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# Wood waste: A short review of recent research

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# 1 Introduction

The Government's Review of Waste Policy 2011 includes measures designed to put us on the path to a "zero waste economy". This Government is committed to being the greenest ever. How we deal with our waste is important for a range of broader concerns such as material security, energy, climate change and wider environmental protection. Good progress has been made over the last decade to reduce the volume of waste sent to landfill and increase recycling but additional benefits can be realised by going further.

Government policy follows the waste hierarchy. Landfill is at the bottom, with waste prevention the preferred option, followed by preparation for re-use, recycling and other types of recovery.

Wood waste is produced by a number of sectors and as part of the municipal waste stream. Wood waste arises in different fractions ranging from untreated, pre-consumer off-cuts to treated wood containing preservatives and via a variety of post-consumer waste.

The Wood Recyclers Associations (WRA) categorises wood waste in four main grades (Table 1). In the UK, the recovery and reprocessing of Grade A and (probably) Grade B are well established, but routes to divert and recycle Grades C and D are less effective. This results in a lot of the wood falling within these Grades ending up in landfill or informal markets. Therefore, one of the commitments in the Government's Waste Policy Review 2011 is to

'*Consult on introducing a restriction on the landfilling of wood waste and review the case for restrictions on sending other materials to landfill including looking specifically at textiles and biodegradable waste*[1]*.'*

The Government has launched a Call for Evidence inviting views on the management of wood waste in England and measures to divert wood waste from landfill to the most appropriate use.

A number of policies and legislation impact on the management of wood waste including the Revised Waste Framework Directive, the Waste Incineration Directive (WID), the Landfill Directive and Landfill Tax, and renewable energy policies such as the Renewables Obligation. A thorough description of these and other policies impacting the management of wood waste is provided in the Task A report of the AEA report (Appendix 1 to the AEA report) and will not be repeated here.

The aim of this document is to review information from various recent reports regarding the sources, markets for, and management of wood waste. The information will inform any future development of options aimed at ensuring wood waste is managed in a way that delivers the best outcome for the environment and economy. The review will also be a resource for consultees alongside the Call for Evidence.

[1] http://www.defra.gov.uk/environment/waste/review/

The following seven reports have been reviewed here (and will be referred to using the names in parentheses):

- An assessment of the environmental impact of the management options for wood waste (WR1209), AEA for Defra 2012 (AEA report)
- Market Situation Report: Realising the value of recovered wood, WRAP 2011 (WRAP 2011 report)
- Wood waste market in the UK, Pöyry Forest Consulting, WRAP 2009 (Pöyry report)
- 2011 Briefing report: The UK waste wood market, Tolvik Consultancy 2011 (Tolvik report)
- Landfill ban: feasibility research, Eunomia 2010 (Eunomia report)
- Landfill bans and restrictions in the EU and US (WR1202), Green Alliance for Defra 2009 (Green Alliance report)
- The business case for wood waste collection hubs, WRAP 2012 (WRAP 2012 report)[2]

## Table 1 WRA wood waste grades (WRAP, 2012)

| Wood Waste Grade | Typical Markets | Typical Sources of Raw Material for Recycling | Materials Within Wood Waste Grade | Typical Non – Wood Content Prior to Processing |
|---|---|---|---|---|
| **Grade A**<br><br>**"Clean"**<br><br>**Recycled Wood** | Manufacture of products such as animal bedding, horticultural mulches, and the panelboard sector.<br><br>Fuel in non WID installations, or manufacture of pellets/briquettes. | Distribution<br><br>Retailing<br><br>Packaging<br><br>Secondary manufacture e.g. joinery<br><br>Pallets | Solid softwood and hardwood, packaging waste, scrap pallets, packing cases, and cable drums.<br><br>Process off-cuts from joinery/manufacturing. | Nails and metal fixings.<br><br>Minor amounts of paint, and surface coatings. |
| **Grade B**<br><br>**Industrial Feedstock** | A feedstock for industrial wood processing | As Grade A, plus construction and demolition | May contain up to 60% Grade A material as above, | Nails/metal fixings.<br><br>Some paints, |

[2] Report due for publication Summer 2012

| | | | | |
|---|---|---|---|---|
| **Grade** | operations such as the manufacture of panel products, including chipboard and medium density fibreboard. | operations, and Transfer Stations. | plus building and demolition materials and domestic furniture made from solid wood. | plastics, glass, grit, coatings, binders and glues.<br><br>Limits on treated or coated materials as defined by WID. |
| **Grade C**<br><br>**Fuel Grade** | Biomass fuel for use in the generation of electricity and/or heat in WID compliant installations. | All above, plus<br><br>Municipal Collections<br><br>Recycling Centres<br><br>Transfer Stations, and<br><br>Civic Amenity Recycling sites | All of the above, plus<br><br>fencing products, flat pack furniture made from board products and DIY materials.<br><br>High content of panel products such as chipboard, MDF, plywood, OSB and fibreboard. | Nails and metal fixings.<br><br>Paints coatings and glues, paper, plastics and rubber, glass, grit.<br><br>Coated and treated timber (non CCA or creosote). |
| **Grade D**<br><br>**Hazardous Waste** | Requires disposal at special facilities. | All of the above plus fencing, track work and transmission pole contractors. | Fencing<br><br>Transmission Poles<br><br>Railway sleepers<br><br>Cooling towers | Copper/ Chrome/ Arsenic preservation treatments<br><br>Creosote |

# 2 Current Situation and Context

This section summarises and compares the available information on wood waste arisings, sources, and composition and how these might be affected by seasonal and regional factors. Comparisons are made to the extent possible given that the reports have been written at different times, and use varying data sources. Most of the research reports refer to UK figures (few have breakdowns of wood waste management in England).

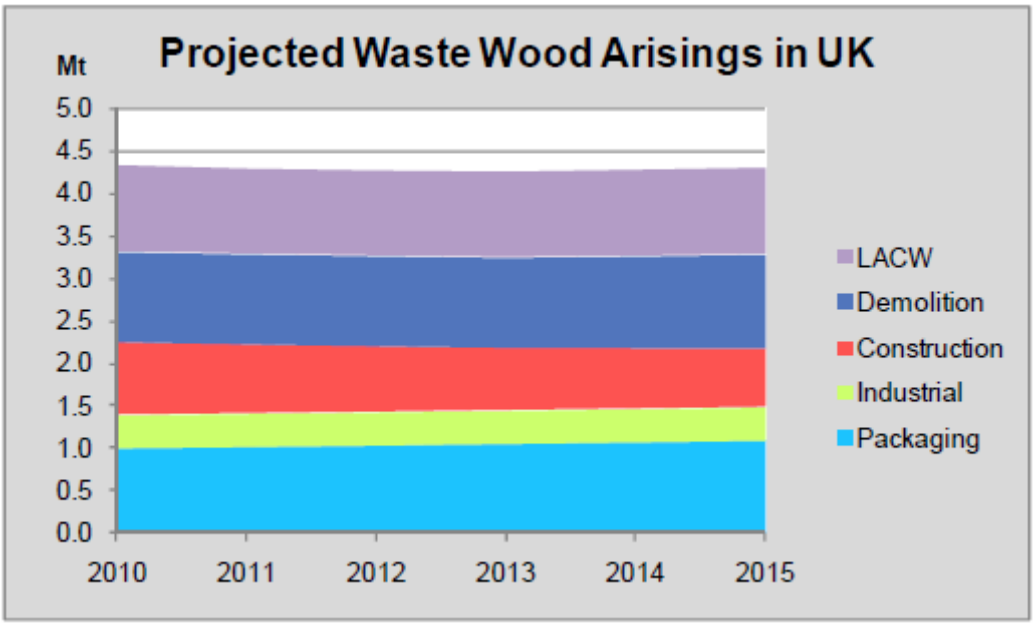
## 2.1 Arisings, Sources and Composition

Wood waste can arise from a number of sources (municipal, commercial and industrial (C&I), construction and demolition (C&D)) and in many different forms. A number of the reviewed reports have tried to quantify the overall UK wood waste tonnages, and to the extent possible, identify the quantities arising from each source.

