Report

# Scotland Landfill Tax Bill 2012: An Economic Assessment.

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Zero Waste Scotland works with businesses, individuals, communities and local authorities to help them reduce waste, recycle more and use resources sustainably.

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# 1 Introduction

Eunomia Research & Consulting ("Eunomia") is pleased to present this Final Report to Zero Waste Scotland regarding the Business & Regulatory Impact Assessment of the Scotland Landfill Tax Bill 2012.

The initial stimulus of this study comes from the following recommendation from the Calman Commission: [1]

> *"Stamp Duty Land Tax, Aggregates Levy, Landfill Tax and Air Passenger Duty should be devolved to the Scottish Parliament, again with a corresponding reduction in the block grant."*

The Coalition Government of 2010 committed to implementing these recommendations, including the transfer of legislative responsibility to Scotland to set the level of Landfill Tax along with some other fiscal instruments.[2] The Scottish Government was then given the ability to set the level of landfill tax from 2014/15 (the end of the period of application of the current UK landfill tax escalator).[3,4]

Following from this decision Eunomia was commissioned to carry out a study looking at the potential options for a Scottish specific landfill tax. The aim of the project was to consider options for varying the landfill tax with respect to the rest of the UK, and to consider the impact this would have on waste policy, and Scotland's goal of achieving a Zero Waste Society. The definition of a Zero Waste Society is summarised below:[5]

> *"everything we use and throw away is a resource which has a value, a value that we should try to preserve, capture, and use again wherever possible.*
>
> *That is what a zero waste Scotland means - not a country where we never throw anything away, but a new approach to making the most effective use of all resources, and avoiding wasting resources or making them unusable wherever we can."*
>
> *Richard Lochhead, MSP - Cabinet Secretary*

This project takes place in the context of Scottish Government's deliberations regarding its options in the light of the provisions of the Scotland Act, which received Royal Assent earlier this year, and which implies that the (currently) U.K.-wide landfill tax will be disapplied in Scotland as of April 2015. In October 2012, the Scottish Government set out a range of questions in a Consultation Document. Most of these were related to changes in the detail of the structure and design. The intention, for the most part, appears to be to maintain a similar tax to the one currently in place across the UK:[6]

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[1] Commission on Scottish Devolution (2009) *Serving Scotland Better: Scotland and the UK in the 21st Century*, Final Report, June 2009, http://www.commissiononscottishdevolution.org.uk/uploads/2009-06-12-csd-final-report-2009fbookmarked.pdf

[2] Scottish Government (2010) Research Specification: Understanding The Policy Options For Implementing A Scottish Specific Landfill Tax, Tender Ref: CR/2010/04

[3] Scottish Government.

[4] HM Treasury (2010) *Budget 2010*, http://cdn.hm-treasury.gov.uk/junebudget_complete.pdf

[5] Scottish Government (2010) *Scotland's Zero Waste Plan: Ministerial Forward*, Accessed 16th July 2010, http://www.scotland.gov.uk/Publications/2010/06/08092645/1

[6] Scottish Government (2012) A Landfill Tax for Scotland: Consultation, http://www.scotland.gov.uk/Resource/0040/00405792.pdf

*4.2 It is therefore the intention of the Scottish Government to introduce a tax on the disposal of waste to landfill when the current UK tax is disapplied from Scotland in 2015.*

*4.3 As the UK landfill tax is well understood and operates well within its intended scope, the Scottish Government does not intend to pursue significant changes to the form or structure of the existing tax regime for the introduction of its replacement in 2015. This will ensure that the stable market conditions needed to support long-term investment are maintained.*

Consultation questions related more to issues such as the range of materials to be included under the Qualifying Materials Order, which sets out the materials qualifying for lower rate tax.

This report informs the Business & Regulatory Impact Assessment (BRIA) that the Scottish Government is required to undertake before any policy decision. The following Section describes the methodology used to carry out the BRIA.

# 2 Methodology

The methodology employed in this study ensures compliance with the guidance on business and regulatory impact assessments (BRIA) from the Scottish Government.[7]

**Box 2-1:** BRIA

*"The BRIA process encourages policy makers to identify the problem and then use available evidence to find proposals that best achieve the policy objectives while minimising costs and burdens. The BRIA (like the RIA on which it is based) is:*

- a tool used by Government to assess and present the likely costs and benefits (monetised as far as possible) and the associated risks of a proposal that might have an impact on the public, private or third sector.
- a continuous process to help Government understand the issues associated with a proposal and avoid unintended consequences, fully think through the reasons for intervention, to weigh up various options for achieving an objective and to understand the consequences of a proposed intervention.

*Once published, the BRIA allows those with an interest in the policy to understand:*

- why the Government is proposing to intervene;
- options the Government is considering, and which one is preferred;
- how and to what extent new policies may impact on them, on business and on Scotland's competitiveness;
- the estimated costs and benefits of proposed measures."

Consequently, the Invitation to Tender sought delivery on four discrete tasks:

*Externality costs associated with landfilling active and inert waste in Scotland. Analysis to include, but not limited to: methane generation and capture rates, transportation and disamenity costs.*
*Forecast of potential waste flows from rest of U.K. to Scotland if the landfill tax is discontinued in Scotland in 2015.*

[7] http://www.scotland.gov.uk/Topics/Business-Industry/support/better-regulation/guidance/Guidance

*Costs and benefits of maintaining the Landfill Communities Fund in Scotland.*
*Detailed monetized costs and benefits under Policy Options One, Two and Three for all relevant sectors to include the following, and any other sector deemed necessary for the analysis:*

The work follows on from a Partial BRIA published in October 2012 which included the following options:[8]

- No landfill tax to apply in Scotland – i.e. do not replace the landfill tax when it is withdrawn from Scotland in 2015.
- Maintain the same landfill tax system as the rest of the UK, set at the same tax rates.
- Maintain the same system as UK but implement a non-self-assessment model.

Note that in this report, we assume that Option 2 implies not a tax which is 'similar' to that in the rest of the UK, but 'the same as' in the rest of the UK. This is broadly aligned with the Scottish Government's current view on the matter. For all intents and purposes, what is described in Option 2 represents 'business as usual', and it also seems closest to the Scottish Government's preferred option. We have defined Option 2 as the Baseline, against which the costs and benefits of the other two Options are measured.

It is accepted that this is a somewhat unusual situation in that a 'do nothing' option could be taken to imply no tax is introduced (and would be a major change from the current situation). From the perspective of the actors who stand to be most affected by changes in the tax, however, Policy Option 2 represents what most would regard as '*the status quo*' (and for this reason, it would be preferable to re-number the Policy Options). Hence, Option 2 is considered as the business as usual (BaU) policy option against which the other options are assessed, and results presented.

