

# ‘Biostabilisation’ of Wastes: Making the Case for a Differential Rate of Landfill Tax

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## Summary of the Case

The new Landfill Tax 'escalator' is having, and will continue to have, a significant impact upon the financial viability of mechanical-biological treatment (MBT) technologies in the UK. If the tax regime does not change, the risk of the UK missing its EU Landfill Directive targets is increased, and the prospects for treating any residual commercial and industrial (C&I) wastes prior to landfill, in the medium to long-term, are also diminished. A higher Landfill Tax inflates the overall cost of 'biostabilising' wastes at MBT facilities prior to landfill and thus Waste Disposal Authorities (WDAs) are more likely to choose alternative treatments which are both slower to implement and for which the non-tax element of the costs borne by WDAs is higher. As it is this non-tax element which determines the magnitude of new funds required by WDAs, in the current situation, the WDA funding gap for waste management services will rise faster than would otherwise be the case.

This paper puts forward the case for 'biostabilised' wastes from MBT facilities receiving the same level of taxation as incinerator bottom ash and soils, which can be shown to have similar externalities when sent to landfill. The evidence base shows that a differential rate of Landfill Tax for 'biostabilised' wastes would:

- Reduce contract prices for all forms of MBT, as sending 'biostabilised' wastes to landfill represents the 'backstop' option for managing market failure;<sup>1</sup>
- Allow MBT facilities to be implemented quickly to meet the UK's obligations under the EU Landfill Directive at least cost;
- Reduce the amount of additional financial support (as a result of pressure to increase council taxes to fund higher gate fees) required by WDAs from HMT;
- Require no changes to primary legislation, and fit harmoniously with the existing Landfill Allowance (Trading) Schemes, the associated EA monitoring system for MBT facilities and the existing system for applying lower rates for 'inactive' materials;<sup>2</sup>
- Mean that MBT facilities financed via long-term contracts for MSW could include additional capacity that is financially viable for residual C&I wastes, as even at £48, the tax will not support dedicated treatment facilities for this stream, which is currently managed through 1-2 year contracts;
- Promote technologies that can be fully integrated wider waste management strategies, which include both separate collection and treatment of kitchen wastes and incineration;
- Ensure, through both 'interim' and long-term MBT contracts, a more gradual phasing out of landfill infrastructure, which is appropriate for the UK which has significant capital investment in the sector;
- Lower the overall environmental impacts of landfill, and waste management more generally, in the UK, particularly with regard to climate change.

Our modelling clearly demonstrates that there is a significant difference between the externalities of landfilling untreated wastes compared to those from landfilling 'biostabilised' wastes, and that a differential rate of tax is, therefore, justified. It should be acknowledged, however, that modelling of this kind is subject to a range of assumptions and will thus always be somewhat controversial. As a result, we have not sought to link the modelled externalities to any new rate of tax. It is also important to note that our work suggests that there is justification for the future £48/tonne rate of Tax, if this is levied on untreated wastes only.

Stricter targets or a possible 'ban' on the landfill of 'active' or 'biodegradable' wastes from 2020 is under consideration by the European Commission and is also muted within England's new Waste Strategy, with Defra stating that it may launch a consultation on the matter. If passed in the UK, any such 'ban' would fit comfortably with the approach proposed in this paper since the definition of 'biodegradable' could be linked to the standard defining when the lower rate of tax should apply. Should a differential rate of Landfill Tax for 'biostabilised' wastes be implemented in the near future, there is little doubt that many MBT facilities across the UK would be built relatively quickly to help WDAs meet the targets set by the Landfill Allowance (Trading) Schemes. Thus, if a 'ban' was announced early and scheduled to meet potential EU requirements, the UK would not only be in a comfortable position in 2020, but the overall externalities from all landfills would be reduced. This would be similar to the approach employed in Germany and Austria two Member States which have already met the requirements of the final Landfill Directive target, without the need for a landfill tax.

The sections below, within this short Briefing Paper, provide background to many of the issues highlighted in this Summary and outline the case in far greater detail. The Paper is also supported by related Technical Appendices.

<sup>1</sup> Other forms of MBT, for example, might produce a fuel for thermal treatment and/or a compost-like output for use in land restoration

<sup>2</sup> As detailed in the Landfill Tax (Qualifying Material) Order 1996

## Past, present and proposed future rates of Landfill Tax

The UK Landfill Tax (the 'Tax') was implemented via the 1996 Landfill Tax Regulations (the 'Regulations') and came into force in October 1996. The Tax was designed to be revenue neutral. The cost to business is offset through a reduction in employers' higher rate National Insurance Contributions from 10.2% to 10%. In addition, the Landfill Tax Credit Scheme (LTCS) was established by HMRC to enable landfill operators to support a wide range of environmental projects by giving them a 90% tax credit against their donations to Environmental Bodies.

The standard rate of Tax was initially set at £7/tonne for 'active' wastes. At the same time a rate for 'inert/inactive' wastes was set at £2/tonne, with no 'escalator' value. Subsequently, in April 1999, the standard rate of tax was increased to £10 per tonne, and was made subject to a £1/tonne/annum escalator through to 2004.

The Strategy Unit review<sup>1</sup> of England's *Waste Strategy 2000*, strongly hinted at the need for the tax to rise to still higher levels.<sup>2</sup> Following a public consultation exercise instigated by ex-Chancellor Gordon Brown's pre-budget report, in the April 2003 budget it was announced that the rate for 'active' wastes would increase at a rate 'not less' than £3/tonne/annum from April 2005 until it reached a level of £35/tonne. Up until now, however, the escalator has not been above £3 per tonne/annum.