The Tolvik report found that in 2010, UK wood waste arisings were 4.3 Million tonnes (Mt). This estimate is considered to be the best available by the forthcoming WRAP 2012 report. The 4.3 Mt arising constituted a decrease from an estimated 5.1 Mt in 2007, mainly as a result of the recession and industry resource efficiency measures. The greatest decrease in wood waste production was seen in the construction sector (28% decrease between 2007 and 2010) (Table 2). According to the Tolvik report, wood waste arisings are not expected to increase, at least by 2015, but will most likely level out at about 4.3 Mt (Figure 1).

The Pöyry report estimated similar numbers for arisings using both a bottom-up (interviews with producers/consumers) and a top-down (information from trade and public bodies) approach, albeit for 2009. Of the estimates that appear in Table 3, the ones resulting from the bottom up approach are seen as less reliable since most respondents provided estimates and further analysis would be required to improve reliability. The top down results, giving an overall figure of 4.6 Mt of wood waste arising in 2009, are considered more accurate as they relate to amounts of wood used by each sector. With regards to composition, the Pöyry report estimates that the majority of wood waste is made up of solid wood waste, about 1.5 Mt of which is classified as clean wood waste (Grade A) (Table 4).

## Figure 1 Projected wood waste arisings to 2015 (Tolvik, 2011)




## Table 2 UK wood waste arisings by source in 2007 and 2010 (Tolvik, 2011)

| Source of Wood Waste | WRAP 2007 Report (kt) | 2010 Updated (kt) | % Change |
|---|---|---|---|
| Packaging/Commercial | 1,169 | 998 | 15 |
| Industrial | 463 | 393 | 15 |
| Construction | 1,184 | 854 | 28 |
| Demolition | 1,138 | 1,068 | 6 |
| LACW | 619 | 1,015 | 15 |
| Adjusted LACW | 491 | | |
| **Total** | **5,064** | **4,327** | **15** |

## Table 3 Wood waste arisings by source (Pöyry, 2009)

| Wood waste source | Bottom-up analysis (Mt) | Top-down analysis (Mt) |
|---|---|---|
| Construction | 1.1 | 1.2 |
| Demolition/Remodelling | 0.8 | 1.1 |
| Furniture | 0.5 | 0.3 |
| Joinery | 0.2 | 0.1 |
| Other Industrial | 0.1 | 0.1 |
| Municipal | 0.6 | |
| Packaging | 1.2 | |
| **Total** | **4.5** | **4.6** |

## Table 4 Estimate of wood waste composition (Pöyry, 2009)

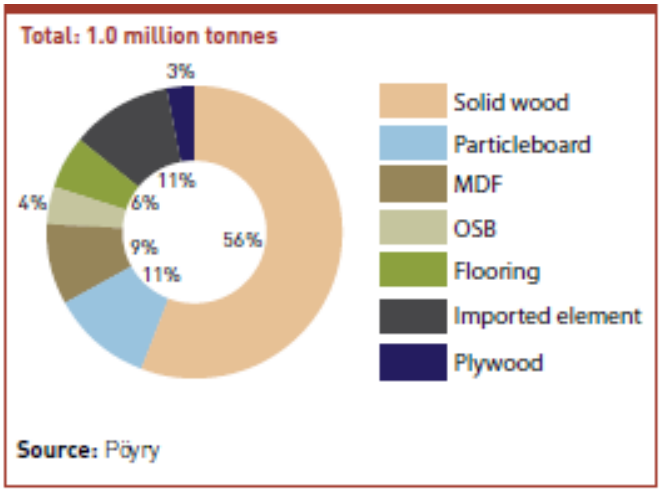
| Wood waste type | Amount (kt) |
|---|---|
| Clean Solid Wood | 1,426.6 |
| Treated Solid Wood | 1,903.4 |
| Particleboard | 568.3 |
| MDF | 261.9 |
| Plywood | 303.8 |
| OSB | 117.2 |

According to WRAP 2011, about 4.1 Mt of wood waste entered the UK waste stream in 2010. Of this, construction activities contributed 1 Mt, demolition activities 1.1 Mt, packaging 1.1 Mt, municipal sources 0.6 Mt and finally joinery and furniture manufacturing contributed the least with 0.4 Mt. As Figure 2 shows, more than half of the wood waste arising from construction sources is solid wood.

The same report also shows that the overall wood waste arisings in 2010 show a decrease of 0.4 Mt from 2007 arisings. The joinery and furniture sector (the sector contributing most of the industrial wood waste) saw the steepest decline in arisings (23% decrease). This could be attributed to the recession but also to industry commitments such as resource efficiency action plans. Furthermore, a 2009 survey of the British Woodworking Federation found than most of the wood waste produced is used as animal bedding or as fuel for heat either by the business or by the employees and so is not reported as waste arisings. Wood waste from the construction sector also decreased markedly, by 13% between 2007 and 2010. Again, the recession has contributed to this decrease as have Site Waste Management Plans (SWMP) which were introduced in April 2008 and require construction companies to plan, monitor and measure the waste they produce onsite. Industry commitments such as 'Halving waste to landfill' have provided further stimulus for wood waste prevention.

WRAP 2011 also noted a decline in packaging of 100,000 tonnes (t), which was attributed to greater reuse of pallets and substitution away from wood packaging. The National Packaging Waste Database (NPWD) shows a decline in wood waste recovered for recycling from 915,000 t in 2007 to 77,000 t in 2010. This is probably due to fewer businesses reporting recycling as Packaging Recovery Note prices fell. Therefore, there is a likely underestimation in the 70% recycling and recovery rate suggested by the NPWD. Finally, the decrease of 100,000 t in municipally produced wood waste, which is generally of low quality and often comingled with furniture, is thought to be the result of a decline in do it yourself (DIY) activities.

## Figure 2 Composition of construction wood waste (WRAP, 2011)




The AEA report gives a significantly higher estimate of UK wood waste arisings, at around 5.6 Mt using figures from WRAP surveys conducted in 2005 and 2009 and EA and Defra surveys of Commercial & Industrial (C&I) waste published in 2009 (data for 2002-2003) and 2010 respectively. Of the 5.6 Mt, about 2.3 Mt came from the construction and demolition (C&D) sector, 1.8 Mt from C&I sources, about 1.1 Mt from Municipal Solid Waste (MSW), and the rest from panelboards and railway sleepers/utility poles (Figure 3). The AEA report also summarises the findings of other older reports and these are included here for completeness (Table 5).

