Working together for a world without waste

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Landfill restriction feasibility research: Wood update August 2012

Background

WRAP commissioned Eunomia to undertake a feasibility research project in 2009/2010 examining the potential economic and social benefits/disadvantages of restricting a number of specific materials to landfill, including wood waste. It is now around three years since the original research was carried out for the report and there have been a number of developments to the way these emissions are modelled which need to be taken into account. It has also come to light that there was an arithmetic error in original modelling and this has been corrected. The full report is in the process of being revised. However, in the meantime, this update has been prepared specifically on wood waste to support Defra's call for evidence on restricting the landfilling of wood waste.

Methodology

Research was undertaken in 2009 to support a Cost Benefit Analysis of options for regulations to restrict landfill. The research included a literature review, discussions with regulators, a series of stakeholder workshops, environmental modelling and a cost benefit analysis. The original report, Landfill Bans: Feasibility Research (2010), considered a wide range of recyclable materials for landfill bans/restrictions and modelled greenhouse gas (GHG) impacts from switching from landfill to different alternative routes.

For the purposes of the study, wood waste was defined to include:

- Natural wood;
- Wood packaging;
- Composite wood materials;
- Wood from tree surgery;
- Wood from construction and demolition, except where bound to other materials.

Although some wood wastes would be readily visible, the study assumed that the influence of landfill tax and renewable energy incentives would be sufficient to ensure that very few large, homogeneous loads of wood would be sent to landfill in the current regime.

Following an initial consideration of options, two types of material-based policy were taken forward for the cost benefit analysis.

- A 'restriction' whereby different types of waste are to be restricted from landfill so that landfilling is avoided as far as is able to be known. In this case, any form of 'sorting' of materials prior to landfilling would be considered sufficient, with carriers required to testify that residual waste destined to landfill had been subjected to a sorting process affecting the restricted material; and
- A 'ban on unsorted waste' whereby different types of waste are to be absolutely diverted from landfill, i.e. none of that type or types of waste are to be landfilled at all. In this case the measure is supported by a defined 'requirement to sort' setting out minimum requirements as to what waste producers, the waste industry and local authorities are required to do to comply with the measure. The 'requirement to sort' would apply irrespective of the destination of residual waste. This was the way in which the ban on 'unsorted waste' has been modelled.[1]

[1] Although we focus in this summary upon a 'requirement to sort' setting out some defined level of activity required of local authorities / businesses, in principle, it might be possible to meet the same objective through other approaches.

All restrictions and bans were modelled relative to a baseline scenario. This baseline considered ongoing changes likely to occur as a result of the landfill tax, as well as other policies already in place in the different nations of the UK. It is important to emphasise that the results are sensitive to a number of variables and various techniques were employed to model, simultaneously, the effects of varying some of the central assumptions.

The original study only considered net benefit to society – the sum of the environmental and the financial benefits. This social metric uses a social discount rate to reflect time preference and to value the costs of capital. It excludes the financial effects of policy instruments such as landfill tax, and the Renewables Obligation. This avoids double counting some environmental impacts which are internalised to some degree in existing policies. The benefits have been worked out over a period of 15 years, starting from 2009, with a discount rate of 3.5% in line with guidelines in the government's Green Book.

In the revised study, the financial cost modelling was undertaken using both a social metric and a private metric. The private metric values capital investments using a weighted average cost of capital appropriate for the sector. It includes the financial effects of taxes and transfers that are excluded under the social metric. The private metric will give a more accurate indication of the costs to businesses and individuals of any proposed change under a given set of policies.

A communications/regulatory cost was also modelled and restrictions were modelled at a cost of £470,000 per material to implement while the ban on unsorted waste was modelled at £70 million per material. The overall costs for banning or restricting a number of materials would be reduced with savings achieved by communicating the changes and introducing regulatory measures at the same time. The majority of these costs would be borne by government and the Environment Agency.

Policy option one: Restriction only

Under the restriction only approach, limited change was expected in the municipal stream since it was assumed:

- HWRCs would already be sorting wood in some form;
- No new collection schemes would be likely to be introduced;
- Any additional material sorted by local authorities would be likely to be of a lower quality than the material being collected today; and
- There would be limited additional activity in the commercial, industrial and C&D streams as the incentive to sort wood waste is already strong.

Wood reprocessors see little possibility to utilise contaminated wood further[2], making energy generation the preferred option. Accordingly, very limited increases in recycling and a larger increase in wood going to energy recovery were modelled (see **Table 1**). The final row in **Table 1** refers to the proportion of wood waste currently forecast as remaining in landfill that is diverted to energy recovery following the introduction of the policy i.e. 50% of the remaining residual wood waste would additionally go to combustion. The assumption is implicit that some wood will remain in residual waste.