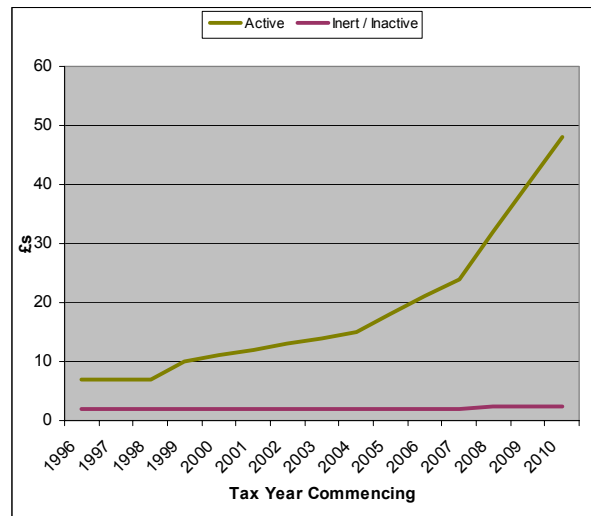
From April 2005, two thirds of the monies previously allocated to the LTCS were switched to a new Business Resource Efficiency and Waste (BREW) programme. BREW was developed in consultation with business representatives, Treasury and DTI (now

DBERR) and allocates funds to specific programmes such as Envirowise, WRAP and NISP to promote more sustainable waste management on the part of commerce and industry.

Gordon Brown's April 2007 budget subsequently proposed a new 'escalator' rate of £8/tonne/annum to be implemented from 2008/9. This will move the total Tax for all 'active' wastes from £24/tonne in 2007/8 to £32/tonne in 2008/9, rising to a total of at least £48/tonne in 2010/11, when the tax rate will be reviewed once more. Included within the same 2007 budget announcement was a rise in the rate of Tax for 'inert' or 'inactive' wastes from £2 to £2.50/tonne, also effective from April 2008.

The rises in Tax for 'active' and 'inert/inactive' wastes since 1996 are shown in Figure 1.

**Figure 1: Landfill Taxes for 'active' and 'inert/inactive' wastes**



## New MBT processes mean that wastes should no longer simply be deemed 'active' or 'inert/inactive'

In the development of the 1996 Regulations, the term 'active' was designed to include all wastes which produce the greenhouse gas (GHG) methane (CH<sub>4</sub>) when under anaerobic conditions in landfill. At this time, Mechanical-Biological Treatment (MBT) processes were barely considered as an option for waste treatment in the UK. Even when the EU Landfill Directive was transposed into UK law, many public policy documents – including *Waste Strategy 2000* – implicitly viewed the choice for dealing with residual waste as one of either landfill or incineration.

*Waste Strategy 2000* mentioned MBT, but gave it no role in analyses of how to meet Landfill Directive targets. Steadily, over time, however, the interest in MBT systems has grown because:

- There is often significant public opposition to incineration;
- Lead times from procurement through to operation of facilities can be much shorter for MBT facilities than for incineration;
- MBT systems can be better integrated with recycling initiatives and do more to preserve flexibility within waste management systems than do conventional incinerators;
- Some MBT configurations perform exceptionally well in environmental terms; and
- MBT systems usually require far smaller amounts of capital.

Through either (or both) aerobic or anaerobic methods, the biological element of MBT processes reduces the propensity of wastes to produce methane. The magnitude of this reduction in 'biodegradability', or level of 'biostabilisation', depends, amongst other things, upon how long the waste is resident within the MBT process, the technical nature of the process and upon the measurement protocol used. As outlined further below and in the Technical Appendices, recent studies have shown that even under the most stringent measurement protocols, losses in biodegradability of up to 90% can be achieved.<sup>3</sup>

The lower rate of Tax for 'inert' or 'inactive' wastes is applied to bottom ash from incineration processes, which some studies have shown to include non-trivial amounts of biodegradable material.<sup>4</sup> The organic layer of soils is also classed as 'inert/inactive' for Tax purposes, but as shown in Table 1, such materials can be measured to have similar levels of 'biodegradability' to wastes treated at MBT facilities. Why, therefore, should the benefits of 'biostabilisation' not be recognised in the Tax structure?

**Table 1: AT4 values of soil and residual waste**

| Substrate   | Respiration parameter AT <sub>4</sub> mg O <sub>2</sub> / g DM |
|---|--|
| Organic layer of soil   | 1.7 – 6.9  |
| 'Biostabilised' waste treated in MBT facilities                     | 1.1 – 7.4  |
| Note: The German standard is 5 mg O <sub>2</sub> / g DM (see below) |  |

Source: K Soyez and S Plickert (2002) Mechanical-Biological Pre-Treatment of Waste: State of the Art and Potentials of Biotechnology, *Acta Biotechnol.* 22(3-4), pp271-284

### The rate of Landfill Tax was originally conceived on the basis of measured externalities

This approach was set out by the Department of the Environment (DoE – now enshrined within DEFRA) in the 1995 UK Waste Strategy.<sup>5</sup> This document made clear that the goal of internalising externalities was the primary one, with the aims of increasing recycling and reducing disposal of wastes to landfill following on from this goal.

The process of setting the rate of Tax was influenced by a study in 1993 by CSERGE, which modelled externalities from four landfill scenarios and resulted in a mean negative value of around £3/tonne, with much of the non-transport element relating to methane emissions.<sup>6</sup> This was contrasted with the results of modelling two scenarios based upon the incineration of wastes, which gave mean positive externalities of around £4/tonne as a result of assumptions relating to 'pollution displacement'. The £7/tonne Tax set in 1996 therefore appears to be crudely based upon the difference between these two externality values.

Regarding the assessment of landfill externalities, the CSERGE study was superseded by a body of work leading to the derivation of landfill externalities by HM Customs & Excise in 2004.<sup>7</sup> This study was driven by an announcement by HM Treasury (HMT) in the 2002 budget that the Government would commission a review of the health effects of waste management and disposal options.

The methodologies and assumptions employed to calculate landfill externalities in both the CSERGE study and the body of work used to support the HM Customs & Excise figures have received some critical

comment.<sup>8</sup> The publication of the Stern Review and other related studies has also shown that work on the valuation of environmental impacts, especially with regard to climate change, has moved on significantly even since 2004.<sup>9</sup>

### This link to externalities was replaced by a primary goal to change behaviour

A 2002 Strategy Unit review acknowledged that the 1996 level of Tax had been set to reflect the externalities from landfill and that this was too low a rate to change behaviour.<sup>10</sup> As discussed above, this report advocated an increase in the 'escalator' value, which came into force in 2005 followed by the subsequent rise announced in March 2007.

To what extent future increases will change behaviour is debatable and is discussed further below, but it is clear that there has been a progressive departure from the original approach based on the externalities associated with landfill. In this context, some argue that the higher rate now reflects the difference between the negative externalities of landfill, and the positive ones associated with recycling.