## Figure 3 Yearly arisings by source in the UK (AEA, 2012)

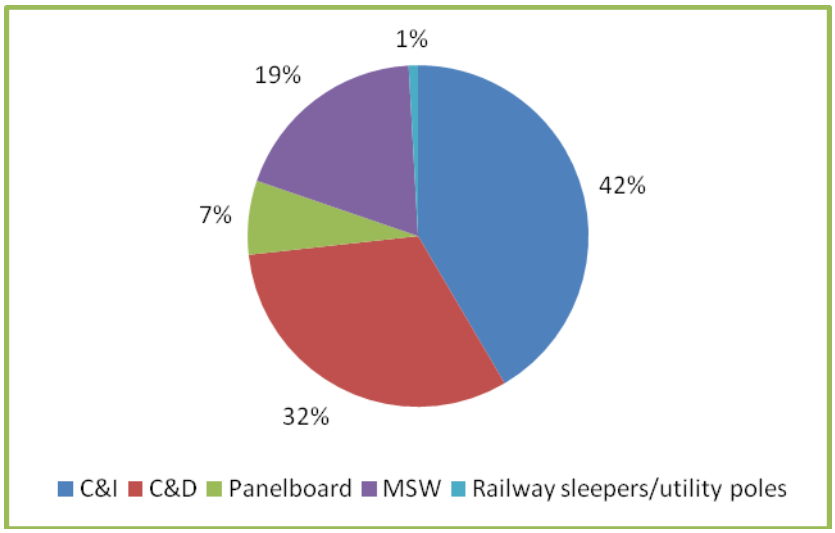


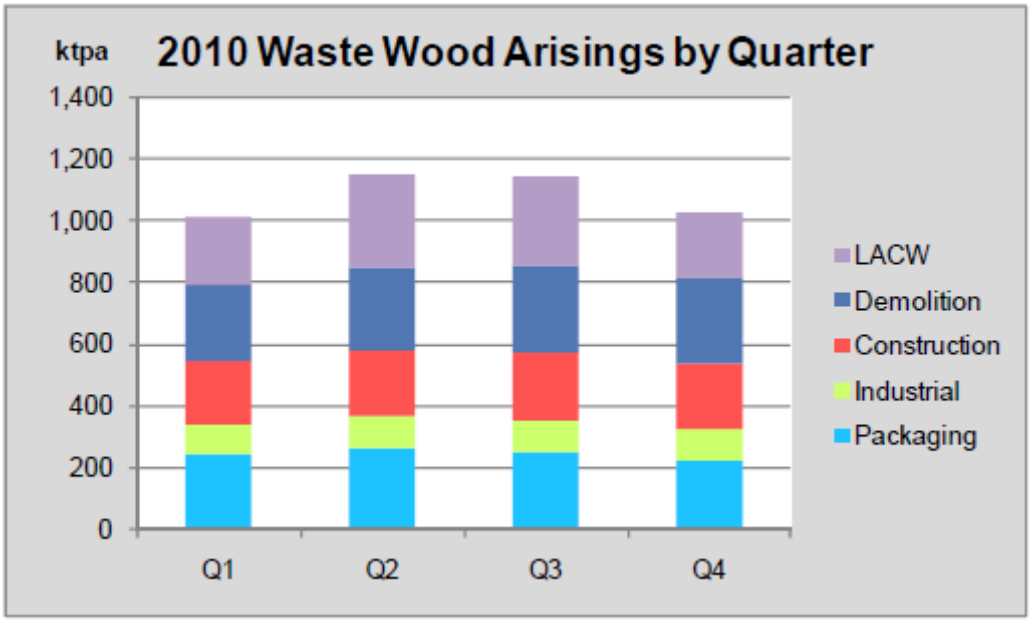
**Table 5 Range of estimates in most comprehensive studies published on wood waste UK (AEA, 2012; Data from CONFOR, 2010)**

| Source of Wood Waste | Author of Report & Publication Year | | | | |
|---|---|---|---|---|---|
| | WRAP 2009 | ERM/DTI 2006/7 | WRAP/MEL 2005 | BRE/Hurley 2004 | TRADA 2002 |
| Municipal | 0.6 | 1.1 | 1.1 | 0.8 | 2.5 |
| Commercial and Industrial | 1.6 | 3.5 | 4.5 | 3.3 | 1.8 |
| Construction, Demolition and remodelling | 2.3 | 2.9 | 5 | 3.3 | 0.9 |
| **Total** | **4.5** | **7.5** | **10.6** | **7.4** | **5.2** |

## 2.2 Seasonal and Regional Variations

There are both regional and seasonal variations in the UK distribution of wood waste arisings. As can be seen in Figure 4 wood waste arising from industrial sources is more or less stable throughout the year whereas there seems to be an increase in C&D and local authority collected wood waste in Q2 and Q3 coinciding with the seasons where most people do DIY type activity and building works at home.

**Figure 4 Wood waste arisings in the UK by quarter (Tolvik, 2011)**

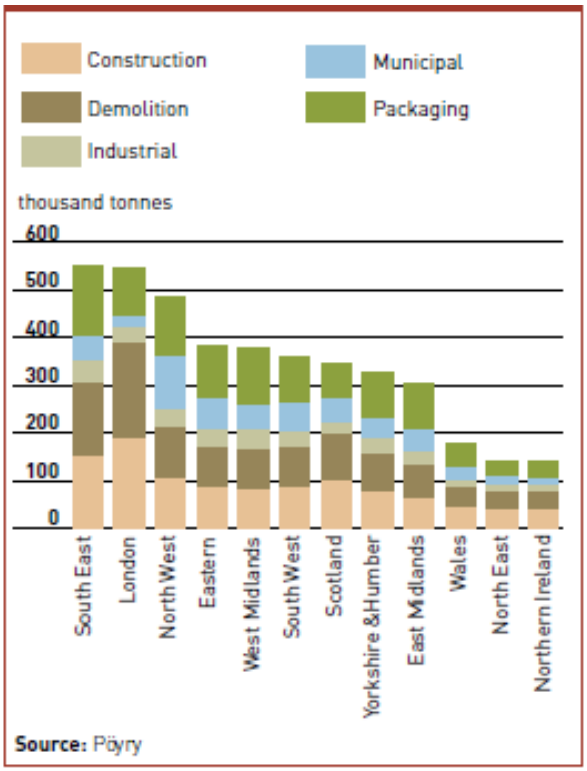



Similarly, wood waste arisings are mostly concentrated in areas with high population density (such as London, Manchester, Birmingham), locations closer to the coast and potentially linked to imports/exports (such as the North East of England, South Coast,

Essex), and relatively rural locations with forestry activity (such as the South West of England) (WRAP, 2012). According to WRAP 2011, in England, almost 40% of wood waste arisings are found in three areas: London, South East and North West (Figure 5).

The Pöyry report contains a more analytical breakdown of the wood waste distribution in the UK by wood waste stream whereas the forthcoming WRAP 2012 report contains a breakdown of wood waste arisings by English local authority.

**Figure 5 Estimated wood waste arisings by region (WRAP, 2011)**



# 3 Collection and Sorting

This section summarises the available information on the collection and sorting of wood waste. To the extent allowed by the available information, it also tries to assess the effects of collection and sorting on the quality of the material.

## 3.1 Collection

Wood waste can be collected via a number of routes depending on its source, amount and grade. Household wood waste is usually collected at household waste recycling centres (HWRC) or via the council's bulky waste collection (in the case of furniture), where this is available. Wood waste from C&D and C&I sources can be collected either by waste management companies in skips or can be taken to reprocessors directly by the producer. There are also a number of informal wood waste disposal routes such as burning in small scale boilers either by the producing company or its employees.

The forthcoming WRAP 2012 report on the business case for wood waste collection hubs assessed the following four scenarios on how to increase collection of wood waste from existing facilities:

1. wood recovery in composting - larger composters already have sites suitable for collection and recovery of wood waste, so the report reviewed the options for composters wishing to provide collection points;

2. Local Authority Household Waste Recycling Centres - the possibility of using these sites as collection hubs for wood waste from small businesses was explored;

3. Collection clusters for SME wood businesses - little is known about the fate of wood waste from SMEs, which do not produce enough for cost effective skip hire. The option of offering collection rounds using commercial bins was investigated; and,

4. Reverse logistics for wood sector businesses - deliveries of wood products to wood sector businesses matched with collection and back haulage of wood waste.

Table 6 explains each of these scenarios in greater detail and describes their prospects.