[2] *Wood recycling rates in the municipal sector may be exaggerated as a result of waste classification in municipal compositions. Much of the non-recyclable wood, such as contaminated composite boards, will be classed as 'Other Combustible'. This fraction often includes 'furniture'. Whilst some attempt has been made to quantify the management of this fraction the study has mainly focused on the Wood Only fraction, that is much more likely to consist of 'clean wood' which can be recycled more easily, hence the recycling rate given above reflects 'clean wood', not the total 'Wood' element in the waste stream. This is impossible to achieve without better data on the composition of waste.*

Policy Option two: Ban on unsorted wood waste

Recycling rates for wood packaging rates are already high in the UK, relative to the rest of Europe, indicating that clean pallets are being effectively recycled.

Table 1 Recycling rates achieved under restriction only

Restriction only		Municipal Solid Waste	Commercial	Industrial	Construction & Demolition
Wood	Baseline recycling rate (2008)	64%	50%	64%	78%
	Baseline recycling rate (2015)	73%	59%	68%	85%
	Resulting recycling rate (2015)	73%	60%	69%	86%
	% Diversion to combustion	50%	50%	50%	50%

With a requirement to sort all waste wood, the effect would be that some hard to reach uncontaminated 'clean' wood would become available, so recycling would increase to a greater extent than under the restriction only. However as industry believes that the majority of waste wood is contaminated and less likely to be suitable for recycling (albeit there are differing qualities of material needed for different 'recycling' operations) and that combustors are actively searching out feedstock for potential Waste Incineration Directive (WID) compliant biomass plants, a strong shift to combustion was modelled (see **Table 2**). The final row in **Table 2** has the same meaning as the final row in **Table 1** above but less wood will remain in residual waste than under restrictions.

Table 2 Recycling rates achieved under ban on unsorted wood waste

Ban on unsorted wood waste		Municipal Solid Waste	Commercial	Industrial	Construction & Demolition
Wood	Baseline recycling rate (2008)	64%	50%	64%	78%
	Baseline recycling rate (2015)	73%	59%	68%	85%
	Resulting recycling rate (2015)	74%	63%	70%	88%
	% Diversion to combustion	70%	70%	70%	70%

Detailed findings

Greenhouse gases (GHG)

Wood contains a large quantity of lignin so it degrades more slowly in a landfill than, for example, food waste. However, if left to degrade over 150 years, the modelling suggests that significant emissions will still occur. The GHG savings can accrue in various ways under the policies for wood. It could be:

- through avoided emissions from landfilling;
- from the offsetting off virgin wood through recycling; or
- through the generation of energy, which offsets the marginal source of electricity. In this modelling the generation technology utilised is a combined cycle gas turbine (CCGT).

The GHG benefits from the diversion of wood waste into recycling and recovery under the two policies are shown below in **Table 3**. Traded emissions are those which are eligible for and would be included in trading under the Emissions Trading Scheme. These relate directly to generation of electricity and so for GHG emissions for landfill are lower than non-traded emissions which are not produced in energy production. International emissions are GHG emissions outside the UK and were assumed to be 0 for this study. Biogenic emissions are emissions produced by natural processes, rather than anthropogenic emissions which are produced by human activity. They are listed separately for this study because they are valued differently to each other.

The main points are as follows:

- The switching of wood waste from landfill to recycling or energy recovery provides a net saving of GHGs;
- The most significant saving is from avoided landfill emissions;
- Other emissions are also saved through the recycling of wood and through combustion in a dedicated WID compliant combustion facility where the energy offsets the marginal source of electricity; and
- The GHG savings from the ban on unsorted wood are around one and half times more beneficial than the restriction.

Table 3 Cumulative GHG emissions (2009-2024) from wood waste restrictions/bans, million tonnes CO_2 eq

	Restriction	**Unsorted Ban**
Traded CO_2 eq	-1.0	-1.3
Non-Traded CO_2 eq	-2.8	-4.2
International CO_2 eq	0	0
Total CO_2 eq (excluding biogenic)	-3.7	-5.6

Note: -ve figures indicate a net GHG saving

Energy

Initially, it is expected that a high proportion of waste wood diverted from landfill will be sought out by operators of combustion facilities. Under the restriction only, a median increase in energy generated of around 2,500 MWh electricity was modelled for the period 2009 to 2024.[3] With the stronger effect of the unsorted ban, more waste would be diverted, and this figure would increase to around 3,450 MWh in the same year.