In the intervening years, the Tax has therefore functioned as a policy tool to try to divert all 'active' wastes, municipal (MSW) and commercial and industrial (C&I) from landfill and to promote waste prevention and alternative forms of waste management higher in the waste hierarchy.

### Behavioural change goals must now be considered in the context of the Landfill Allowance Schemes

Despite many years of planning and discussion, the EU Landfill Directive was not passed by the European

Commission until 1999. The Government consulted upon options for meeting targets in 1999.<sup>11</sup>

The system for implementing the Landfill Directive found expression in the Waste and Emissions Trading Act (the 'WET Act') which was enacted only late in 2003. In the intervening period, recycling targets and the Tax were the only major policy drivers in place for reducing the amount of BMW being sent to landfill in the UK.

The Article 5 obligations of the Landfill Directive require the UK to reduce the quantity of BMW landfilled to:

- 75% of a 1995 baseline by 2009/10;
- 50% of a 1995 baseline by 2012/13; and
- 35% of a 1995 baseline by 2019/20.

Different devolved assemblies have introduced Landfill Allowance Schemes (LASs) with slightly different characteristics in order to meet their share of the overall UK obligation. In England, Defra introduced the Landfill Allowance Trading Scheme (LATS) in April 2005. Under the LATS, waste disposal authorities (WDAs) have been allocated finite numbers of 'allowances' for the amount of BMW they can send to landfill each year. The total number of allowances allocated to WDAs falls year-on-year, although some provisions do exist for 'banking' and borrowing into and out of, respectively, non-target years. As indicated by the name of the scheme, in England (but not currently in the devolved administrations) WDAs can trade allowances during times of surplus or shortage. The total number of allowances issued in each of the key target years listed above is equal to the UK's overall target, thus

theoretically providing for a system of least-cost compliance.

To deter 'under-performing' authorities from missing their targets, fines have been set by Defra at £150/tonne of BMW sent to landfill in excess of a WDA's allocation (again, devolved administrations do not all have the same level of fines). In reality, however, the trading element of the LATS is such that in England, WDAs are likely to be able to purchase allowances from others for less than this value as long as the supply of allowances exceeds demand for them. Considerable uncertainty, however, surrounds what the 'market' price might be at any given time.

It is these targets and the uncertainty that surrounds them, which now functions as the key driver for diversion of BMW (and MSW more generally) from landfill. Indeed, the mechanism has become the key financial driver for action across the UK.

It is therefore interesting to explore the interrelationship between the Tax and the LASs. In this context, the new 'escalator' will have two conflicting impacts:

- In a tradable scheme (i.e. the LATS), a higher tax could – in the medium to long-term – reduce the traded value of allowances. This is because the tax closes the gap between the cost of landfill and the costs of alternative treatments; but
- A higher tax will make some options for delivering on LAS obligations – notably MBT – more expensive. Given that MBT can be implemented relatively speedily, lower take-up will slow the rate of decline in the quantity of BMW landfilled. In tradable schemes, the demand for allowances, at a given point in

time, will therefore be above the level which might otherwise prevail. This will have the effect of increasing the price of allowances in tradable schemes, and in all LASs, it will increase the likelihood of non-compliance (and fines being levied).

The balance of these two effects is likely to be conditioned by the amount of time WDAs have to alter their decision making processes. The one year between April 2007 – when a change in the level of the escalator was announced – and April 2008 – when the new escalator will be implemented – does not represent sufficient time for adjustment. Rather, this adjustment will occur over several years. As a result, the price of allowances is likely to rise.

It is worth stating that in contracts for treatment of residual MSW, risks associated with 'change in law' (such as changes in the Landfill Tax) are usually borne by the WDA. Higher landfill taxes will have a significant impact upon the business case for different treatments being considered, and hence, the choice of technology made by WDAs. As is explored in more detail below, this puts MBT processes at a disadvantage vis-à-vis other treatment technologies because they are affected by unjustifiably high landfill taxes.

### Lower externalities of 'biostabilised' wastes are recognized by the LATS

To support the LASs, the Environment Agency (EA) has developed a protocol by which to measure the reduction in 'biodegradability' of wastes achieved by MBT facilities. Guidance on this measurement protocol has been published by the EA and related consultants, but it is still undergoing further development and verification.<sup>12</sup> In addition to the use

of a 'loss on ignition' (LOI) test, the protocol is based upon the use of two core biological tests. These are the BM100 (adapted from a test known as Biochemical Methane Potential or BMP) and the DR4 (adapted from an Italian test known as the Dynamic Respiration Index or DRI).

The EA protocol involves taking 'biodegradability' measurements for wastes entering and exiting the MBT facility. The percentage reduction in 'biodegradability' is then applied to a mass balance calculation of the overall waste management system to determine the amount of BMW sent to landfill reported by the WDA to Defra.

In contrast to systems in other Member States (discussed below), there is no threshold limit in the UK to determine whether a waste is biodegradable or not, as the measurement system functions as a sliding scale. Waste at any level of 'biodegradability' can be sent to landfill, but this is reflected directly in the amount of LAS allowances 'used' by a WDA in any given year. Consequently, the LASs appear somewhat at odds with the Landfill Tax, which does not differentiate between variations in the 'biodegradability' of wastes sent to landfill.

### **The current rate of WDA procurement is such that LATS targets will be missed**

During the first LATS compliance year in 2005/6 WDAs sent 2.8m (18.5%) fewer tonnes of BMW to landfill than the total number of allowances allocated by Defra.<sup>13</sup> To meet the compliance year targets in the Directive, however, authorities must reduce total BMW sent to landfill by:

- 1.2m tonnes between 2005/6 and 2009/10;

- A further 3.7m tonnes between 2009/10 and 2012/13 (assuming the above target is met); and
- A further 2.4m tonnes between 2012/13 and 2019/20 (assuming the above target is met).