Taking the above conditions into account, the methodology used to carry out the project tasks, and meet the obligations in the BRIA guidance, is as follows:

- Waste flows expected under Option 1 and Options 2 & 3 were modelled (note the waste flows in options 2 & 3 are the same). The waste flow modelling included an assessment of the likely waste flows both within Scotland (e.g. of Scottish waste), and in respect of cross-border waste movements (due to the price differential for landfilling waste);
- Calculate the change in waste flows between these two options. This then forms the basis for calculating the change in costs (financial and environmental) of the Options relative the BaU position;
- Derive unit (per tonne) figures for collection and treatment costs in order to calculate the total change in financial costs between the options (the figures used in this study draw on work already carried out during a CBA of the implementation of the Scottish Zero Waste Plan);[9]
- Estimate the change in administrative and regulatory costs between the policy options;
- Derive unit figures for environmental impacts relevant to the policy options. Again much of this work draws upon the previous ZWP CBA study mentioned above. The notable elements of additional work, however, relate to the

[8] Scottish Government (2012) *Partial Business and Regulatory Impact Assessment*, http://www.scotland.gov.uk/Resource/0040/00405804.pdf

[9] Eunomia (2011) *Economic Assessment of the Zero Waste Plan for Scotland*, Final Report for WRAP, http://www.zerowastescotland.org.uk/sites/files/wrap/CBA%20ZWP%20Final%20report.pdf

environmental externalities associated with landfilling. These were updated and enhanced from the previous study;
- Consider the costs and benefits of the landfill communities fund (LCF);
- Calculate overall costs and benefits of the policy options and present the final results;
- Describe the key risks associated with the change in policy.

This report is therefore structured in the same way as the methodology set out above:

- Section 3 Model Waste Flows;
- Section 4 Financial Costs;
- Section 5 Environmental Externalities; and
- Section 6 Results from BRIA.

The remainder of this section outlines key methodological issues.

## 2.1 Scope

It is important to note that the scope of the analysis is Scotland only. Therefore any inputs into the system account as impacts in the analysis, but in reality they may be transfers of impacts from elsewhere in the UK. For example, in relation to impacts from landfilling of waste coming across the border from other parts of the UK, the BRIA will include the additional impact of more landfilling in Scotland, but it will not credit the avoidance of waste landfilled in England or Wales. Thus if the boundaries of the analysis were the UK the results would be different, but this approach is appropriate for an assessment of this nature which is seeking to outline the impacts to the Scottish environment from any policy decision.

## 2.2 Approach to Costs and Benefits

It should be noted that the BRIA Toolkit and other guidance is relatively silent on how costs and benefits should be treated within a BRIA. There is little guidance on matters such as the timeframe to be covered, the discount rate to be used (and whether these should be different for public and private sector costs), and how the costs and benefits should be presented when they span a period of time. We therefore used the same approach as is suggested for Impact Assessment in England. This implies: a ten-year forecast; a 3.5% discount rate; costs and benefits to be presented in Net Present Value terms; valuation of benefits from GHG mitigation as per Defra / DECC Guidance; and valuation of non-GHG air pollutants as per the IGCB recommendations. Costs and benefits will be presented in real 2012/13 terms.

## 2.3 Effect of Tax on Zero Waste Plan Objectives

Of considerable significance to this work is the fact that the Waste (Scotland) Regulations 2012 have introduced measures which will bring about significant changes to how waste will be managed in future.

The outcome where the landfill tax is removed in Scotland implies the most dramatic change relative to the BaU position. This implies maintaining the Zero Waste Regulations, but removing the landfill tax. The question that needs to be addressed is '*what does the landfill tax make happen that would not happen anyway under the Zero Waste Regulations?* There are two issues here that affect the analysis:

- The first relates to 'long-term outcomes'. The underlying question is '*In 2025, will waste be managed (or generated) differently without a tax in place to the way in which it would be managed with the tax in place?*
- The second relates to the trajectory for the management of waste. The underlying question is '*will the trajectory by which waste is (generated or) managed be affected by the removal of the tax?*

The first question would have implications for steady-state costs and benefits in the longer term. The second question has implications for costs in the short-term, and might be of relevance even if one took the view that the end points (in terms of management of waste arising within Scotland) are the same.

In this study, following discussions with the Scottish Government, we modelled a position with the working assumption that the major policy objectives are still met in the absence of a landfill tax, but we assumed that a greater level of regulation and enforcement is required. Therefore we sought to include a high level assessment of the extent to which enforcement costs would need to be raised in order that the carbon targets and the like would be met.

## 2.4 Impact on Industrial Waste Prevention

Although the data is poor and no formal modelling is possible (for example, based on price elasticities of waste generation), our analysis of what data does exist suggests that industry has made efforts to reduce waste over time, and it seems reasonable to assume that the escalating (over time) landfill tax has played a part in this. This is consistent with work undertaken in the early days of the tax by ECOTEC.[10] Some of these changes will not be 'reversed' if the tax is removed, but others might be.

For this reason, we took the view that it would be sensible to have a slightly higher level of waste generation in a 'no tax' scenario than in one where the tax is applied at the expected level of £80 per tonne. Price incentives are weaker for households, and we might not expect the same level of impact in this sector (households, for example, are not billed for waste services on a marginal cost basis). Our assumptions regarding the magnitude of the reduction in waste prevention are set out in Section 3 below.

## 2.5 Illegal Dumping of Waste

When landfill taxes are applied in a country illegal dumping of waste is always a concern, as waste producers seek to save costs by avoiding authorised disposal locations. Thus, if the landfill tax was removed, this may reduce the incentive to disposal of waste illegally, so that illegal dumping may fall.[11] Ideally we would seek to include this aspect in the modelling work. However, there are a number of reasons why we have not incorporated this into the existing analysis. First, by definition, the extent of this activity is not known. Consequently, no financial assessment can be made of the losses to legitimate operators. Second, the extent to which the activity gives rise to harm (relative to legitimate disposal) is also unclear, and will depend upon the nature of the material. Third, the extent to which the activity remains profitable under complete removal of the tax cannot be ascertained. Work undertaken for what was then DETR in 2000 highlighted a range of illegal activity associated with the landfill tax.[12] Much of this activity was related to the much smaller tax (at least, in absolute terms) on inert wastes, and a good deal of it related to the existence of sham recovery operations exploiting exemptions from what was then waste management licensing (for

[10] ECOTEC (1998) Employment and Sustainability: The UK Landfill Tax. Dublin: European Foundation for the Improvement of Living and Working Conditions.

[11] Regulatory economics suggests that the extent of illegal activity will reflect a balance of views in respect of the risk adjusted costs of being caught, and the benefits derived from undertaking the illegal activity. As the tax falls, so the benefits from illegal disposal would be expected to fall also, reducing (other things being equal) the attraction of such activity.

[12] ECOTEC (2000) Effects of Landfill Tax – Reduced Disposal of Inert Wastes to Landfill, Final Report to DETR.

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recovery operations). This experience tends to suggest that relatively small price changes, perhaps especially for wastes from construction and demolition, can be a driver of illegal activity, as well as activity that exploits – within the letter of the law – the opportunities for avoiding payments of landfill tax.