## Table 6 Explanation and prospects of each scenario assessed in the WRAP 2012 report (WRAP, 2012)

| Option | Explanation | Prospects |
|---|---|---|
| Wood recovery in composting | A good network of sites already exists, many with permits, and there is evidence that significant quantities of wood waste are already handled, albeit into lower value markets. | At least 250,000 tonnes already enter composting processes, and potential capacity could be much greater with limited additional investment. A significant amount of oversize reject fraction from composting processes is wood material. Some composters already process wood waste into products. |
| Local Authority HWRC sites | Low value markets are achieved by many local authorities due to limited wood sorting. Investigation of improved onsite sorting, and access by small traders. | At least 600,000 tonnes already pass through HWRC sites, and very large additional capacity could be mobilised with limited additional investment. Some local authorities are already engaging in non household collections using HWRC sites. |
| Collection clusters for SME wood businesses | Wood collections from small businesses in particular have historically not succeeded due to high logistics costs relative to low arisings level from each business. This option proposes investigating the economics of building collection routes at sufficient density to ensure viability. | Currently, an estimated 200,000 tonnes are processed through 'informal' recovery routes – provision of a cost effective alternative might be expected to recover significant new material, especially in light of supply chain pressures discussed in the survey in Section 8 above (note: refers to section in WRAP 2012 report). |
| Reverse logistics for wood sector businesses | Wood businesses receiving deliveries of wood products manage wood wastes through reverse logistics – backhauling waste to the original distribution location for onwards recovery. | This enables substantial collection of clean new wood waste at low marginal transport cost by using existing transport movements to return wood waste to a collection point for processing to end markets. |

The WRAP 2012 report finds that overall, wood waste collections are working efficiently but there might be a market failure when it comes to collecting low grade wood waste from small businesses. As far as the scenarios are concerned there might be opportunities for composters to create wood waste collection hubs, and some already do this successfully, but it depends on local circumstances and supply and demand factors. Offering a collection service through HWRCs to small businesses for a fee seems to be promising, both in terms of the amounts that could potentially be collected, particularly from C&D small businesses, but also in terms of the economic benefits that this option could bring to local authorities. While only a minority of HWRC sites are likely to be suitable for use as wood collection hubs, the large number of HWRCs overall could still enable a significant

network of new sites to be made available for non-household waste. Significant cost savings are likely when implementing wood segregation at source at HWRCs. Furthermore, this option does not seem to compete with existing collection routes as the individual amounts are likely to be small. The options of collection clusters from SMEs and reverse logistics could be viable, but in practice they may require the recruitment of a large number of businesses and additional costs and effort.

## 3.2 Sorting

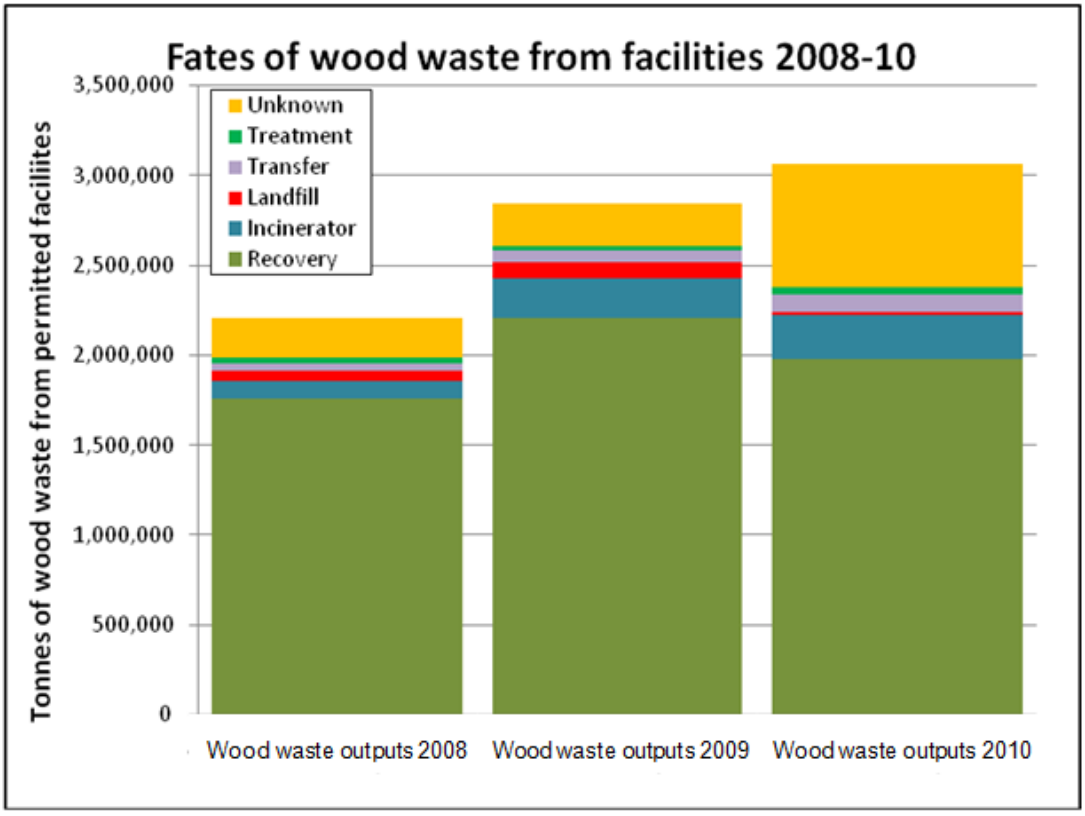
The price of wood waste depends on its quality and thus the sorting and grading operations required to meet the expected wood quality. Wood sorting is 'designed in' to the collection system by pricing incoming wood waste according to its content. This gives waste producers and intermediaries price incentives to keep lower grade wood waste separate. The wood waste is then subject to a range of sorting and grading processes. More investment and overheads in processing are required to produce high value feedstocks whereas high throughput and low handling costs are necessary to produce a lower value, higher volume product. Larger processors may choose some balance between the two. Some examples of possible processing operations can be found in the forthcoming WRAP 2012 report.

Wood waste is often sorted according to its grade. Grade A material goes to higher value markets such as animal bedding and panel products as well as in any incinerator. Grade B can be used in panel products and WID compliant incineration[3]. Grades C and D must be used in a WID compliant incinerator (Grade D is hazardous wood waste and only suitable for specialist landfill or WID compliant incineration). Sorting wood waste into the various grades is not always straight forward and is not always done consistently by all producers. The PAS111:2012 ‘Specification for the requirements and test methods for processing waste wood’ provides guidance on the quality requirements for a number of end-uses and also sets out 'Grades' for wood waste. There is a separate PAS, PAS104:2004 ‘Wood recycling in the panelboard manufacturing industry’ testing for chemical contamination which is still being developed. The WRAP 2012 report also provides information on other ways that can be used to test and grade wood waste.

The forthcoming WRAP 2012 report also shows that in the last 3 years wood waste categorised as separate wood waste fractions in the UK increased from 2.2 Mt to 3.0 Mt indicating that more wood waste is being separated. Of the 3 Mt only 0.6% was sent to landfill. Therefore, the report estimates that the amount of wood waste sent to landfill annually in the UK does not exceed 1 Mt, a lower estimate than the Tolvik, Pöyry and AEA reports. According to the authors of the report, their estimate is also supported by anecdotal evidence that significant quantities of wood waste are managed through informal ‘unknown’ routes (Figure 6).

