as landfill tax increases (£24 in 2007/08, increasing to £48 in 2010/11) and as a result of requirements for waste to be treated prior to landfill that were introduced in October 2007.

A further incentive that may be considered is a ban on sending certain types of waste to landfill, as trailed in Waste Strategy for England 2007.

Ban on wood to landfill

Germany introduced a landfill ban on untreated biodegradable organic waste in 2003. In the UK a ban on waste wood to landfill would provide the market with incentives to construct diversion facilities.

Under the Waste Strategy for England 2007 the Government will consider subject to further analysis, further bans on the landfilling of biodegradable and recyclable wastes. This consideration is linked to the evidence arising from the work on priority waste streams which includes wood. Any proposals to introduce further landfill bans will be subject to further consultation in 2008.

6.2. Aggregators

Private sector aggregators have responded to the demands of the market where markets exist for low grades of waste wood.

6.3. Users

The supply chain for waste wood depends on the existence of viable recycling end-markets, or WID compliant waste wood biomass capacity.

6.3.1. Economics

Biomass plants under certain scenarios can be economically viable. While the economics are complex, the following measures may be expected to reduce the economic barriers:

- RO banding – greater support for dedicated biomass
- Reduce fuel measurement and sampling compliance obligations associated with the RO;
- Increase incentives for waste fired CHP; and
- Increase awareness of UK intensive energy users;
- Raise awareness of the increasing demand for virgin forestry and the consequent need to diversify fuel sources to include waste wood; and
- Local Government support for procurement of biomass facilities.

Changes to the RO

Section 4.6.2 explains planned changes to the Renewables Obligation that will improve the climate for waste wood combustion. These include greater support for dedicated biomass plant through a banded Obligation, neutrality for SRF and more flexibility in Ofgem's fuel measurement and sampling procedures.

Compliance with the RO

There are difficulties in cost-effectively measuring the biomass content of mixed waste due to its heterogeneous nature. BERR and Ofgem are considering ways in which the fuel measurement system can be more flexible whilst producing appropriately accurate and reliable results[38]. This includes looking at a proposal from elements of industry regarding a process to monitor the flue gas for the relative proportions of carbon 12 and carbon 14 to determine the ratio of fossil fuel to organic content.

Awareness

Awareness is discussed in more detail in section 6.3.4.

Increase Incentives for waste fired CHP

The RO only provides support for renewable electricity, although it rewards electricity produced in biomass and waste Good Quality CHP plant in recognition of the greater environmental benefit and capital costs of CHP. The Government published a Heat Call for Evidence[39] in January 2008. This sought views on potential support mechanisms for renewable heat to help reduce CO_2 emissions and contribute to the UK's share of the EU renewable energy target.

6.3.2. Planning

Local planning authorities are required to draw up spatial plans which make provision for adequate waste treatment facilities. The need for more facilities in which to burn wood should increasingly be reflected in such plans. There is a tension between pressure to locate such plant close to potential users of its waste heat – who may often be found in towns and cities – and the need to protect air quality. For these reasons waste wood burning plant is particularly likely to be suitable for industrial sites away from major centres of population.

6.3.3. Fuel supply chains

Government supports the National Industrial Symbiosis Programme[40] (NISP), which brings together producers, users and potentially aggregators of

[38] Government response to Reform of the RO (para. 5.11): http://www.berr.gov.uk/files/file43545.pdf
[39] http://www.berr.gov.uk/files/file43609.pdf
[40] http://www.nisp.org.uk

materials that would otherwise be disposed of as waste. NISP has played a significant role in the development of the fuel supply chain for the wood burning power station, Wilton 10[41].

Regional catchments for LAs

LAs may also be able to support the development of fuel supply chains by working towards regional procurements of waste wood biomass plants. This is being pursued by Project Integra (Hampshire County Council) as they seek to develop a regional waste wood catchment area for waste wood fired, WID compliant combustion plant located in Hampshire.

CA sites in England currently collect approximately 500ktpa of waste wood. These tonnages – and with scope to collect a lot more, e.g. from commercial sources – could potentially be used to support funding for five regional facilities with a capacity of ~100ktpa. This approach could be developed in Regional Spatial Strategies, with plant potentially capable of being procured using Private Finance Initiative (PFI) credits. A private sector partner could be procured to assist with electricity and heat and power offtake arrangements.