Our analysis of waste composition data and new facilities coming into commercial operation across the UK indicates that the first target could be met through source separated collection of biodegradable wastes, i.e. paper for recycling and food wastes for composting / anaerobic digestion. This approach might be aided by variable charging for household wastes, as backed by the findings of the Lyons Inquiry<sup>14</sup>, or by the types of revenue neutral scheme being consulted upon by Defra in the wake of the publication of the new Waste Strategy for England.<sup>15</sup>

Meeting the second target also *ought* to be achievable through similar measures, supported by incentive schemes. Whilst some WDA areas may achieve this, however, many appear to be relying more on residual waste treatment methods. Several WDAs are therefore focusing on the procurement of infrastructure for the treatment of residual MSW to reduce the amount of BMW sent to landfill.

An influential report to the Treasury by the Office of Government Commerce (OGC), as part of the 'Second Kelly Market' review in 2006, found that whilst there was a need for rapid investment, the current system is not operating with sufficient efficiency for the UK to meet its obligations under the Directive.<sup>16</sup> The tendency for councils to attempt to procure large-scale, integrated waste management contracts has resulted in a 'bottle-neck' whereby many suppliers do not have the capacity or resources to bid. This has

resulted in a lack of competition for some contracts, and thus rising gate fees and delays to suitable infrastructure development.

A report from the National Audit Office (NAO) estimates that if there is no change to the current approach taken by WDAs, the 'collective' UK target under the Directive will be missed by around:<sup>17</sup>

- 270,000 tonnes in 2009/10 target; and
- 1.4 million tonnes in 2012/13.

Such outcomes would result in the UK potentially being taken by the Commission to the European Court of Justice (ECJ) and handed a daily fine until compliance with the Directive is achieved.

### **'Biostabilisation' offers the UK an option for least-cost compliance with the early targets of the EU Landfill Directive**

Due to the aforementioned 'bottle-neck' in the procurement of waste infrastructure, to get residual waste treatment facilities up and running in time to meet the 2012/13 LATS targets, many local authorities are considering the procurement of MBT facilities to 'biostabilise' wastes prior to landfill under two forms of contract:

- 'Interim' – typically 7-10 years in length, and potentially financed by prudential borrowing;
- Long-term – typically 25-year contracts procured via public private partnership (PPP) arrangements.

As a result of lower public opposition, planning and environmental permitting can generally be achieved far more quickly for MBT facilities than for thermal treatment processes such as incineration, gasification

and pyrolysis. Build times are also usually shorter. Both UK and EU experience indicates that tendering, planning and permitting processes for thermal treatment facilities can take up to 10 years, meaning that if an authority was to commence procurement today, such facilities might not be operational before the middle of the next decade, and possibly, not until 2017.<sup>18</sup>

Data can be derived from Environment Agency licensing information to show that landfill capacity in most regions, apart from London and, perhaps, the South East, is sufficient to sustain contracts based upon sending 'biostabilised' wastes to landfill. As a result, such contracts are – subject to the processes being able to guarantee reductions in biodegradability in line with EA measurement protocols – bankable, and attractive to WDAs seeking to avoid exposure to fines, or (in England) the uncertainties inherent in the market for tradable landfill allowances.

A further, important consideration is the fact that MBT processes reduce the mass and volume of wastes. This is achieved not only through removal of recyclable materials for recycling and energy-rich materials for recovery, but also via reduction of both 'biodegradability', through the degradation of volatile solids, and moisture content. The weight of waste actually sent to landfill can, therefore, be far less than that which entered the facility. In volume terms, the placement density in the landfill is also likely to be significantly higher, which helps reduce utilisation of landfill capacity in the future.

Contracts based upon 'biostabilisation' of wastes therefore fit with a more gradual phasing out of landfill, which is appropriate for the UK which has significant capital investment in the sector. In the case of 'interim' contracts, following which landfill

capacity could become scarce (depending upon future planning and permitting of new sites) related MBT infrastructure, configured for sending 'biostabilised' wastes to landfill, need not become redundant. Through relatively straightforward technical adaptation, in the form of faster and warmer airflow in the biological treatment phase, such facilities can be re-engineered from 'biostabilisation' to what is known as 'biodrying'. This latter process is adapted to deliver what is known as either a refused derived fuel (RDF) or a solid recovered fuel (SRF) for subsequent thermal processing.

Interim 'biostabilisation' contracts can therefore effectively be used to buy time in the short term. Successful operation of the facility can then provide the basis for establishment of a long term 'fuel supply' contract to fit in with the more lengthy procurement of an incinerator or gasification facility, or with an industrial client, for example, a cement kiln or chemicals manufacturer.

Furthermore, as discussed in more detail below, MBT facilities can be adapted to include the treatment of separately collected kitchen and green wastes. The case for such "double duty" sites is well diffused across Europe, notably in those countries which are already meeting Landfill Directive obligations.

### **A differential rate of Tax would reduce WDA contract prices for all types of waste 'pre-treatment' technologies**

The discussion thus far has focused upon 'biostabilisation' as the primary goal of MBT facilities. As mentioned above, however, the 'biodrying' form of MBT along with another technology known as autoclaving are also currently being considered as

procurement options by WDAs. Furthermore, some contracts are focusing on the potential to use outputs from MBT facilities as soil improvers in land remediation / restoration projects.

Such 'pre-treatment' approaches do not directly rely upon landfill in the same way as 'biostabilisation' processes, where the expressed intention is to reduce biodegradability and related impacts for waste to be landfilled. Frequently, however, as with 'biostabilisation' contracts, the financial modelling for such facilities assumes that material *may* have to be landfilled, owing to the difficulties inherent in seeking guarantees for outlets for the material over the lifetime of a contract.

A lower rate of Tax would mean that in the event of failure to guarantee a market outlet for material, operators of 'pre-treatment' facilities would have the option to 'biostabilise' and landfill these outputs at far lower cost than is currently the case. In the existing situation, as the potential costs of market failure (and thus landfill) are priced into the contract, the overall gate fee paid by a WDA is likely to be significantly higher than the cost of the system which actually operates. To the extent that risk averse WDAs make choices based upon the costs of waste treatment technologies, the existing tax regime simply prices potentially lower cost solutions out of the market.