[3] Waste Incineration Directive compliant plants

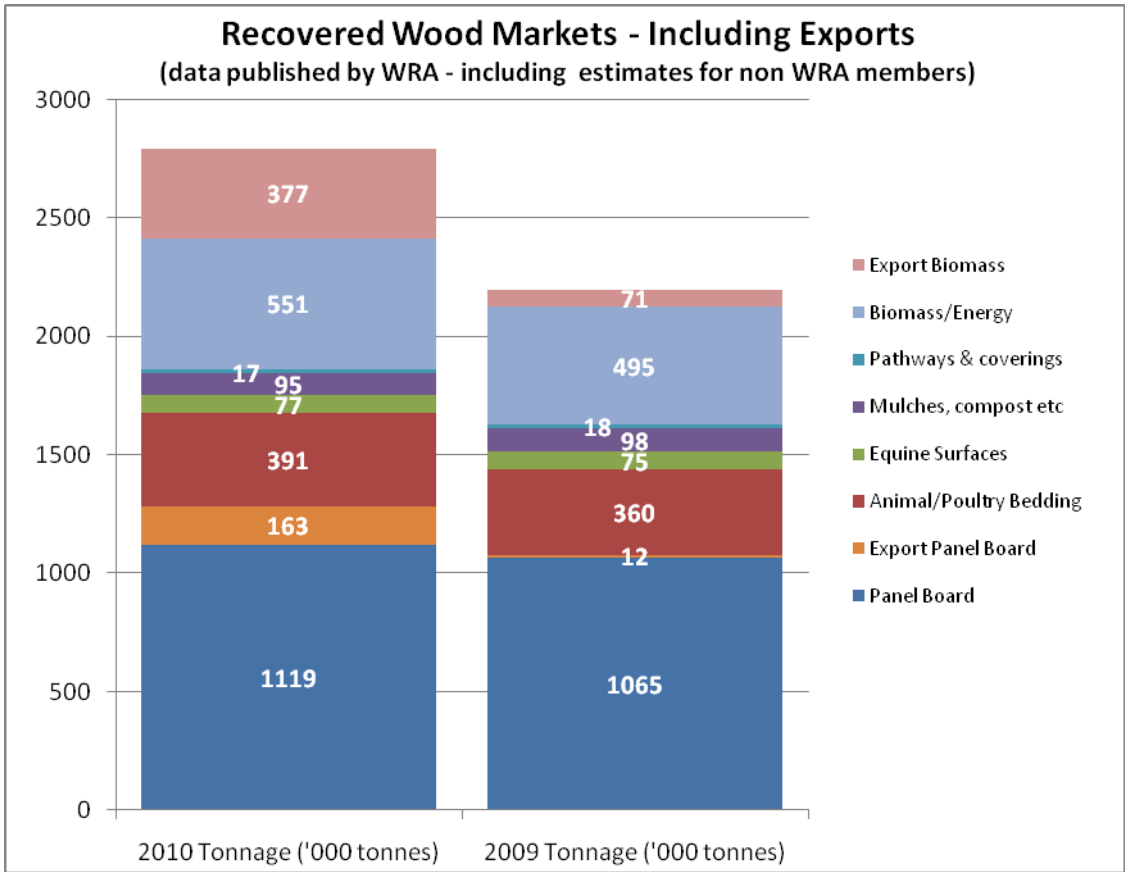
**Figure 6 Fates of wood waste from facilities, 2008-2010. These do not include virgin timber and exempted (WRAP, 2012)**



# 4 Markets

As can be seen by Figure 7 below, between 2009 and 2010 there were important changes in the end markets for wood waste. While demand from the domestic panelboard industry decreased slightly, overseas demand for panelboard and overall exports of wood waste, increased greatly. An increase in demand of about 60,000 t was seen in the biomass sector, while demand for animal/poultry bedding and equine surfaces also increased, albeit to a smaller extent (WRAP, 2012).

**Figure 7 Key markets for recovered wood waste (WRAP, 2012)**




The Tolvik report estimates that in 2010 wood waste demand in the UK was 3.2 Mt. Given that wood waste production was estimated by the same report to be 4.3 Mt, this suggests that in 2010 there was a 74% wood recovery rate in the UK. The majority (ca. 1.1 Mt) of this recovered wood waste went to the panelboard market, and about equal amounts were used for animal bedding, biomass energy, and exports (Table 7). The remaining 1.1 Mt were disposed of at landfill or via other 'informal' outlets as follows: 0.35 Mt in the residual Local Authority Collected Waste (LACW), 0.5 Mt in non-LACW, 0.1 Mt to inert landfill and up to 0.2 Mt unaccounted for.

## Table 7 UK end markets for wood waste (Tolvik, 2011)

| Waste Wood End Market | Tolvik 2010 Estimate (kt) |
|---|---|
| Panel board | 1,119 |
| Bedding | 500 |
| Equine | 75 |
| Mulches | 150 |
| Pathways | 17 |
| Biomass Energy | 551 |
| Informal Commercial | 100 |
| Informal Domestic | 150 |
| Exports | 540 |
| **Total** | **3,202** |

The AEA report has quite different figures compared to the other reports. Wood waste arisings are estimated at about 5.6 Mt, of which the report estimates that 2.2 Mt (39%) are disposed of at landfill, about 1.5 Mt are used in biomass plants (both WID and non-WID compliant), 0.55 Mt used as animal bedding/compost/landscaping, about 0.45 Mt used in energy from waste and almost 0.9 Mt go to unknown uses. Table 8 shows the estimated arisings by sector and how they are managed (all references in the table appear in the AEA report).

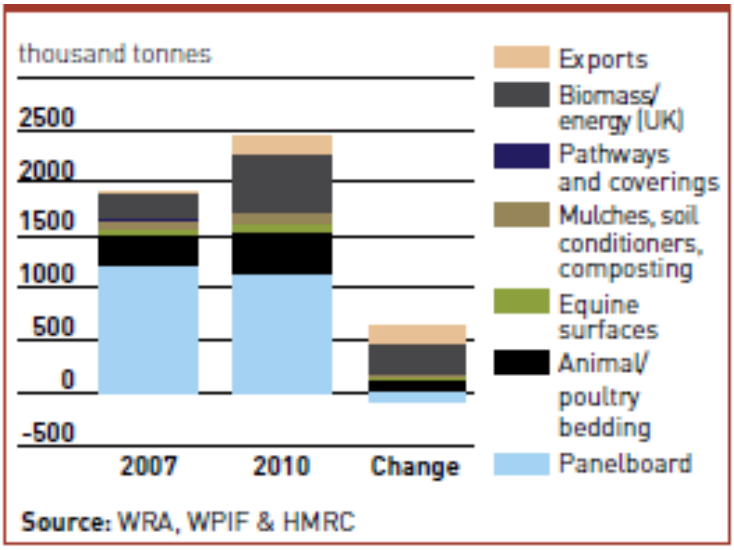
## Table 8 Summary of wood waste arisings and management routes (AEA, 2012)

| Sector | Estimate(s) | Management |
|---|---|---|
| **MSW** | - 1.056Mt/y (Defra 2009);<br>- 1.065Mt /y + 0.6Mt/y furniture waste (WRAP 2005)<br>- 0.62Mt/y (WRAP 2009) | • Around 90,000t/y furniture recycled through Furniture Reuse network.<br>• Wastedataflow indicates that wood recycled through CA sites was 461,589 in 2008-9.<br>• The remainder is landfilled or incinerated |
| **C&D** | - 101,000 t/y (WRAP 2005)<br>- WRAP (2009): 1.18Mt/y Construction waste;1.14Mt/y demolition waste. *Thought to be an underestimate due to lack of data from construction sector (Defra 2010)*.<br>- TRADA and Enviros (2005):1.2Mt/y construction waste, 2.1 Mt/y demolition waste. | Some timber re-use on site.<br>CRWP (2008) says that demolition contractors are likely to encounter more materials in the future that cannot be recycled readily (e.g. treated timber with adhesives).<br>CWRP (2010) estimates that around 65% of timber waste from construction is diverted from landfill.<br>However, where the tonnage arising is low contractor often feels it is not worth recycling (Comley, 2009)<br>Environmental permitting allows demolition arising to be treated on site, which means that a contractor can burn clean wood on site provided a permit is granted and no more than 10t is burnt in 24 hours. |