6.3.4. Knowledge

Currently there is a lack of knowledge and expertise within the market for the opportunities for waste wood to be used as a biomass fuel source. Traditional waste management companies are focussed on MSW contracts and energy companies tend to perceive waste as a risky area. WIDP intends to remedy this through its market development programme, which is focussed on the following key areas:

- Intensive energy users with heat load;
- Intensive energy users without heat load (e.g. cement kilns);
- Producers of large tonnages of waste wood such as the panel-board industry;
- Energy producers and Renewable Energy Companies; and
- Waste management companies.

Intensive energy users are increasingly seeking to limit their exposure to increasing fossil fuel energy costs, and often have demands for heat and steam. CHP plant for industrial intensive energy users is likely to be financed and built on the strength of long term SRF contracts but waste wood, on shorter term contracts, could provide an additional fuel source once such capacity is operational. Together, these fuel sources can mitigate price risks associated with fossil fuels, increased security of supply and mitigate carbon emissions.

Producers of large tonnages of waste wood will be seeking to mitigate their exposure to increases in landfill tax. A waste wood biomass plant may be used to mitigate this risk. Furthermore, it is common that wood producers also have high energy demands.

[41] http://crisp.international-synergies.com/_layouts/Downloads/UK_Wood.pdf

Energy producers are increasingly interested in renewable energy sources to maximise RO revenues.

Waste management companies are likely to have expertise in installation of waste biomass infrastructure and are likely to have an interest in supply chains and potentially in development of facilities.

7. Conclusions

- Energy Recovery and Recycling are the main alternatives to sending waste wood to landfill;
- Recycling outlets currently require higher grades of waste wood than energy recovery;
- Recycling outlets are well developed and there is limited scope for a significant increase in recycling due to dependence on output from other industries and the contaminated nature of most waste wood;
- Currently energy recovery is the most likely method of diverting additional waste wood from landfill;
- Incentives for producers to segregate waste wood are limited, but these are increasing with future landfill tax increases and requirements to pre-treat waste prior to landfill;
- Aggregation and waste wood supply chains are in their infancy. There are low barriers to entry so supply chains are likely to develop where demand for waste wood exists;
- Development of WID compliant biomass facilities for waste wood is complex and the sponsors of such plants are not obvious;
- Waste wood can help to diversify fuel sources away from over reliance on clean wood to create greater business model flexibility;
- Commercial arrangements are required with a number of parties (including fuel supply, heat offtake, electricity offtake);
- Compliance with legislation is onerous (e.g. land use planning, WID compliance, Integrated Pollution Prevention and Control permits); and
- Waste wood fired biomass plants need to be carefully structured to ensure that support can be claimed (e.g. in the form of ROCs and ECAs for Good Quality CHP).

Appendix 1

Contributing organisations

Our grateful thanks go to the following organisations that assisted in the production of this report.

BERR
Biffa
Carbon Trust
Croydon Tree Station
Drax Power
Edmund Nuttall Ltd
Energy Power Resources Limited (EPRL)
Forestry Commission
Greenenergy
Howarth Associates
Kronospan
NISP
Scottish Enterprise Lanarkshire
Sembcorp
Slough Heat & Power
Thames Valley Energy
UK Wood Recycling
Wood Recyclers Association
WRAP

Appendix 2

Third party reports used

Publisher	Title	Date
WRAP	Review of wood waste arisings and management in the UK	June 2005
Biomass Task Force	Biomass Task Force Report to Government	October 2005
Defra	Waste Strategy for England	May 2007
DTI	Reform of the Renewables Obligation	May 2007
(Defra / DTI)	UK Biomass Strategy	May 2007
DTI	Meeting the Energy Challenge – A White Paper on Energy	May 2007
Environment Agency	Waste wood regulatory position statement and technical report	October 2007