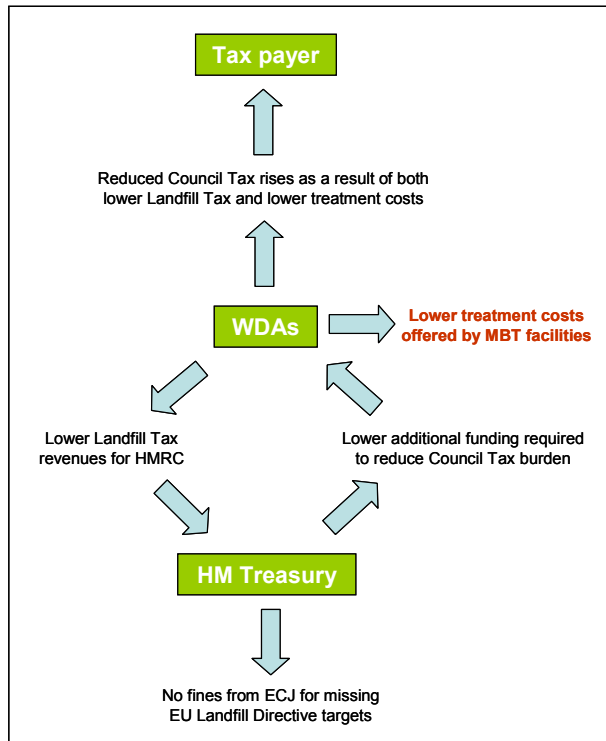
### **A differential rate of Tax would result in lower costs for HM Treasury**

As mentioned above, the increased costs brought about by the new 'escalator' – for both existing and future contracts – are likely to be borne by the WDA. It is likely that some of this additional bill from HMRC will be reflected in increased Council Tax charges. Both local councillors and the media are therefore



likely to exert pressure on HMT to provide the additional financial support to WDAs to minimize the impact on the public and on local authority budgets. To some degree, this will result in a ‘circularity’ of funding between central and local government as shown in Figure 2.

**Figure 2: Financial Flows resulting from a Differential Rate of Landfill Tax**



As discussed throughout this paper, the new escalator will ‘price out’ many MBT facilities, leaving

higher cost options (excluding Tax) as the preferred choice for WDAs. Unlike the additional Tax revenues received by HMRC, however, these extra costs will not be ‘circular’ and a large proportion will thus undoubtedly be passed on to HMT. As shown in Figure 2, a greater proliferation of lower cost MBT facilities sending ‘biostabilised’ wastes to landfill would therefore reduce the financial burden for HMT.

As outlined above, a differential rate of Tax would also mean a reduction in the price of contracts involving other ‘pre-treatment’ technologies. This would aid the UK in meeting its Directive targets, which would mean HMT was not at risk of paying fines to the ECJ for non-compliance.

### A differential rate of Landfill Tax would support treatment of residual C&I wastes

In Defra’s new Waste Strategy for England, it is stated that the new Landfill Tax ‘escalator’ will give greater financial incentives to businesses to reduce, reuse and recycle wastes. This is true in the sense that in the absence of a similar mechanism to the LASs, the choice of management method for non-hazardous C&I wastes is dictated almost wholly by the overall costs of treatment, of which the Tax currently represents a significant percentage. Where they might be available in relatively homogeneous – and thus cost effective – streams, it therefore makes financial sense to recycle and reprocess specific materials, e.g. metals, paper and plastics, but for residual wastes, landfill will remain the cheapest option.

In most parts of the country landfill void remains readily available, and thus whilst gate fees might be much higher in some areas, i.e. the South East, they are typically within the range of £15-30/tonne. The LASs mean that less MSW is likely to be sent to

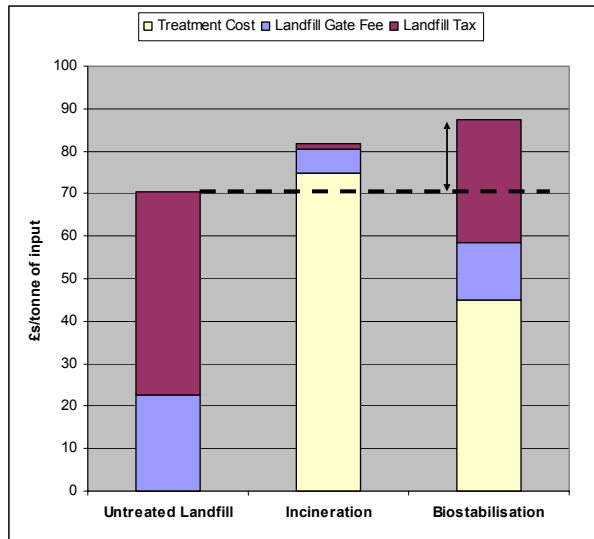
landfill in future, and therefore gate fees for C&I wastes are likely to remain at these levels in the medium-term. With the Tax set to rise to £48/tonne in 2010/11, total costs of landfill for C&I wastes will thus rest between £63 and £78/tonne.

The C&I waste management market is very price competitive; contracts rarely last more than two years, with one year collection/disposal contracts more typical. Consequently, raising finance for the construction of dedicated residual waste treatment facilities solely on the basis of such contracts is very unlikely.

The latest criteria with which WDAs procuring contracts for MSW through the Private Finance Initiative (PFI) must comply, encourages the inclusion of capacity for C&I wastes at new treatment facilities.<sup>19</sup> Although there are significant potential complications to this approach, for example, public objections to the increased size of facilities, under the current regulatory regime it represents the most likely route through which to develop any kind of residual C&I waste treatment. The viability of this route, however, will logically depend upon whether this capacity can compete with landfill on cost.

Based upon data provided by technology suppliers, Figure 3 shows the likely future treatment costs and landfill gate fees (including all relevant amounts of Tax) for sending untreated wastes to landfill, or to an incinerator and those for an MBT facility producing a ‘biostabilised’ waste for landfill. For the incinerator scenario, the landfill gate fee may in reality be made up of the costs of sending hazardous fly-ash to a hazardous landfill, or for third parties to use bottom ash for construction purposes, but whatever the destination, we feel the figure used is sufficiently accurate.