| | | |
|---|---|---|
| | | Treated timber can be difficult to manage appropriately, as very little can be re-used or recycled CRWP (2009). Generally contractors commented that recycling markets are not reliable month on month. This report also identified that some of this 'dirty' wood is being sent to Germany.<br>WRAP (2005) disposal in tonnes:<br>- Recycled: 47,476<br>- Spread on registered sites 25,088<br>- Used for back fill: 11,531<br>- Landfill engineering or restoration: 9409<br>- Disposal at landfill: 7598<br>CRWP (2009) estimate:<br>Disposed off site: 19%<br>Recycled off site: 75%<br>Energy recovery: 3% |
| **C&I** | 4.48Mt/y (WRAP 2005) (Resource dominated by furniture and other industrial wood production waste, followed by construction and other industry waste)<br><br>WRAP (2009) estimated: 0.46Mt/y industrial wood waste. | Large proportion of furniture and industry waste wood used for heat on site. From AEA (2010) RESTATs survey the figure for wood usage for heat in UK was 502,970t in 2009. This was dominated by the use of 365,469t in 2009 for combustion in the Wood Panel Industry.<br>Other uses include recycling to panel board, animal bedding and mulching.<br>Remainder will be landfilled or incinerated but it is likely that this is a small fraction of total arisings. |
| **Packaging** | 1.7Mt/y (WRAP 2009)<br>1.055Mt (2009) - Waste packaging statistics, Defra web site | According to Defra statistics 76.9% (940,460t) was recycled in 2009. Most of this was re-processed in the UK, although a small amount went abroad. |
| **Joinery industry** | 125000-200000 t/y. (BWWF, CPA and BRE (2009)). | BWWF, CPA and BRE estimate that 22% of joinery waste if burnt for heat on site; and 16% is sold as fuel. For machine waste 6% used for heat on site; 4% used for particle board manufacture; 56% used for animal bedding; 12% sold for fuel; and 23% for other use (mainly composting). |
| **Arboricultural arisings** | Confor (2010) 120,000t/y 2.3Mt/y (Kilpatrick *et al* 2008) | ADAS estimate from land used for urban, recreational and transport purposes. Forest Research estimate that around 0.5Mt of this arboricultural resource goes to landfill, the rest being managed *in situ* or chipped for mulch. |

Much like the Tolvik report, WRAP 2011 shows that in 2010 the largest end market for wood waste was the panelboard sector consuming 1.1 Mt (Figure 8). Overall, 2.3 Mt of wood waste were recycled or used in energy recovery. However, contrary to the Tolvik report, WRAP 2011 found that just 0.2 Mt were exported for recycling or recovery, with 195,000 tonnes of mostly low grade wood exported to Belgium and Denmark. The estimate of the amount going to landfill is similar to the Tolvik report at 1.2 Mt.

**Figure 8 Recovered wood end markets (WRAP, 2011)**




## 4.1 Panelboard

The future growth in demand for recovered wood from the panelboard industry will depend on the recovery of the construction and furniture sectors but estimates suggest that demand will remain below 2007 levels for some time (as recovery from the effects of the recession is likely to be slow). On the other hand, demand from animal bedding and equine surfaces, which increased as wood recyclers diversified operations and now makes up 20% of recovered wood demand, is likely to stay high as substitutes such as straw and hay are more costly (WRAP 2011).

## 4.2 Biomass

Given the high demand for wood waste from the domestic biomass industry and for exports (ca.1.1 Mt), the Tolvik report tried to estimate the amount of wood waste that would be available for domestic biomass and exports in the future (Table 9). The authors estimate that by the end of 2012 recovery of wood waste would be 3.3 Mt and demand from other sectors (not biomass and export) would be 2.1 Mt. This would leave 1.2 Mt available for use by the biomass and export sectors. Subtracting the existing domestic biomass and export demand (1.1 Mt) leaves 0.1 Mt of wood waste available to new biomass facilities and export routes. This is projected to rise to 0.5 Mt by 2015 (assuming

a projected improvement in recovery rates to reach 85%, similar to other EU countries).

Assuming that the planned and existing biomass facilities will require domestic wood waste to cover 10% of their energy needs (32 Mtpa), the Tolvik report estimates that by 2015 there will be a shortfall in supply if only 25% of planned biomass capacity is developed. The supply shortfall is further compounded by the fact that Packaging Recycling Notes (PRNs), which were designed to stimulate recycling capacity, are very low for wood waste, at £1 - £2 per tonne, and with recycling targets remaining steady, PRNs are unlikely to act as a stimulus for wood waste recovery.

The increase in demand from the biomass sector is also anticipated by the authors of the Pöyry report, who expect that demand for wood waste for the production of pellets will also increase. Similarly, the WRAP 2012 report estimates that the main growth customer for new recovery will most likely be biomass. However, it also recognises the possibility raised by the Tolvik report that the current trend in exporting wood will be long term meaning that less will be available for domestic biomass. Therefore the international trade in wood waste becomes an important consideration both for domestic recovery and for biomass investment.

**Table 9 Projected wood waste demand and wood waste available for biomass and exports in the UK (Tolvik, 2011)**

| Waste Wood (Mt) | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Recovered | 3.2 | 3.3 | 3.3 | 3.4 | 3.5 | 3.7 |
| Demand – excluding Biomass and Exports | (2.1) | (2.1) | (2.1) | (2.1) | (2.1) | (2.1) |
| Available for Biomass and Exports | 1.1 | 1.1 | 1.2 | 1.3 | 1.4 | 1.6 |

## 4.3 Export and Import

Export markets, could also be a long term outlet for wood waste as demand from Germany, which currently imports up to 1 Mt of wood waste, is likely to increase as nuclear plants are abandoned by 2022. Demand from Sweden, which has incineration overcapacity but also has contractual obligations to supply heat, is also likely to increase (Tolvik, 2011).

Using only the standard classification code that refers to wood waste (STIC 24620 '*Sawdust & wood waste & scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms'*), for consistency with previous WRAP reports, the authors of the WRAP

2012 report calculated that the amount of wood waste exported in 2010 was 195,000 t, significantly lower than that reported in other reports. However, it also mentions that data by the Wood Recyclers Association which shows 540,000 t exported in 2010 appear realistic and are consistent with other sources. The explanation given for this discrepancy is that it is possible that wood is exported using other codes (for clean wood) and therefore the HMRC data, used to arrive at the figure in the forthcoming WRAP 2012 report, underestimates the amount of wood waste exported.