The view of Zero Waste Scotland is that illegal activity is an ongoing problem, but its extent is unknown. Equally, therefore, the influence of a removal of the tax is not entirely clear, albeit one might expect some wastes that are currently dealt with outside of formal disposal channels (including some which are legitimately recovered under exemptions from permitting) to move back to operating landfills.

## 2.6 Effect on Landfill Gate Fees

The Partial BRIA notes the possibility that under the Options where the tax is removed, landfill operators could allow their gate fees, exclusive of tax, to rise. That having been said, despite major increases in the tax, the effect on real landfill gate fees has been to affect minor reductions rather than substantial changes. For example, as the tax has risen by £8 per tonne per year in recent years, median gate fees appear, by and large, to have held up in nominal terms (as evidenced by successive years' results from WRAP's report on gate fees), suggesting that the tax is still largely incident on the service user (the tax is being passed through more or less in full to the waste producer). We suggest that this is because, by and large, the 'tipping point' at which there is a wholesale switch from landfill to other residual waste treatments has not been reached. The demand for disposal services remains relatively inelastic in the short term, not least because it takes time to develop alternative facilities for residual waste treatment. Generally, the tax appears to have had the effect of squeezing any excess profits from the sector, both as a result of increasing prices of landfill relative to alternatives, but also, by increasing competition for the remaining (diminishing quantity of) waste which is still sent for disposal.

The inelastic nature of demand for disposal services suggests that any rise in pre-tax gate fees might be limited as the tax falls (this is explored further in Appendix 1. We note that the consultation on the draft BRIA indicated that most landfill operators did not believe gate fees would rise significantly, but economic theory suggests that it would in a competitive market, with the rise being determined by the nature of the supply curve (for landfill services) and the demand curve (for landfill disposal). In this work, we work with an assumption that the pre-tax gate fees do not increase. We also explore a sensitivity in which pre-tax gate fees increase under Option 1 (where the landfill tax is removed).

## 2.7 Costs Considered in the Analysis

The scope for the analysis includes costs and benefits associated with actors in the Scottish economy. As will become clear, the movement of waste across the border from other parts of the UK may be considerable if the tax is removed without countervailing measures put in place. This would be motivated by the opportunity to save money through landfilling in Scotland. These savings are not included in this analysis.

# 3 Model Waste Flows

As indicated in the Methodology section much of this report was based upon existing analysis carried out when undertaking a CBA of the Zero Waste Plan. All of the detailed assumptions regarding the waste flows forecast under the ZWP are detailed in the report.[13] In order to avoid duplication, we concentrate here on those assumptions that have changed or are new in this model.

[13] Eunomia (2011) *Economic Assessment of the Zero Waste Plan for Scotland*, Final Report for WRAP, http://www.zerowastescotland.org.uk/sites/files/wrap/CBA%20ZWP%20Final%20report.pdf

## 3.1 Options 2 & 3 ('with tax'): Scottish Waste Flows

The waste flows adjusted here are described as 'ZWP Scenario' in the previous report. The following points describe how key assumptions have changed from the original ZWP study:

- Commercial waste growth rate was reduced from positive over the period 2011 to 2014 to 0% to reflect current economic trends (weaker GVA);
- Industrial waste growth rate reduced from positive over the period 2011 to 2014 to -0.7% to reflect original trend – no post-recession bounce back has been observed (after 2014 growth rate of -0.7% is maintained until 2025);
- The Regulations have different years of implementation for certain aspects, compared with what was originally put in the plan (and thus what was modelled in the previous study):

    A: all recyclables covered in collections from businesses in 2014;
    B: food waste collected separately from large food businesses in 2014 (est. 55% capture);
    C: food waste collected separately from all food businesses in 2016 (est. 70% capture);
    D: containers given to households for all recyclables from 2014; and
    E: food waste collected from households from 2014.

- Under the BaU scenario, residual waste treatment increases steadily until the ban on landfilling in 2021, using the following proportions:

    F: MBT – Stabilisation = 0%;
    G: MBT – Thermal = 65%; and
    H: Incineration + pre-sorting = 35%.

Clearly estimating future changes in waste generation and management is full of uncertainty. Therefore, the estimations we have made have some margin of error attached. It is not within the scope of this study to fully explore the sensitivities around such assumptions, but our experience suggests they are a rational central case.

## 3.2 Option 1: Scottish Waste Flows

In addition to the changes from the original model to this model under the BaU scenario, the following also apply:

- Industrial waste growth rate increased from -0.7% to -0.2% after 2014 until 2025 in order to model the reduced effect on waste prevention that occurs due to the removal of the tax. Note, this will increase the total amount of all waste in all management routes for industrial waste e.g. between scenarios there will be increases in recycling / biowaste treatment due to the increased waste generation.
- The proportion of C&D waste landfilled increases due to skip hire businesses switching back to landfill. We have modelled an increase from 2% under Options 2 & 3 to the maximum level of 5% under Option 1. Hence, there is an increase in landfilling, but the maximum 5% target is still met;
- Under Option 1, there is no new building of treatment plants until 2018 when some new capacity starts to come on-line. This is due to the fact that landfill will be much cheaper in the intermediate years, prior to the ban on landfilling of biodegradable wastes taking effect. The treatment share projected for 2021 is now:

    A: MBT – Stabilisation = 50%;

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B: MBT – Thermal = 25%; and
C: Incineration + pre-sorting = 25%.

- The shift to MBT – Stabilisation is due to the much cheaper overall gate fee for this process (since the landfilled stabilised wastes are not subject to landfill tax). The other treatment types will see a smaller reduction in gate fees due to the removal of landfill tax.

## 3.3 Option 1: Forecast of Potential Waste Flows from Rest of U.K. to Scotland

It is assumed the cross-border waste flows under Options 2 & 3 are negligible (or that the influx of material is offset by export of a similar amount so that net exports are zero, or close to zero.

Under Option 1 the cross-border waste flows would be expected to be quite significant if no countervailing action is taken by the authorities in England and Wales. It is assumed here that no such countervailing action is put in place, and that the removal of the (in future) £80 per tonne tax makes it profitable to move waste considerable distances to Scottish landfills on the basis that the far lower landfill price in Scotland justifies, economically, the decision.

Two scenarios have been modelled:

- Low movement – where waste flows are limited to existing capacity constraints;
- High movement – where the maximum potential movement across the border is modelled.