**Figure 3: Estimated total cost of selected residual C&I waste management options in 2010/11**



Note: Landfill gate fees and Tax vary according to the tonnage of waste landfilled per tonne of input waste to the treatment process

Figure 3 suggests that the new Tax ‘escalator’ is unlikely to be sufficient to divert residual C&I wastes from landfill to incineration. It also shows, however, that a lower rate of Tax for ‘biostabilised’ wastes would result in potential additional capacity at existing MBT facilities (treating predominantly MSW) becoming economically viable for C&I wastes. An appropriate, practicable level of Tax which might bring about this ‘tipping point’ is discussed in more detail below.

### What happens in other EU Member States?

Much of the data in the Technical Appendices to this Briefing Paper relate to research undertaken in other

EU Member States. This is because countries such as Germany, Austria and Italy have implemented MBT technologies in advance of the UK, and thus have already developed related regulatory and fiscal mechanisms.

In Germany, there is no landfill tax levied on any non-hazardous wastes, rather the Umweltbundesamt (German Environment Agency) has effectively established a ‘ban’ on biodegradable material being sent to landfill. As detailed in the ‘Ordinance on Environmentally Compatible Storage of Waste from Human Settlements and on Biological Waste-Treatment Facilities’, this ‘ban’ includes strict threshold limits which must be met for both a respirometric test and total organic carbon (TOC) content of wastes. As a result, all biodegradable materials must be treated prior to landfill.

Austria has largely followed the approach in Germany, although with a slightly more lenient respirometric test threshold. Both countries have an additional requirement based on maximum gross calorific value (GCV).

Despite the measures in Germany being effective without a landfill tax, in 2006 in Austria the rate of tax for non-treated wastes rose from €65 to €87/tonne (around £59), whilst that for dedicated landfills accepting biologically treated waste only is set at €21/tonne.

Both Germany and Austria have not only met their 2016 targets under the EU Landfill Directive (equivalent to the UK’s derogated 2020 target), but have also succeeded in diverting significant levels of biodegradable C&I waste from landfill.

In Italy, the rate of landfill tax varies on a regional basis according to the level of source segregation

achieved within a given region. In the north, where levels of recycling are generally higher, landfill tax is typically in the range of €10-25/tonne, whilst in the south rates are in the range of €20-50/tonne. A respirometric test threshold is adopted for classifying whether waste is biodegradable (or not) for the purposes of calculated diversion pursuant to the Landfill Directive, albeit waste is not excluded from landfill on this basis.

Meeting the respirometric test thresholds in Italy is not linked to any lower level of landfill tax. Wastes which have been ‘pre-treated’ (either by incineration or MBT), however, are eligible for a lower rate of tax. In this context, for Districts which also reach recycling targets, rebates may be as high as 80%.

Both ‘bans’ and taxes on landfill are also effectively in place in Denmark (€74/tonne), Sweden (€31/tonne) and the Netherlands (€84/tonne). A lack of MBT in these Member States, however, means that these ‘bans’ relate to ‘combustible’ wastes rather than any use of biodegradability thresholds.

The UK is fairly unique therefore in that it:

- Has in place mechanisms (i.e. the LASs) which recognise variable contributions of different MBT processes to reducing the biodegradability of MSW sent to landfill; but
- Gives no recognition at all to the value of applying the same treatment to other (non-municipal) wastes.

The application of financial and regulatory drivers in the UK therefore appears increasingly confused. The original, rather narrow, focus on EU Landfill Directive targets has given rise to a situation where MSW is perceived as ‘dealt with’ through the LASs, and the

fate of C&I wastes is being steered through the Tax. There appears to be limited appreciation of the interactions between the two instruments, even though technical solutions which are accepted as appropriate for delivering LAS targets are intimately affected by decisions on the Tax.

### **‘Biostabilised’ wastes have far lower externalities than untreated wastes**

The full evidence base and methodology for modelling the externalities from ‘biostabilised’ vis-à-vis untreated wastes is contained within the Technical Appendices to this document. Using our Atropos© model which has been developed over several years, we have used a range of assumptions for each parameter relevant to landfill externalities.

The most significant of these externalities relate to the balance of GHG emissions from landfill, which are dependent upon variables such as:

- Treatment time at the MBT facility;
- Methane capture rates at the landfill; and
- The ‘carbon intensity’ of displaced power generation.

Two other forms of externality taken into consideration are the impacts of trace components within landfill gas, such as aromatic hydrocarbons and ammonia, along with the impacts of leachate and other emissions to water. Measurement of such externalities from ‘biostabilised’ wastes is problematic, however, as although MBT has been in place in other Member States for some time, analysis of relevant data has not been undertaken. Therefore, although the externalities for such parameters will be lower for ‘biostabilised’ wastes sent to landfill, we

have been forced to use reference values attributable to untreated wastes. It should thus be acknowledged that our model potentially understates the beneficial impact of ‘biostabilisation’ on the nature of wastes being landfilled.

Similarly, little relevant data exists with regard to the reduction in externalities relating to ‘disamenities’ for local communities caused by noise, dust, litter and odour from landfills. We have therefore excluded measurement of such ‘disamenities’ from our analysis, such that again it should be noted that we are understating the benefits of ‘biostabilisation’.

Atropos© is what might be termed a ‘state-of-the-art’ tool, which applies lifecycle assessment (LCA) thinking within the framework of cost-benefit analysis (CBA). Using the latest data from a range of studies, it not only monetizes environmental impacts – for example, each tonne of CO<sub>2</sub> emitted – but discounts those which might occur in the future, i.e. from landfill, to account for the fact that human beings tend to place higher value on costs or benefits today.

The approach to assessing climate change impacts largely echoes that undertaken in the recent Stern Review.<sup>20</sup> As detailed in the Technical Appendices, however, we use what we consider to be more acceptable values for the social costs of carbon (SCC) and also apply a higher discount rate as specified in the HM Treasury Green Book.

The version of Atropos© used for this paper takes into consideration the impact of wastes once resident in landfill only. ‘Whole system’ modelling, i.e. inclusion of emissions from the MBT facility undertaking the ‘biostabilisation’ process is not appropriate where we are considering the rate of tax which should apply to landfilled wastes. This is because from a public policy perspective, the goal of such an instrument should be

to seek to tax, directly, the source of the targeted externalities, i.e. the impact of waste when deposited in landfill.