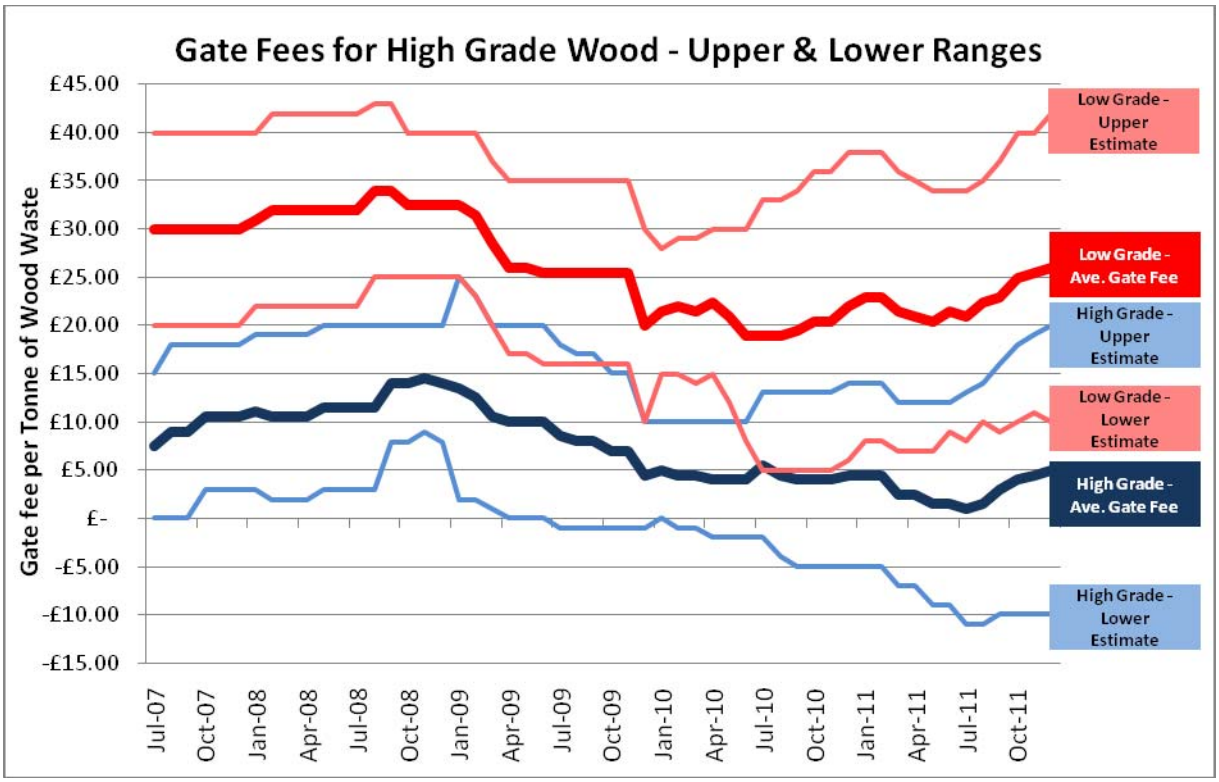
The UK is an overall net importer of wood fibre. In the 12 months up to November 2011, 1.06 Mt of wood waste were imported into the UK. While most exported wood fibre is wood waste and some forestry by-products, most imports are from North America (particularly Canada) and are of forest wood fibre by-products. Most wood fibre is imported and exported from port locations in England, and most imports and exports are of mostly clean wood wastes as the international trade of fuel grades and treated wood wastes is more complex from a regulatory perspective (WRAP, 2012).

## 4.4 Pricing

Imported material has a low cost (£7.79 per tonne not including shipping which will add significantly to overall cost), whereas exported material has a high value per tonne (average £26.75 plus shipping costs). But the price of exported material varies significantly throughout the year, meaning that exports only rise when the price is favourable. Taken together, the available import and export prices would indicate that domestic supply must take place within the range £26 - £35 per tonne for clean wood waste in order to be competitive with alternative international sources of supply and end markets.

Figure 9 shows the gate fees for high grade (clean, untreated wood waste along with some non-hazardous lower grade solid wood waste) and low grade (non-hazardous treated, MDF and chipboard) wood waste. The current national average gate fees, according to the forthcoming WRAP 2012 report, are roughly £5 per tonne for high grade wood waste and £25 for low grade wood waste. However, there are localised variations between and within regions depending on demand and supply factors, with some wood recyclers/reprocessors paying producers for clean, high quality wood waste. Prices for hazardous wood waste are not shown in Figure 9 since factors such as their production location and nature of hazard can cause significant variations in gate fees. As an indication, the WRAP 2012 report gives the example of railway sleepers contaminated with carbohydrates which could have gate fees of around £125 per tonne.

## Figure 9 Gate fees for wood waste received (WRAP, 2012)




The forthcoming WRAP 2012 report concludes that demand from export markets makes it economically feasible to develop more domestic collection and processing capacity whereas a reliable supply of imported wood waste makes investment in biomass capacity feasible. Therefore, it suggests that, with both collection and processing infrastructure and biomass demand in place, and provided that wood waste quantities are sufficient to affect the UK market, the market could set a ceiling price for buyers to pay and a floor price for sellers to accept so as to maintain the necessary amount of fibre in the UK market, as this could also bring advantages (economic, administrative and quality) both for the buyer and the seller.

# 5 Landfill Restrictions

The possible introduction of restrictions (or bans) to landfill is a subject that was covered by a number of the reviewed reports, which analysed other countries that have introduced such restrictions on wood waste and looked at whether such an option could be implemented successfully in the UK.

The main reasons why landfill restrictions have been implemented in other countries are:

- to promote upstream changes in material use;
- to move waste management up the hierarchy;
- to shift waste from landfill into incineration; and
- to mitigate problematic emissions (such as greenhouse gases) that arise from certain materials in landfill.

Typical targets for landfill restrictions are:

- combustible wastes/wastes suitable for incineration;
- wastes exceeding a threshold level of biodegradability;
- materials that have been collected separately for recycling; and
- organic/compostable wastes (Eunomia, 2010).

The Green Alliance report reviewed four European Countries (Austria, Germany, the Netherlands and Sweden), one region of a European Country (Flanders in Belgium) and a US state (Massachusetts) that have implemented restrictions on the landfilling of a range of materials, including wood waste. The report found that the objectives of the restrictions depended on how mature the country's waste policy was. Countries like Germany with high levels of material recovery put restrictions in place to focus on residual waste, whereas for example Massachusetts aimed to increase material recovery and so put restrictions on separately collected recyclables or compostable waste. Energy policy considerations did not feature strongly in the countries' motivations and increase in energy from waste was seen as a 'nice to have' or a welcome 'by-product'.

The analysis of the implemented schemes showed that supporting instruments to landfill restrictions are necessary as restrictions alone are not sufficient to divert the targeted waste/waste stream from landfill. An important supporting instrument was landfill taxes (in all the cases landfill tax was set at a high rate). The four EU countries studied, had high landfill taxes, above 75 euro per tonne. The Netherlands had a moratorium on new landfills since 1994 and in Flanders and Massachusetts measures were taken to restrict recyclable waste from incineration (although in Massachusetts tyres and wood can be incinerated). Austria, Flanders and Sweden have incineration taxes alongside landfill taxes and Massachusetts has a moratorium on new incineration capacity. All the case studies implemented mandatory separate collection for certain wastes and all in one way or another have pay as you throw systems in place.

Importantly, all the cases studied had high recycling and composting rates before or shortly after the restrictions were implemented, so it is hard to determine the effects of the

restrictions on alternative treatments. However the combined effect of restrictions and the package of supporting measures (fiscal, voluntary etc.) resulted in increases in recycling and composting rates, and in more cases also reduction in incineration rates.

The Eunomia study[4] looks at whether the costs and benefits of specific landfill bans and restrictions (i.e. measures which do not completely ban waste from landfill) justify their use. The revised results of the research identify the cost benefit analysis for wood waste restrictions as being positive. Sorting prior to recovery seems to be beneficial. Requirements to sort should be based around minimum standards for services which should make high captures of material for recycling highly likely, whilst not being prescriptive.

The Eunomia report suggests the following approach for wood waste:

- For household waste: all HWRCs should be required to collect wood waste possibly sorted into contaminated and cleaner grades;
- From C&I sources: wood waste should be separately collected possibly at HWRCs or through payment of relevant fees.
- For wood waste from industry, where it could contain contaminated wood waste, it should be graded by reprocessors; and
- C&D operators should sort their own wood waste (Eunomia, 2010).