Appendix 3

List of permitted waste incineration facilities

England - Permitted waste incineration facilities 2006

Sites in London are highlighted in green

Source: Environmen

Site	Comment	Incinerator Type	Capacity (annual throughput in tonnes)
Sheffield CC, Bernard Road (Veolia)	Veolia	Municipal	225,000
Cleveland Waste Management, Billingham (Sita)		Municipal	350,400
GM Waste, Bolton		Municipal	120,000
Hampshire Waste, Chineham (Veolia)	Onyx	Municipal	102,000
MES Dudley, West Midlands		Municipal	105,120
Edmonton, London	London Waste	Municipal	550,000
Coventry	Coventry & Solihull Waste Disposal Company Lt	Municipal	315,360
SELCHP, London		Municipal	488,000
WRG, Nottingham		Municipal	201,480
Kirklees Waste Services, Huddersfield (Sita)		Municipal	148,920
NEWLINCS, Grimsby		Municipal	56,000
MES, Stoke on Trent		Municipal	210,240
MES, Wolverhampton		Municipal	110,000
Tyseley, Birmingham		Municipal	257,040
Allington - Kent Enviropower	Started during 2006	Municipal	500,000
Onyx Hampshire Ltd (Portsmouth)	Started during 2006	Municipal	187,000
Onyx Hampshire Ltd (Marchwood, Southampton)	Started during 2006	Municipal	187,000
Isles of Scilly, Porthmellon	Municipal waste only - no household waste	Municipal	3500
		Municipal Total	**4,117,060**
Thames Water, Beckton, London		Sewage Sludge	105,120
Yorkshire Water, Blackburn Meadows Sheffield		Sewage Sludge	70,080
Yorkshire Water, Bradford		Sewage Sludge	70,080
Yorkshire Water, Brighouse		Sewage Sludge	87,600
Severn Trent, Coleshill, North Warks.		Sewage Sludge	43,800
Thames Water, Crossness, London		Sewage Sludge	61,320
United Utilities, Widnes		Sewage Sludge	50,000
Yorkshire Water, Leeds, West Yorkshire		Sewage Sludge	87,600
Severn Trent, Stourbridge		Sewage Sludge	17,520
		Sewage Sludge Total	**593,120**
Blagden Packaging, Avonmouth, Bristol		Hazardous	37,274
Lubrizol, Bromborough, Merseyside		Hazardous	11,000
Glaxo Dartford		Hazardous	40,000
Shell, Ellesmere Port		Hazardous	38,000
Shanks, Fawley (Now Veolia)		Hazardous	35,040
Chemical Manufacturing & Refining, Hendon, Su	Now SRM, Hendon Dock, Sunderland	Hazardous	21,000
BIP Speciality Resins, Oldbury, West Midlands		Hazardous	17,250
Ineos chlor, Runcorn		Hazardous	30,000
Reichold, Mitcham		Hazardous	1,402
Fine Organics, Seal Sands		Hazardous	26,876
MOD, Shoeburyness		Hazardous	-
Glaxo, Ulverston		Hazardous	-
Scott Bader, Wellingborough		Hazardous	8,760
Cleanaway, Ellesmere Port (Now Veolia)		Hazardous	75,000
SRM Ltd (Rye)		Hazardous	31,250
Solvent Resource Management Ltd (Knottingley)		Hazardous	22,000
Solvent Resource Management Ltd (Morecambe)		Hazardous	15,000
Solvent Resource Management Ltd (North Tyne Process Plant)		Hazardous	2,500
Castle Cement, Ketton, Rutland	Burns HW and non-HW	Cement Kiln - Hazardous	340,733
Castle Cement, Ribblesdale	Can burn cemfuel, chipped tyres and MBM	Cement Kiln - Hazardous	178,250
CEMEX UK Cement Ltd, South Ferriby		Cement Kiln - Hazardous	40,000
CEMEX UK Cement Ltd, Barrington		Cement Kiln - Hazardous	65,000
Steetley Dolomite Ltd, Thrislington		Lime Kiln - Hazardous	50,000
Steetley Dolomite Ltd, Whitwell		Lime Kiln - Hazardous	9,600
		Hazardous Total	**1,095,935**
Wessex Incin, West Woodlands		Animal Carcass	13,140
Vetspeed, Thriplow		Animal Carcass	8,355