The potential for cross-border waste movements have been modelled in the following way:

- First, the cross-border waste movements model, developed in a previous study on landfill tax for Scottish Government, was used to assess the potential distance waste would travel. With the removal of the tax at £80 per tonne, the price differential could potentially result in waste from the far South West corner of England being transported to Scottish landfills. Thus, in principle, any waste in the UK could move, either by road or rail, to Scottish landfills;
- Waste management in England and Wales was modelled using forecast growth and recycling rates by sector. This leads to an estimate of the total amount of residual waste generated over time (residual waste is expected to fall over time as recycling increases). We have assumed a continued increase in recycling rates in England and Wales under the assumption that existing policy objectives in each country are met, despite the price differential (which might reduce the incentive to recycle in those countries if other measures prove inadequate to maintain the momentum to recycle more);
- Data from Eunomia's residual waste review was used to calculate the total residual waste treatment capacity in operation or under construction in England and Wales.[14] This was then netted off from the total available residual waste, by region. Where future capacity exceeds supply of residual waste in that region, the total quantity of waste treated was capped at the level of supply;
- It is assumed that no new residual waste treatment capacity would be built in England or Wales (excluding plant already under construction) as long as the supply of landfill in Scotland was able to match demand. This might not be the case if the English or Welsh governments insist that actors fulfil their duty to apply the waste hierarchy (as per the Waste (England and Wales) Regulations 2011), but there is scant evidence of this being enforced at present in England;

[14] Eunomia (2012) *Residual Waste Infrastructure Review: High-level Analysis – Issue 3*, http://www.eunomia.co.uk/documents/Eunomia_Residual_Waste_Infrastructure_Review_High-level_Version.pdf

It was assumed that all waste, except that treated by existing plant could potentially move to Scotland.[15] This includes LAC landfilled waste, as contractual arrangements might allow contractors to landfill waste at any site, not at a particular specified site (again this is a worst case position);**Table 3-1**

The table below shows the tonnages of waste that could be supplied by England and Wales under these assumptions.

**Table 3-1:** Waste Movements Potential (million tonnes)

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| **Total Residual Waste in Eng. and Wales** | 27 | 25 | 24 | 23 | 21 | 20 | 19 | 18 | 16 |
| **Total Capacity in Operation or in Construction in Eng. and Wales** | 11 | 12 | 14 | 15 | 15 | 15 | 15 | 15 | 15 |
| **Total Remaining Waste (potential for cross-border movements)** | 16 | 13 | 10 | 8 | 7 | 6 | 4 | 3 | 2 |

The following then describes how the two scenarios were modelled.

## Low movement scenario

A constraint on flows was then applied, reflecting the ability of Scottish landfills to accept the potentially large quantity of waste that could be supplied by England and Wales. The approach taken is as follows:

- The total annual capacity which Scottish landfills can accept under the terms of their permits (active wastes) was estimated at 10 million tonnes;[16]
- The projected total active waste landfilled in Scotland was subtracted from this annual limit to derive a figure for the maximum level of additional annual landfilling which could take place with no change in permitting conditions, and no increase in available capacity;
- The annual figures were also constrained by the total available existing void space (~66 million tonnes).[17] These constraints were used to limit the total potential movement of waste (as outlined above) e.g. a low movement scenario.

[15] It would, of course, be possible for some wastes treated at existing treatment plants to, subsequently, be sent to Scottish landfills for disposal. Indeed, this might be expected where flows of waste into existing treatment facilities are not those which are tied to specific facilities under long-term contracts (either explicitly, or implicitly by virtue of the nature of the targets which the contractor is required to meet).

[16] SEPA waste sites and capacity information.
http://www.sepa.org.uk/waste/waste_data/waste_site_information/waste_sites__capacity.aspx

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### High movement scenario

A high movement scenario was considered to be a case where enough permits were potentially able to be upgraded, such that all the potentially available waste movement would occur. This is effectively the same as the 'potential for cross-border movements' row in Table 3-1.

The figures for both scenarios are presented in the table below:

**Table 3-2:** Potential Additional Landfilling of Waste in Scotland

| | 2015 | 2020 | 2025 | Total (2015-25) |
|---|---|---|---|---|
| **Low movement scenario** | 8 | 0 | 0 | 31 |
| **High movement scenario** | 8 | 2 | 2 | 38 |

The main caveats around this approach relate to uncertainties in both the quantities of waste arising in England and Wales for treatment, and the potential for price differentials to form the business case to ship waste to Scotland. Given that existing price differentials between the UK and recovery plants in the Netherlands is showing a rapid increase in the amount of waste shipped out of the UK for treatment, it does not seem outside of the realms of possibility that significant quantities of waste would travel up to Scotland as a result of the price differential.

One other point we have not addressed in this modelling relates to the ongoing debate over devolution. If Scotland was fully devolved from the UK, and became a separate EU Member State, rules under the Waste Shipments Regulations dictate that transfer of wastes between Member States for disposal is prohibited other than under quite specific circumstances, and thus, the waste flows under this scenario would not be expected to be greatly different from the BaU position.

## 3.4 Net Change in Waste Flows (Options 2 & 3 to Option 1)

Table 3-3 presents the differences in the management of waste in Scotland between Options 2 & 3, and Option 1.

Waste collected for Recycling / Composting / AD increases due to an uplift in the generation of industrial waste between the scenarios (no tax equates to a reduced waste prevention effect, and thus more waste generation in Option 1). This effect also increases other treatments in relation to the projected management share in each year out to 2025.

In addition, the quantity of residual waste sent to MBT facilities operating in stabilisation mode increases in Option 1, principally due to the fact that the gate fee for this treatment type will be less than the other types of treatment on the market (due to the removal of the tax on the landfilled outputs of the process). A key transition date in the timeline is 2021, where the ban on biodegradable waste to landfill comes into effect.

[17] SEPA (2010) *Landfill Capacity Report for Scotland, 2009*, http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&ved=0CDsQFjAB&url=http%3A%2F%2Fwww.sepa.org.uk%2Fwaste%2Fwaste_data%2Fwaste_site_information%2Fidoc.ashx%3Fdocid%3D58b7d684-

Conversely, Option 1 sees a large reduction in the quantity of waste treated at MBT/MHT sites which send residues to thermal facilities, and at incineration plants, as treatment is significantly more expensive in comparison to landfill and alternative residual waste treatment processes (see above).

In the period from 2015 to 2020 there is a significant increase in the landfilling of active wastes in Scotland under Option 1. This is due to the strong economic incentive to continue to landfill residual waste under Option 1. The amount of waste landfilled from 2021 falls sharply when the ban on biodegradable waste to landfill comes into effect. Smaller increases in the landfilling of inert wastes are also seen as a result of the removal of the lower rate tax

**Table 3-3:** Change in Mass Flows between Options 2 & 3 and Option 1 ('000 tonnes)

| | 2015 | 2017 | 2019 | 2021 | 2023 | 2025 |
|---|---|---|---|---|---|---|
| **Total Recycling / Composting / AD** | 6 | 19 | 31 | 43 | 54 | 66 |
| **Total MBT – Stabilisation** | 10 | 23 | 225 | 719 | 714 | 710 |
| **Total MBT/MHT – Thermal** | -182 | -448 | -616 | -645 | -638 | -632 |
| **Total New Incineration + Sorting** | -95 | -234 | -277 | -178 | -175 | -172 |
| **Active Landfill** | 262 | 644 | 646 | 85 | 84 | 84 |
| **Inert Landfill** | 6 | 22 | 34 | 36 | 36 | 35 |

In addition, the

Table 3-4 indicates the key changes between the main waste management routes. This shows that removing the landfill tax in Scotland would:

- Increase disposal;
- Reduce recovery; and
- Increase waste generation.