At a ‘biostabilisation’ facility, the amount of waste sent to landfill (based upon one tonne input to the MBT facility) is likely to be around 0.6 tonnes as a result of both materials recovery for recycling and both carbon and moisture losses. As the MBT facility is excluded from the ‘system’, however, we have modelled the externalities from a full tonne of ‘biostabilised’ waste in landfill. The model assumes that this tonne of waste has been resident in the biological treatment phase for a sufficient period to meet the threshold stated in the 2<sup>nd</sup> Draft of the (sidelined) EU Biowaste Directive. This document – discussed twice by all (old) EU member States – suggested that for waste to be considered ‘no longer biodegradable’ for the purposes of the Landfill Directive, one of two threshold criteria would have to be met:

- A respirometric activity after 4 days (AT<sub>4</sub>) of <10mg O<sub>2</sub>/ kg of dry matter; or
- A Dynamic Respiration Index (DRI) of <1g O<sub>2</sub> / kg of volatile solids / hour.

The former represents the measurement protocol employed in Germany and Austria (albeit at a higher threshold value), whilst the latter represents that employed in Italy. As discussed above, the DR4 and BM100 protocols developed by the EA to support the LASs do not include any kind of threshold value. We feel it is sensible, however, that one of these measurement systems should be used to determine the appropriate threshold level for applying a differential rate of Tax in the UK once waste has been shown to reach a level of stability equal to that

proposed in the 2<sup>nd</sup> Draft of the Biowaste Directive. This, after all, was an agreed measure to establish where waste should be considered 'no longer biodegradable' from the perspective of the Landfill Directive.<sup>21</sup>

The results shown in Table 2 are based upon a range of central assumptions detailed in the Technical Appendices, in which we have also modelled the externalities from sending 'biostabilised' wastes to what might be termed 'dedicated' or 'stabilised' landfill cells, as currently takes place in Germany and Austria.

**Table 2: Externalities from Wastes Sent to Landfill**

| Scenario                                  | Externality |
|---|-------------|
| 1. Untreated waste sent to landfill       | £40.28      |
| 2. 'Biostabilised' waste sent to landfill | £15.28      |

Table 2 shows that the new escalator and future rate of £48/tonne for untreated wastes could potentially be justified on the basis of externalities. More importantly in the context of this study, however, the results under our central assumptions clearly show that 'biostabilised' wastes result in externalities some £25 lower than those from untreated wastes.

To test the reliability of the results, we ran three forms of sensitivity analysis on each scenario as detailed in the Technical Appendices. These included changes to core parameters relating to GHG emissions, as discussed above, and to treatment times. The most significant variation from our central results was caused by the use of a higher gas capture rate (60%) at the landfill (from a central capture rate of 50%), which gave a difference in externality of £19.38

between untreated and 'biostabilised' wastes. We would consider, however, such a high gas capture rate as unrealistic. Perhaps more accurate, is our modelling a lower gas capture rate (30%), which raises this difference in externality to £30.61.

### Setting a differential rate of Tax for 'biostabilised' wastes

It should be acknowledged that although our goal is that the externalities measured should be as accurate as possible, modelling of this kind will always be somewhat controversial. We are thus not attempting to directly link the difference in externality modelled for 'biostabilised' wastes sent to landfill to a value for a lower rate of Tax. As discussed above, the Tax is no longer linked to a direct evaluation of externalities, and thus such an approach would not be sensible. Rather, we are aiming to demonstrate that the relative difference between the two types of waste justifies a differential rate, but that the value of this should be set with reference to both:

- The extent to which Government wants to change behaviour; and
- Ease of implementation at a regulatory and policy level.

With regard to the first of these criteria, the potential impacts upon the management of both MSW and C&I wastes must be considered.

In terms of MSW, the above discussion and analysis has shown that after the recent rise in the Tax 'escalator', the UK is more likely to miss its targets under the Landfill Directive. Decisive action is required to ensure that these targets are met and that the UK does not incur fines from the European Court of Justice.

This paper has argued that a reduction in Tax for 'biostabilised' wastes represents the most likely route by which C&I wastes will be treated prior to landfill. Figure 3 shows that in 2010/11, to provide for risk and the cost of capital to finance additional capacity at MBT facilities (treating predominantly MSW), the reduction in Tax would have to be significant.

Passing new primary legislation to enable a differential rate for 'biostabilised' wastes would be a lengthy process, and negate the potential for MBT to help meet the UK's targets under the Landfill Directive. Thus to ensure that the system can be easily implemented by both HMT and the EA, we propose that 'biostabilised' wastes receive the same level of taxation (now £2.50/tonne) as incinerator bottom ash and soils. At a regulatory level, this would require only that:

- 'Biostabilised' wastes are added to the list of 'inert/inactive' materials listed in the Landfill Tax (Qualifying Material) Order 1996;
- The EA produces guidance (based on its existing measurement protocols for the LASs) for a threshold level at which waste is no longer considered 'biodegradable'; and
- The EA continues to monitor the performance of all MBT facilities sending material to landfill, as per the existing requirement for the LASs;
- A relevant Waste Transfer Note (WTN) is provided by the plant operator to the landfill accepting such wastes, as per the existing requirement for 'inert/inactive' wastes.

Under this approach, a transition to a differential rate of tax would be both fast and cost-effective.

## Potential integration with the wider policy framework

Implementation of the proposed differential rate of Landfill Tax would require sufficient space to be made in the forthcoming Finance Bill to be passed in this year's Pre-budget Report and in the 2008 Budget. To meet this deadline it is therefore important to demonstrate here the synergies between 'biostabilisation' of wastes at MBT facilities and Defra (and DBERR) policy objectives.

In the recent review of England's Waste Strategy, Defra has set desired rates of recycling for MSW at 40% by 2010, 45% by 2015 and 50% by 2020, with these likely to be integrated into three core indicators as part of a wider assessment framework for local authorities. The Strategy states that new national targets for the reduction of commercial and industrial waste going to landfill will also shortly be introduced and claims that on the basis of the policies set out in the Strategy, levels of C&I waste sent to landfill will fall by 20% by 2010 (from a 2004 baseline).

Due to upfront mechanical sorting, all forms of MBT – to varying degrees according to their level of sophistication – will deliver greater levels of recycling from the residual waste stream through capture of metals, as well as (depending on design) inert materials and plastics. This is true for MSW even after source-separation has taken place at the kerbside, as well as for C&I wastes, which currently rarely undergo any kind of source-separation.