University of Bristol School of Clinical Veterinary Science		Animal Carcass	3,153
Institute for Animal Health		Animal Carcass	900
		Animal Carcass Total	**25,548**
Edmonton, London	Approx 10% of Edmonton MWI throughput	Clinical	8,760
White Rose, Ashford		Clinical	8,760
Shanks, Fawley		Clinical	65,700
Merck Sharp & Dohme, Harlow, Essex		Clinical	1,752
Hillingdon, London		Clinical	12,264
WRE Ipswich		Clinical	8,760
White Rose, Knostrop, Leeds		Clinical	17,520
Medical Energy, Redditch, Worcs.		Clinical	13,140
Pfizer, Sandwich		Clinical	15,155
Glaxo, Stevenage		Clinical	7,884
Yorkshire Env Solutions, Nottingham	Now White Rose	Clinical	6,500
Glaxo Dartford		Clinical	13,140
Grundon CWI Colnbrook	Commissioning new plant in 2007	Clinical	10,000
Peake GB Limited		Clinical	4,550
Compton Laboratories Incinerators		Clinical	1,800
Pontefract Clinical Waste Incinerator	White Rose Environmental Ltd	Clinical	4,500
Salford Clinical Waste Incinerator		Clinical	8,000
New Cross Clinical Waste Incinerator		Clinical	2,500
Dstl Incineration Facility Porton Down		Clinical	1,270
CEPR Waste Incinerator (Centre for Emergency Preparedness and Response)		Clinical	1,050
Singleton Incinerator		Clinical	1,500
Veterinary Laboratories Agency		Clinical	8,200
Sidcup Clinical Waste Incinerator	White Rose Environmental Ltd	Clinical	6,600
Bournemouth Waste to Energy	White Rose Environmental Ltd	Clinical	10,000
Addenbrooke's Hospital Incinerator	Cambridge	Clinical	4,500
Viridor Waste Management Derriford Incinerator		Clinical	4,270
		Clinical Total	**239,315**
Fibropower, Thetford Power Station		Animal by-product Combustion Plant	438,000
Fibrogen, Glanford Power Station, Flixborough, North Lincs		Animal by-product Combustion Plant	96,360
Fibropower (Eye Power Station)		Animal by-product Combustion Plant	160,000
Slough Heat and Power		Combustion Plant	350,000
East London Sustainable Energy Facility (ELSEF	Commissioning in 2007	Combustion Plant	105,000
Isle of Wight Energy from Waste Plant		Combustion Plant	35,000
Bynea Organic Chemicals		Combustion Plant	10,500
Duddery Hill Chemical Works		Combustion Plant	7,000
Aroma and Fine Chemicals Ltd		Combustion Plant	2,500
Robinson Bros, West Bromwich	Not clinical waste	Combustion Plant	2,102
Pentagon Chemicals Ltd		Combustion Plant	1,750
Formica, North Shields, Tyneside	North Shields Waste to Energy (WTE) Plant	Combustion Plant	-
Ancillary Components, Wymington, Beds		Combustion Plant	438,000
Aylesford Newsprint	Paper sludge - Not sewage sludge	Paper sludge	132,000
EON UK CHP Kemsley Ltd		Paper sludge	190,000
Blue Circle, Westbury, Wiltshire		Cement Kiln - Non-hazardous	43,800
Castle Cement, Ribblesdale,		Cement Kiln - Non-hazardous	-
Rugby Cement, Southam, Warks	Burns tyres	Cement Kiln - Non-hazardous	25,000
Lafarge Cement UK, Hope Works		Cement Kiln - Non-hazardous	105,000
Lafarge Cement UK Cauldon works		Cement Kiln - Non-hazardous	120,000
Lafarge Cement UK Aberthaw Works		Cement Kiln - Non-hazardous	25,000
Widnes Animal Rendering		Rendering plant	245
Neerok Ltd, T/A Woodhead Brothers Meat Company (Colne meats)		ABPR Incinerator	4,000
Cheale Meats Ltd (Orchard Farm Abbattoir)		ABPR Incinerator	850
		Other' Total	**2,292,107**
		Grand Total	**8,363,085**