All of these effects run counter to the objective of the revised Waste Framework Directive to move waste up the waste hierarchy, and the thrust of the Scottish Zero Waste Plan, which seeks to improve resource efficiency in the economy.

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**Table 3-4:** Total Change in Mass Flows between Options 2 & 3 and Option 1, 2012 to 2025 (million tonnes)

| Option | Landfilled | Incinerated and Other Recovery | Recycled / Reused | Composted | Total Waste Managed |
|---|---|---|---|---|---|
| **Option 2 & 3** | 19 | 24 | 123 | 19 | 185 |
| **Option 1 (Scottish Waste Only)** | 23 | 20 | 124 | 19 | 186 |
| **Option 1 (Inc. Cross-border Waste)** | 91[1] | 20 | 124 | 19 | 254 |
| *1) The average of low and high movement scenarios for cross-border waste flows is taken for this figure.* | | | | | |

Note, as discussed in the Methodology Section, it has not be possible to quantify the effect on illegal waste from removing the tax, and therefore, any such effect in this regard has not been included in the waste flows.

# 4 Financial Costs

As with the waste flows, most of the financial related data was taken from the ZWP CBA study. In this analysis, all collection costs and organic treatment costs remained as per the existing ZWP CBA model. Residual waste treatment costs were updated, as this is where the majority of the change in waste flows is occurring.

## 4.1 Residual Treatment Costs

The residual waste treatment costs were updated as follows:

- Landfill tax values (and other financial figures) were updated so that they reflected values in real 2012/13 sterling;
- Unit opex and capex costs per treatment types were combined to give the total estimated cost per tonne of waste treated;
- The capex for new build incineration plants was increased to reflect the additional cost of the pre-sorting equipment required under the Zero Waste Regulations. In addition, revenues from the sale of the extracted material were included in the operational costs;
- Costs for MBT/MHT to thermal were updated to 2012/13 sterling;
- Two costs for all non-landfill treatments were estimated: one assumed that where residues were landfilled the cost would include the landfill tax, and the other assumed the residues were disposed to landfill without tax being applied. The latter costs were used from 2015 onwards under Option 1;
- Landfill gate fees were updated with a blended rate for Scotland (£20 per tonne);

The following table shows the unit costs (effectively a gate fee) for the residual treatments:

**Table 4-1:** Residual Treatment / Disposal Gate Fees

| Residual | Gate Fee (£/tonne) |
|---|---|
| **MBT stabilisation to Landfill (with LF tax)** | £113 |
| **MBT stabilisation to Landfill (no LF tax on stabilised wastes)** | £93 |
| **MHT producing SRF for ATT** | £111 |
| **Incineration - Operational (2010)** | £88 |
| **Incineration - Proposed** | £125 |
| **Landfill (Active)** | £20 |
| **Landfill (Inert)** | £0 |

### *4.1.1 Increased Landfill Gate Fees Scenario*

As discussed in Section 2.6 there is a possibility that under Option 1 (removal of landfill tax after 2015) landfill operators might increase gate fees as demand for cheap landfill will be very high. We therefore have included an additional scenario where landfill gate fees are increased from the baseline average of £20 per tonne to £60 per tonne. This is to give an indication as to the effect of this on the overall results, and thus the policy decision would be.

## 4.2 Change in Administrative Costs

It has to be said that there are likely to be some benefits from ensuring cross-consistency of what are currently landfill tax returns made to HMRC, and site returns made to SEPA. This is a point we have highlighted in the past, but the benefits of better data in this regard are not so easy to quantify in terms of monetised benefits.

The administration costs for Government used were those supplied to Eunomia by Scottish Government. These are as follows:

Total Costs for Setting up Like-for-like System:

- £540k set up cost in run-up to implementation (£295k in 2013, £245k in 2014);
- £300k per annum running costs from 2015 onwards;

Total Costs for Setting up Non-self-assessment model:

- £615k set up cost in run-up to implementation (£335k in 2013, £280k in 2014);

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- £360k per annum running costs from 2015 onwards.[18]

Note, the model is still missing the change in administration costs for landfill operators, but this is not likely to be a significant figure. We have not been able to estimate the level of administrative costs to the landfill operators themselves under the different options.

## 4.3 Change in Regulatory Costs

For the purposes of this report the additional regulation costs required in order for the regulations to be effective without the tax, have been estimated as four times the regulatory costs of implementing the ZWP. This cost was estimated during the ZWP CBA study. It was not within the scope of this study to carry out a major review of this information.

## 4.4 Maintaining the Landfill Communities Fund in Scotland

The LCF is a tax credit scheme that allows operators of landfill sites to contribute up to 5.6% of their landfill tax liability to environmental bodies and reclaim 90% of this contribution as a tax credit. In principle, Scotland could set up a similar scheme.

In Appendix 2, we consider the potential costs and benefits of establishing a similar scheme. We argue that the decline in the tax take over time under Scenarios 2 and 3 (where the tax is still in place) make it likely that the revenues to be administered under the LCF will be fairly small in future, and that it would be appropriate for the scheme to be relatively light in terms of its future administration.

We were also asked to consider the costs and benefits of setting up a scheme in Scotland. Our view is that this needs to be considered against a counterfactual where the revenue accrues to the public purse. As such, as we discuss in Appendix 2, it is difficult to be confident that the scheme would deliver benefits net of costs relative to the most likely counterfactual. In principle, the additional benefits from leveraging in 10% of funds (the element over and above tax credits) are likely to be offset by the costs of administering the fund, at least to some degree. Consequently, we have assumed no net benefit relative to the counterfactual scenario of the fund accruing instead to the public purse.

# 5 Environmental Externalities

As with the financial costs, most of the data used in this study was taken from the ZWP CBA study. All elements remain the same except for externalities associated with landfilling. These updated assumptions are described in the following sections. Note that emissions associated with transport are not included in the modelling, nor is the monetisation of emissions to water or land.

## 5.1 Landfill Emissions

The other main monetised negative externalities (i.e. negative impacts) from landfill come from the fugitive methane emissions. These depend upon the material landfilled (how much methane is generated), the efficiency with which this is captured for flaring / energy generation, and the extent to which the landfill cap oxidises the methane, converting it to carbon dioxide.

The landfill model built for this project is based on the Tier 1 model contained within the IPCC 2006 inventory software (this is available for download from http://www.ipcc-nggip.iges.or.jp/software/new.html ). The Tier 1 landfill model provides different default assumptions with regard to landfill gas generation from deposited waste for each country

[18] Based on same uplift in absolute terms from SEPA figures to SPICE note

based on climatic factors; relevant assumptions were selected for Scotland. The assumptions incorporated into the landfill module within the inventory software were copied across into a separate Excel file so that impacts could be calculated for one tonne of each type of waste.