The Strategy also sets targets for the recovery of municipal waste at 53% by 2010, 67% by 2015 and 75% by 2020. It is arguable whether these could be met by recycling and composting alone, and thus Defra asserts that greater levels of energy-from-waste

(EfW) should be introduced not only to meet these targets but also address the wider goal of energy security. With regard to incineration, Defra is careful to stress that this should not be to the detriment of recycling through 'locking in' large tonnages of waste in long-term contracts. Recommendations are made for 'modular' and 'flexible' facilities and contracts to be implemented. This appears to be at odds with the current emphasis on procurement through PFI, which usually relies upon long-term guarantees for input tonnages to finance capital intensive infrastructure.

It is important to note that the Strategy also stresses significant support for AD and refers to the recent proposed review of the Renewable Obligation (RO) upon which Defra worked closely with DBERR. This review is likely to result in each megawatt-hour (MWh) of electricity generated by AD facilities receiving two ROCs, i.e. double that which was previously allocated.

As mentioned above, some forms of MBT include AD followed by a 'biostabilisation' process, whilst others can be built such that they can be adapted into 'bidrying' facilities – to produce fuel for either dedicated thermal plant or for industrial use – at a later date should this be appropriate.

MBT facilities are also both flexible and modular, i.e. new lines can be added with relative ease. Furthermore, the biological elements of many MBT facilities are largely the same as those used in composting or AD of source separated wastes. Should WCAs introduce food waste collections at a later date, therefore, the existing MBT infrastructure is capable of being adapted, either in full, or in part if more than one treatment line is present, for the treatment of source separated biowastes. As stated above, the case for such "double duty" sites is well diffused across Europe, notably in those countries equally

committed to a fundamental shift from landfill towards integrated waste management.

MBT thus represents a key opportunity for Defra to meet the goals for both flexibility and energy generation outlined in its Strategy, potentially without the need for politically sensitive, capital intensive incineration infrastructure.

Finally, stricter targets or a 'ban' on the landfill of 'active' wastes from 2020 has been given consideration by the EU Institutions and is also muted within the Strategy with Defra stating that it may launch a consultation on the matter. If passed in the UK, any such 'ban' would fit comfortably with the approach proposed in this paper since the definition of 'biodegradable' could be linked to the standard defining when the lower rate of tax should apply. Should a differential rate of Landfill Tax for 'biostabilised' wastes be implemented in the near future, there is little doubt that many MBT facilities could be built across the UK relatively quickly to help WDAs meet LAS targets. Thus, if a 'ban' was announced early and scheduled to meet potential EU requirements, the UK would not only be in a comfortable position in 2020, but the overall externalities from all landfills would be reduced.

As mentioned above, this 'graduated' approach would also fit with a steady phasing out of landfill infrastructure that is appropriate for the UK. It is also similar to that employed in Germany, which has already met the requirements of the final Landfill Directive target, without the need for a landfill tax.

## Glossary of Terms

|        |   |
|--------|---|
| ABPR   | Animal By-Products Regulations                            |
| AD     | anaerobic digestion                                       |
| BAT    | best available technology                                 |
| BMW    | biodegradable municipal waste                             |
| BREF   | Best Available Technique (BAT) Reference (document)       |
| BVPI   | Best Value Performance Indicators                         |
| CCA    | Climate Change Agency                                     |
| CHP    | combined heat and power                                   |
| CNG    | compressed natural gas                                    |
| C&I    | commercial and industrial (waste)                         |
| CO2    | carbon dioxide  |
| CSERGE | Centre for Social & Economic Research on the Global Env   |
| CV     | calorific value   |
| Defra  | Department for Environment Food and Rural Affairs         |
| DTI    | Department for Trade and Industry                         |
| DBERR  | Department for Business, Enterprise and Regulatory Reform |
| EA     | Environment Agency  |
| EfW    | energy from waste   |
| ETS    | Emissions Trading Scheme                                  |
| EU     | European Union  |
| GHG    | greenhouse gas  |
| GQCHP  | good quality combined heat and power                      |
| IPPC   | Integrated Pollution Prevention and Control               |
| kt     | kilo tonne (1,000 tonne)                                  |
| LATS   | Landfill Allowances Trading Scheme                        |
| LCA    | Lifecycle assessment                                      |
| Mt     | million tonnes  |
| MBT    | mechanical and biological treatment                       |
| MDC    | marginal damage cost                                      |
| MHT    | mechanical heat treatment                                 |
| MRF    | materials recycling facility                              |
| MSW    | municipal solid waste                                     |
| MWh    | megawatt hours  |
| PFI    | Private Finance Initiative                                |

|      |                                   |
|------|-----------------------------------|
| PPC  | Pollution Prevention and Control  |
| PPP  | Public Private Partnership        |
| PRN  | Packaging Recovery Notes          |
| RDF  | refuse derived fuel               |
| RO   | Renewables Obligation             |
| ROC  | Renewables Obligation Certificate |
| SCC  | social cost of carbon             |
| SCR  | selective catalytic reduction     |
| SNCR | selective non catalytic reduction |
| SOx  | oxides of sulphur                 |
| SRF  | solid recovered fuel              |
| tpa  | tonnes per annum                  |
| WID  | Waste Incineration Directive      |
| WRAP | Waste Resources Action Programme  |

## Notes and References

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- <sup>17</sup> *Reducing Reliance on Landfill in England: Report by the Comptroller and Auditor General, National Audit Office on behalf of Defra*, July 2006
- <sup>18</sup> Defra (2005) *Delivering Key Waste Management Infrastructure: Lessons Learned from Europe*, December 2005
- <sup>19</sup> Defra (2006) *Criteria for Securing Waste PFI Credits*, May 2006
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- <sup>21</sup> The UK method of measurement of biodegradability, designed by the Environment Agency to support the LATS, does not allow any output from an MBT facility to be deemed 0% biodegradable. Compared to systems in other Member States, such as Germany and Austria (which use a threshold value to determine whether a waste is biodegradable or not), therefore, this method represents a form of over-regulation which imposes higher costs upon WDAs than might otherwise have been the case