Environmental benefits

The environmental benefits for the policies on wood are shown in **Table 4**. Key observations are that:

- The most significant part of the net environmental benefit from each of the policies is from reduced GHG emissions;
- The costs related to air emissions are small by comparison; and
- As with the GHG benefits, the ban on unsorted wood gives environmental benefits around double those expected from the restriction only.

[3] *Note the dedicated combustion facility modelled in this study generates electricity only. It is recognised that CHP facilities will provide different environmental benefits. However, these are not expected to change the policy recommendation for wood waste restrictions/bans.*

Table 4: Net present value (NPV) of environmental benefits from wood waste restrictions/bans, £ million

	Restriction	Unsorted Ban
GHGs	£90	£140
Air Quality	-£0.3	-£0.5
Net Environmental Benefits	£90	£130

Note: +ve figures indicate a net environmental benefit

Financial savings

The financial savings associated with the two policies are shown in **Table 5** below.

Table 5: Net present value (NPV) of financial savings from wood waste restrictions/bans, £ million

	Restriction	Unsorted Ban
Financial Saving (Social Metric)	-£40	-£120
Financial Saving (Private Metric)	£110	£100
Comms / Regulation Element	-£0.47	-£70

Note: -ve figures indicate a net financial cost

Key observations are:

- Under the social cost metric there are net financial costs for both policy options;
- When considering the costs under the private metric, there are financial savings under the restriction option and the unsorted ban option.
- The communications and regulation element comprises a significant proportion of the costs under the ban on unsorted waste option. These savings could be reduced if a number of materials were targeted at the same time.

Net benefit to society

The figures for the net benefit to society are shown in **Table 6**. The range shown around the results for Net Benefits to Society in Table 6 indicates the level of variation that can be expected from varying the assumptions used in the Monte Carlo analysis, given the upper and lower bounds of the confidence interval. These show that:

- The most influential factor in determining the net benefit to society, for policies directed at banning wood waste from landfill, is GHG savings.
- A benefit to society is possible under the restriction, but looks less likely under the unsorted ban option due to the regulation and communication costs. If these costs were met by a range of materials rather than a single one, the relative performance of the ban on unsorted wood waste would improve.

Table 6: Net present value (NPV) of net benefit to society from wood waste restrictions/bans, £ million

	Restriction	Unsorted Ban
Net Environmental Benefits	£90	£130
Financial Saving (Social Metric)	-£40	-£120
Upper (90% Interval)	£90	£80
Net Benefit to Society (median value)	£50	£20
Lower (10% Interval)	£10	-£40

Note: +ve figures indicate a net financial benefit

Key parameters

Assumptions were tested around the overall results from the model to find out how sensitive the results were if key parameters were varied using a Monte Carlo analysis. This approach includes a range of possible values and tests the sensitivity of the results to varying the assumptions used. The most significant variable that affects the net benefit to society is the landfill gas capture rate. The analysis presented uses assumptions of landfill gas capture ranging from 30% to 75% of landfill gas produced and reports the median value. The recycling benefit, collection and treatment costs are also influencing factors. Results have been rounded to the nearest ten million.

Conclusions

- Restrictions and a ban on unsorted waste have been considered in this update for wood waste. The results presented above focus on the results of modelling of the environmental benefits of these two policy options and a cost benefit analysis were either to be introduced, looking at benefits over 15 years from 2009-2024.
- The model suggests that there would be net environmental benefits of around 3.7 million tonnes of CO_2 eq over this period from the introduction of restrictions. The Net Present Value of these environmental benefits would be £90 million.
- Financial savings of £110 million over 15 years would be available to businesses and individuals from introduction of landfill restrictions, assessed using the private cost metric. There would however be costs overall to introduce restrictions of around £40 million, assessed using the social cost metric which excludes taxes and transfers.
- Taking environmental benefits and costs using the social cost metric together, the modelled cost benefit analysis suggests that a wood waste to landfill restriction could deliver a net benefit to society of £50 million.
- The other policy option modelled was a ban on unsorted waste, which would effectively be a ban on wood waste to landfill. There would be higher financial costs to implement such a measure and as such the available benefits are not as great with wood waste.
- Higher environmental benefits would be achieved through a ban on unsorted waste, due to the larger amount of material that would be diverted from landfill through this measure. The monetised environmental benefits of a ban on unsorted wood waste have been worked out at £130 million over a 15 year period.

- If currently landfilled wood were to be used as a biomass fuel, investment in the relevant technological infrastructure would be required.
- Following sensitivity analysis, the most significant working assumption affecting the estimates of the net benefit to society is the landfill gas capture rate.