In addition to the standard assumptions contained within the Tier 1 model identified above, the modified version of the model created for the current analysis incorporated the following assumptions with regard to landfill gas management:

- Landfill gas capture was set to 50% for the period over which gas is generated;
- The calorific value of methane was assumed to be 38 MJ / kg;
- The efficiency of the gas engine used for electricity generation at the landfill was assumed to be 38%;
- 50% of the landfill gas captured over the lifetime of the facility was assumed to be used for electricity generation. The remainder was assumed to be flared.

With the exception of the gas capture assumption, all other assumptions were based on those included within the default model developed by IPCC for reporting emissions from landfill to the UNFCC. Assumptions with regard to landfill gas capture used within the model are in line with those used during the development of the carbon based recycling targets for Scotland. The externalities have been valued using Guidance from DECC / HM Treasury.

The modelling of gaseous emissions is related back to waste composition so that non-gassing materials generate different externalities to those which contain biodegradable components. This allows for the modelling of externalities of both ‘inert’ waste, and ‘active’ waste, and more generally, of waste with varying compositions.

A small additional negative externality relates to the air pollutants caused by the fugitive emissions and the emissions associated with combusted biogas. These are rather small by comparison. Emissions data has been multiplied by figures for unit damage costs from the air pollutants, as agreed by the Intergovernmental Panel on Costs and Benefits, which sets damage costs for key pollutants for use in policy appraisal on behalf of Government.

Landfills generate energy from the biogas that is captured and combusted in gas engines. This energy is taken to imply an environmental credit since it avoids the generation of energy which would otherwise have to take place. Again, this benefit has been estimated using sources already referred to.

## 5.2 Disamenity

For a review of studies on disamenity, see Appendix 3.

### *5.2.1 Landfills*

This study uses disamenity figures derived from a previous study by Cambridge Econometrics. We have applied the figures obtained from the Cambridge Econometrics study for the reduction in house prices with distance from the landfill to the Scottish housing stock.

The approach, outlined in more detail in Appendix 3, gives a figure of £22.90 per tonne, much higher than for the GB as a whole.

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### *5.2.2 Incineration*

There is a growing literature regarding the externalities related to disamenity from incineration. In this study, we have used a figure of £6 per tonne.

### *5.2.3 MBT*

For MBT, as far as we are aware, no studies are available which have derived figures from first principles. We have assumed a somewhat lower figure (£4 per tonne) for the pre-treatment process than for incineration, but have added additional externality figures depending upon the nature of the outputs (so additional externalities are linked to landfill and incineration, according to the fate of residues from the process).

# 6 Results from BRIA

## 6.1 Financial Costs

- The net costs are broken down by treatment type:

  A: Landfill Operators;
  B: Recycling Sector;
  C: Non-landfill Residual Waste Treatment Sector;

- And by key actor:

  A: Local Authorities;
  B: Commercial and Industrial Sector; and
  C: Construction and Demolition Sector.

We present the changes in financial costs for different treatment types first and then by key actors.

Table 6-1 illustrates the difference in treatment costs between the Option 2 (BaU) and Option 1. The key driver of the changes in costs is the change in the management of wastes in Scotland (see above).[19] In addition, the change in unit costs (or gate fees) between treatment types influences the overall pattern of the change. The most significant cost saving (represented by negative figures) is from the active rate landfill tax. This is due to the removal of the tax from 2015/16 onwards.

In the case of MBT/MHT – Thermal, savings are evident since, under Option 1, we see a drop in waste treated at these residual waste treatment facilities. The same can be said for incineration, where a cheaper alternative – MBT – Stabilisation – becomes available.

[19] Note that the change in costs of managing wastes generated in England and Wales is outside the scope of this analysis.

**Table 6-1:** Change in Treatment Costs between Options 2 & 3 and Option 1, £ million 2012/13 Real Terms

| | 2015 | 2017 | 2019 | 2021 | 2023 | 2025 |
|---|---|---|---|---|---|---|
| **Active Landfill – Tax** | -£144 | -£105 | -£72 | -£39 | -£39 | -£39 |
| **MBT/MHT – Thermal** | -£13 | -£37 | -£54 | -£60 | -£59 | -£59 |
| **Incineration + Sorting** | -£8.8 | -£23 | -£29 | -£22 | -£22 | -£22 |
| **MBT – Stabilisation** | -£16 | -£15 | £1.1 | £39 | £39 | £38 |
| **Active Landfill - Gate Fee** | £4.0 | £12 | £12 | £1.7 | £1.7 | £1.7 |
| **Other Treatment Costs** | £0.04 | £0.5 | £1.0 | £1.5 | £1.9 | £2.4 |

For MBT – stabilisation, there are savings in early years, but there is an increase in spending on these facilities in later years as more waste is sent to them than in the business as usual scenario. After 2021, when the ban on sending biodegradable waste to landfill comes in, waste switches from more expensive treatments to this now much cheaper option (due to the removal of the tax on the landfilled outputs), and thus overall cost of treatment increases relative to Option 2 (BaU).

As more waste is landfilled under Option 1 there will also be an increase in total gate fees paid to landfill operators. Finally, there are some other additional treatment costs, mainly associated with a greater quantity of industrial waste in the waste stream.

Table 6-2 shows the distribution of costs across the key groups of actors. The greatest change in costs is seen in the C&I sector, followed by Local Authorities. The lowest change in costs is seen in the C&D sector where volumes of waste landfilled (which are not already exempt from the tax) are lower and gate fees are minimal.

**Table 6-2:** Financial Costs by Sector, Options 2 & 3 and Option 1, £ million 2012/13 Real Terms

| | 2015 | 2017 | 2019 | 2021 | 2023 | 2025 |
|---|---|---|---|---|---|---|
| **Local Authority** | -£71.43 | -£68.09 | -£58.04 | -£32.57 | -£32.49 | -£32.41 |
| **Commercial and Industrial Sector** | -£87.09 | -£82.30 | -£67.01 | -£31.20 | -£30.36 | -£29.53 |
| **C&D Sector** | -£18.02 | -£17.08 | -£16.21 | -£15.37 | -£15.15 | -£14.94 |

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Table 6-3Table 6-3 below shows the overall financial costs from switching between Option 2 (BaU) and Option 1. It is clear that the most significant costs are those associated with the treatment of waste, which, as indicated above, is mainly the change in residual waste treatment costs.

**Table 6-3:** Total Financial Costs, Options 2 & 3 and Option 1, £ million 2012/13 Real Terms

| | 2015 | 2017 | 2019 | 2021 | 2023 | 2025 |
|---|---|---|---|---|---|---|
| **Change in Collection Costs** | £0.3 | £0.9 | £1.5 | £2.0 | £2.6 | £3.2 |
| **Change in Treatment Costs** | -£176 | -£167 | -£141 | -£78 | -£78 | -£77 |
| **Change in Regulatory / Admin Costs** | £3.5 | £3.4 | £3.4 | £3.5 | £3.5 | £3.5 |
| **Total Change in Costs** | -£172 | -£162 | -£136 | -£73 | -£71 | -£70 |

## 6.2 Environmental Externalities

Table 6-4 and Table 6-6 show a summary of the environmental externalities from 2015 to 2025, under both low and high cross-border waste movement scenarios. Although there is more industrial waste in the waste stream, and therefore more industrial recycling, no credits have been given as more waste is actually generated in this scenario. Thus as a proxy for including waste production impacts, we have removed the recycling offset. This is likely to be an underestimate, but the additional tonnages are small, and not significant compared with other impacts modelled in the analysis.