In much the same way as the Green Alliance report, the Eunomia report found that very few countries use only landfill restrictions as a means of diverting waste from landfill. Countries with landfill restrictions usually also have the highest landfill taxes. Landfill restrictions without additional measures will not guarantee the destination of the material diverted and on their own have limited effect on recycling and waste prevention. The use of high landfill taxes seems to be more important where the lead time for implementing a restriction is short, as a high tax can prevent repeated resort to exemptions.

For restrictions on materials/products to be successful the material has to be readily visible and easily removed from a site, and homogeneous loads of it coming to the landfill i.e. single stream. Both types of these materials are likely to be found in diminishing quantities at landfill as landfill tax increases. More reduction in landfill of target material could be achieved if the restriction is made the responsibility of the collector or reprocessor rather than the landfill operator. This could be done through Duty of Care, and other policy instruments such as producer responsibility and a requirement to recycle (Eunomia, 2010).

[4] Some revisions have been made to the analysis in the report since the original report has been published to correct a calculation error. See the Call for Evidence for more information

# 6 Issues/Concerns Identified

All the reviewed reports identified a number of issues/concerns regarding the collection, sorting, processing and treatment/use of wood waste. This sector aims to summarise some key points.

## 6.1 Market

Most of these relate to the economic value of different grades of wood waste and how this might be affected by government/policy interventions, and other factors affecting supply and demand:

- PRNs carry a very low value at the moment;
- European demand might pose a threat to market dynamics for the panelboard industry;
- Government incentives encouraging electricity generation from renewable sources, such as biomass, causes concerns, particularly in the panelboard industry, that such incentives impair their ability to compete for recovered wood;
- There is friction in the market caused by the fact that local authorities prefer to recycle wood waste but there is increasing demand for wood waste as a fuel in biomass energy generation plants;
- Wood waste might no longer be a viable option for animal bedding and landscape uses as wood waste value continues to increase;
- As construction practices move toward timber frame construction particularly for social housing there is less waste produced on site and more in the factory where its value is better recognised;
- Wood waste reprocessors and aggregators are concerned that demand for Grades A and B exceeds supply resulting in rising costs for reprocessors;
- It will become ever more important to separate Grade A from other grades of wood waste to maximise the value of the waste stream;
- Wood waste prices change infrequently possibly because it is quite costly for recyclers to review whether their prices are consistent with current demand and supply conditions. It might be worth to shop around since there are quite significant differences in the prices that recyclers pay for high grade wood as well as in the prices that owners of low grades pay for their disposal;
- The UK is net importer of wood waste. Increasing gate fees and imports suggest that there is strong demand for wood waste, meaning that the market can absorb an increased level of recovery, and supply might actually outstrip demand. But

imported wood fibre carries a low cost, and although it is a lower grade wood, it provides a constraint on the market value of wood waste overall.

## 6.2 Infrastructure

These mostly regard the availability of infrastructure to successfully collect, process and treat/reuse wood waste in the UK:

- There are logistical issues regarding the separation of wood waste at many sites. For example it is not economical for small C&D companies to separate wood waste. Furthermore limited space in civic amenity sites might restrict the amount of wood that can be handled;

- UK reprocessors deal mostly with Grades A and B meaning that Grade C and loads of Grade B contaminated with Grade C end up in landfill;

- Wood waste arisings labelled as hazardous, such as that treated with chromated copper arsenate (CCA) and creosote, are forecast to continue to increase for the foreseeable future but options to recycle or recover energy from them are currently limited;

- Potential investors in wood waste biomass facilities need to consider the geography of their location, as transport economics will have a significant impact on their catchment area;

- There is currently very limited evidence of collections from small businesses in the wood sector which may be too small (or have too little space) to support skip collections at an economic price. A requirement to recover wood waste through a landfill restriction could prompt growth in this area. This could facilitate the development of wood collection rounds, but is likely to mostly recover lower grade wood, as clean wood waste is already likely to be recovered from most businesses;

- In current conditions, the risks of developing small scale collections of wood relate mainly to the difficulties of recruiting customers to collection rounds. As this is unlikely to change without new regulatory requirements, new collection schemes are likely to require ongoing subsidy to remain operational except where local market conditions enable high route density and transport efficiency to reduce collection costs and make the operation viable. These situations are likely to be the exception rather than the rule; and,

- The risks of developing take back schemes are likely to outweigh benefits. A landfill restriction would increase the interest in reverse logistics as a wood recovery solution, but this approach is currently of limited interest.

## 6.3 Statistics/Grading

A theme appearing in a number of reports concerns the way that wood waste is categorised. Different sectors use different terminology and the standard waste categorisation codes are not necessarily used uniformly. This leads to problems with data handling.

## 6.4 Landfill Restrictions

Rather than concerns, this section aims to summarise the key practices that, according to the reviewed reports, will be catalytic in ensuring the successful implementation of a landfill restriction:

- Clear signals that there will be a restriction;
- Sufficient lead in times. It is not considered wise to introduce restrictions before reaching the desirable recycling/recovery rates. Even then the lead in time should be 5-7 years for material based measures (such as would be a landfill restriction on wood), and 7 to 10 years for biodegradable wastes. The constraints of the existing planning system should be taken into account when deciding on the lead in times (for example for food, green and wood wastes additional infrastructure could be necessary);
- The effect of restrictions on market certainty for collection and reprocessing and on residual waste treatment should be considered in advance;
- A simple compliance system;
- A clear view of the overall objectives of a restriction (i.e. if increase in energy from waste is the goal then this should be part of a clear policy, not the default result of a restriction). The incineration of recyclable/compostable material should be discouraged;
- Effective supporting instruments (economic such as landfill tax, upstream measures such as mandatory separation, collection of food waste, quality standards for recycled products or other 'pull' factors to drive markets);
- Resources to enforce the restriction should be made available;
- Materials quality should be maintained (a requirement to sort as a complementary measure to a restriction on unsorted waste should not be overly prescriptive while still ensuring high quality materials);
- Possible side-effects such as flytipping and cross-border waste movement, which would put increased pressures on the regulator, should be considered; and
- Public support.

# 7 Data Gaps

All the reports that tried to calculate the UK wood waste arisings had to make several assumptions and ended up with best estimates in many cases. This is mainly because of the lack of data from the construction and joinery sectors, which reflects the large number of small businesses that use wood and generate wood waste. There is also limited data on hazardous wood waste arisings (WRAP, 2011). The AEA report suggests that the lack of coherent and up-to-date data and statistics on wood waste could be attributed to the fact that there is little incentive (or easy method) for producers to monitor wood waste arisings separately. Therefore most work depends on estimates or extrapolations. Clearly, better data would help to understand where most effort should be focused.

There also seems to be a lack of data regarding the amounts of wood waste exported as there is great discrepancy between HMRC data and WRA estimates, possibly due to the coding of wood waste. A more accurate picture of the amount and grades of wood exported would allow for better estimates of the necessary domestic capacity.

# 8 Concluding Remarks

One of the Government's commitments in the Review of Waste Policies was to consult on introducing wood waste restrictions to landfill. As part of this process, a Call for Evidence consulting on the management of wood waste has been launched. Responses to the Call for Evidence will be used to help develop options aimed at ensuring wood waste is managed in a way that delivers the best outcomes to the environment and the economy.

This document summarises the available information and data presented in a small number of recent reports dealing with the issue of wood waste and its management. It is not intended to be an exhaustive review of the evidence on wood waste. Nonetheless, it is hoped that it will prove a valuable resource for consultees to the Call for Evidence.