**Table 6-4:** Total Environmental Externalities (Low Cross-border Movement Scenario), £ million 2012/13 Real Terms

| | 2015 | 2017 | 2019 | 2021 | 2023 | 2025 |
|---|---|---|---|---|---|---|
| **Change in Dry Recycling** | £0 | £0 | £0 | £0 | £0 | £0 |
| **Change in Organics Treatment** | £0.00 | -£0.01 | -£0.02 | -£0.04 | -£0.06 | -£0.09 |
| **Change in Residual EfW** | -£3.4 | -£10.3 | -£13.1 | -£8.9 | -£8.9 | -£8.9 |
| **Change in Other Residual Treatments** | -£7 | -£21 | -£27 | -£18 | -£18 | -£18 |
| **Change in Landfill (Scottish Waste)** | £11 | £34 | £38 | £16 | £16 | £16 |
| **Change in Landfill (Cross-border Waste)** | £552 | £567 | £424 | £343 | £0 | £0 |
| **Total Change in Environmental Costs** | £553 | £569 | £422 | £333 | -£10 | -£11 |

There are some small savings from additional AD treatment of industrial food wastes, but more significant savings from

switches in residual waste treatment. In terms of additional externalities from landfilling under Option 1, the vast majority relate to the landfilling of waste from cross-border movements. For this reason, as the cross border movements increase, so the externalities from landfilling waste in Scotland increase.

**Table 6-5:** Total Environmental Externalities (High Cross-border Movement Scenario), £ million 2012/13 Real Terms

| | 2015 | 2017 | 2019 | 2021 | 2023 | 2025 |
|---|---|---|---|---|---|---|
| **Change in Dry Recycling** | £0 | £0 | £0 | £0 | £0 | £0 |
| **Change in Organics Treatment** | £0.00 | -£0.01 | -£0.02 | -£0.04 | -£0.06 | -£0.09 |
| **Change in Residual EfW** | -£3.4 | -£10.3 | -£13.1 | -£8.9 | -£8.9 | -£8.9 |
| **Change in Other Residual Treatments** | -£7 | -£21 | -£27 | -£18 | -£18 | -£18 |
| **Change in Landfill (Scottish Waste)** | £11 | £34 | £38 | £16 | £16 | £16 |
| **Change in Landfill (Cross-border Waste)** | £746 | £584 | £424 | £343 | £342 | £341 |
| **Total Change in Environmental Costs** | £747 | £586 | £422 | £333 | £331 | £330 |

## 6.3 Net Change in Costs and Benefits

The above analysis has provided a forecast of the potential financial and environmental impacts from the policy options considered in the BRIA. To provide an overall picture of the options, both types of cost are considered together in this Section. The costs and benefits are shown below in Table 6-6, note negative costs are savings. All the results in this Section, where they do not specifically refer to a given year, are represented in Net Present Value (NPV) terms for the period from to 2025.

Table 6-6, which shows the results where the cross border movements are at the lower end of what may be expected, clearly indicates that for Option 1, there are savings in financial costs, but these are exceeded by the increased environmental damages. In Table 6-7, the situation becomes more marked as the financial costs remain the same, but the environmental externalities increase.

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**Table 6-6:** Overall Costs and Benefits of Switch from Option 2 (BaU) to Option 1 (Low Cross-border Movement Scenario), NPV to 2025, £ million 2012/13 Real Terms

| Cost Category | Change in Costs |
|---|---|
| **Total Change in Financial Costs** | -£1,070 |
| **Total Change in Environmental Costs** | £2,870 |
| **TOTAL** | £1,800 |

*Note: negative figures represent savings*

**Table 6-7:** Overall Costs and Benefits of Switch from Option 2 (BaU) to Option 1 (High Cross-border Movement Scenario), NPV to 2025, £ million 2012/13 Real Terms

| Cost Category | Change in Costs |
|---|---|
| **Total Change in Financial Costs** | -£1,070 |
| **Total Change in Environmental Costs** | £4,160 |
| **TOTAL** | £2,790 |

*Note: negative figures represent savings*

The following issues deserve to be re-emphasised at this point:

1 Strictly speaking, it is not accurate to sum the costs and benefits as presented above since there is an element of double counting in the change in the payments of landfill tax is included in the analysis. However, the removal of the tax does represent a real saving to businesses. Therefore, the costs are presented alongside the environmental externalities;

2 The main form of double counting results from the fact that the estimated financial savings include savings related to the removal of the tax on landfill when moving away from the BaU. The tax-related part of the financial savings relates to payments in lieu of landfill-related externalities. These are captured separately in the change in environmental externalities. The effect of stripping out the effect of the tax is to reduce the financial savings by around £600 million in Tables 6-6 to 6-8. This actually worsens the impact of moving away from the BaU. It should be recalled, however, that none of the financial savings accruing to businesses outside Scotland are factored into the analysis.

3 The emphasis of the BRIA is on the costs and benefits which occur within Scotland. This focuses on the costs of the changes in waste management within Scotland, and the externalities which relate to Scottish waste management facilities. Under Scenario 1, there are clearly savings that accrue to companies based outside Scotland and this is that is driving the movement of waste across the border. This movement is also the source of additional revenue for Scottish landfill operators. These figures are not included in the above analysis.

As discussed in the Methodology section (and Appendix 1), there is a chance that landfill operators will increase gate fees if the tax is removed. We therefore ran an additional scenario with gate fees increasing from £20 per tonne to £60 per tonne. This means that the price differential falls from around £80 per tonne to £40 per tonne. At a £40 price

differential, it is not cost effective to transport waste (by road) from the South West of the UK. There is the possibility to transport the waste by rail, but taking a conservative approach we assume that 50% of the maximum available cross-border waste moves under this scenario. The overall result of this scenario is shown in

Table **6-8**.

**Table 6-8:** Overall Costs and Benefits of Switch from Option 2 (BaU) to Option 1 (WITH INCREASE IN LANDFILL GATE FEES), £ million 2012/13 Real Terms

| Cost Category | Change in Costs |
|---|---|
| **Total Change in Financial Costs** | -£930 |
| **Total Change in Environmental Costs** | £2,060 |
| **TOTAL** | £1,130 |

As one can see the increase in gate fees reduces the cost savings that would be realised by Local Authorities and businesses once the tax is removed. The difference – some £140 million in NPV terms – effectively represents additional revenue realised by landfill operators, the vast majority of which would be realised as profit. Evidently, operators would stand to make a considerable amount of money if the removal of the tax enabled them to increases their gate fees significantly, as indeed it may.

The above analysis has highlighted the effect of moving from Policy Option 2 to Policy Option 1. The move to Policy Option 3 (Maintain similar system as UK model but implement a non-self-assessment model) from Policy Option 2 incurs some additional costs of NPV £0.575 million over the period 2012 to 2025, but the mass flows are expected to remain the same as under the Baseline. Thus, the presence or otherwise of a non-self-assessment system has a minor impact, and one that is far less significant than that of removing the tax (as one would expect).

## 6.4 Risks

The BRIA guidance note indicates that potential risks of policy options should be considered alongside the costs and benefits.

It seems reasonable to point out that if the tax was going to be removed, then a complete removal as of April 2015, little more than 2 years away, would cause massive disruption in the waste management market. The waste industry has called, repeatedly, for certainty in the policy environment. Removal of the tax at what, in waste management terms, is a moment's notice would potentially lead to a complete loss of credibility on the part of Scottish Government, and its policy-making in this area.

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The extent of the turmoil which the change would create for projects which are in development, or being procured, or even for contracts which have already been concluded on the basis of expectations of rising landfill tax, should not be under-estimated. Furthermore, some would argue that whatever the distribution of costs across sectors, within sectors, it will reward the laggards and effectively punish the front-runners on the basis that they probably would not have taken decisions which they have done if they had known that the tax would suddenly be removed.

It goes without saying that it will not be possible to understand the terms of each and every contract for waste management in Scotland and how this policy change might affect those extant contracts.

If it was the case that operators increased gate fees as a result of the removal of the tax, and this is somewhat difficult to gainsay, but it seems likely to happen (the question remains as to the extent of the change), then the loss of Government revenue will have effectively coincided with an increase in rents accruing to operators of landfill. From an economic perspective, this transfer – from public finances to excess profits of landfill operators – does not seem entirely welcome.

As noted in the report, there is a likelihood that if the tax was removed, the cross-border flows into Scotland would become significant. Although fuel duty does, by and large, internalise transport externalities, some of these might be visited on specific sectors of the population and the sheer volume of movements of waste along specific transport routes could become considerable. This outcome does not sit well with the aspiration to deliver a Zero Waste economy (indeed, it is difficult to imagine a measure more antithetical to it).

If the decision is taken to establish a LCF (or equivalent) for Scotland, it should be noted that any appropriate administrative apparatus should reflect declining fund revenues in the future.

The decision regarding how the tax should be assessed deserves clarification. The merit of a non self-assessment method appears to be in terms of the validation of data across different sources. The system needs to be made administratively simple for operators (who already have to report landfill tax and their site returns anyway), but the system would need to be designed to ensure that benefits accrue as a result (otherwise, what would be the argument for the additional costs?).

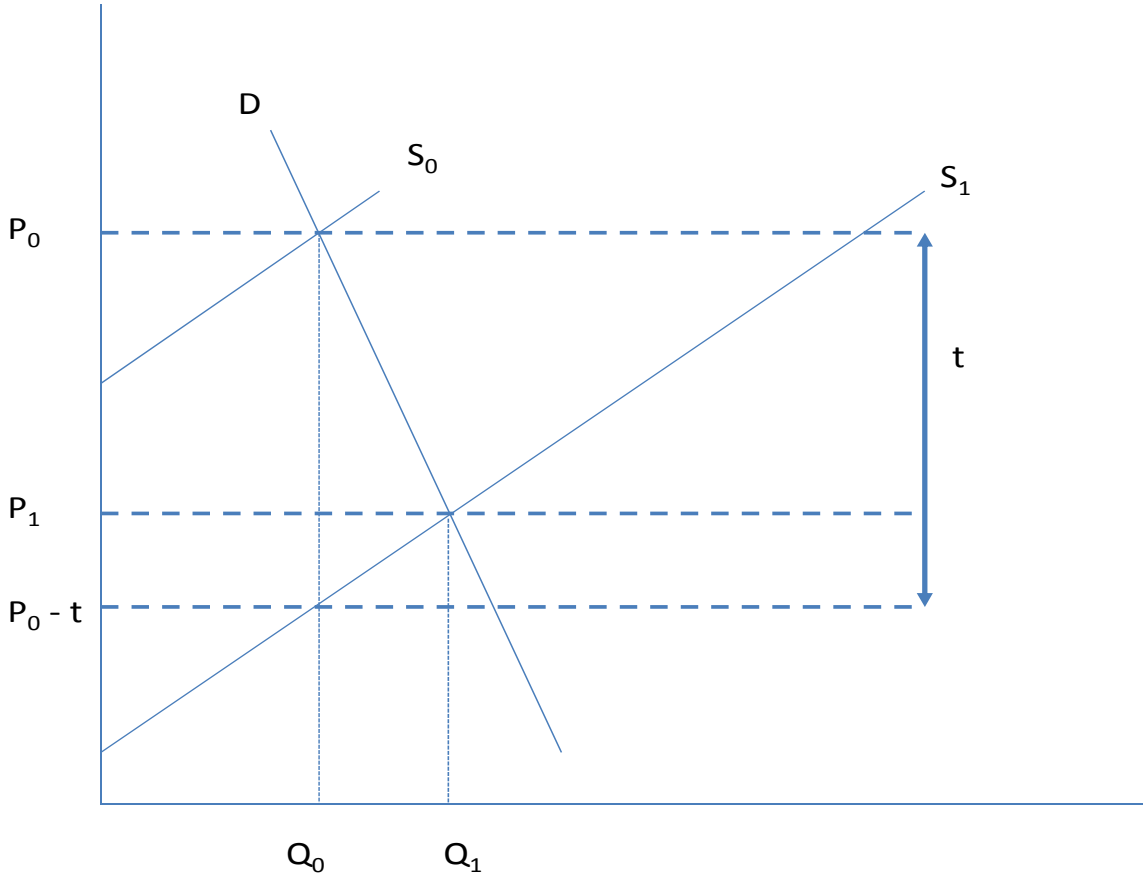
## A.1 Landfill Prices Under Removal of the Tax

The inelastic nature of demand for disposal services suggests that any rise in pre-tax gate fees might be limited as the tax falls. It may also be the case that local authorities have in place contracts which automatically rise or fall with landfill tax, so that the pre-tax gate fees may not rise at all in the short-term. We note that the consultation on the draft BRIA indicated that most landfill operators did not believe gate fees would rise significantly, but economic theory suggests that it would in a competitive market, with the rise being determined by the nature of the supply curve (for landfill services) and the demand curve (for landfill disposal).

The extent of any increase will be almost impossible to estimate, but the probability that gate fees will rise is not negligible, so some further consideration is given to this issue.

Figure A1-1 shows what would be expected with a reasonably elastic supply curve and a reasonably inelastic demand curve. Removing the tax 't' would not lead to a reduction in price from the original level, $P_o$ to ($P_o$-t), but a less pronounced fall to $P_1$., with demand for landfilling increasing from $Q_0$ to $Q_1$.

**Figure A1-1:** Static Supply and Demand Analysis of Removal of Tax

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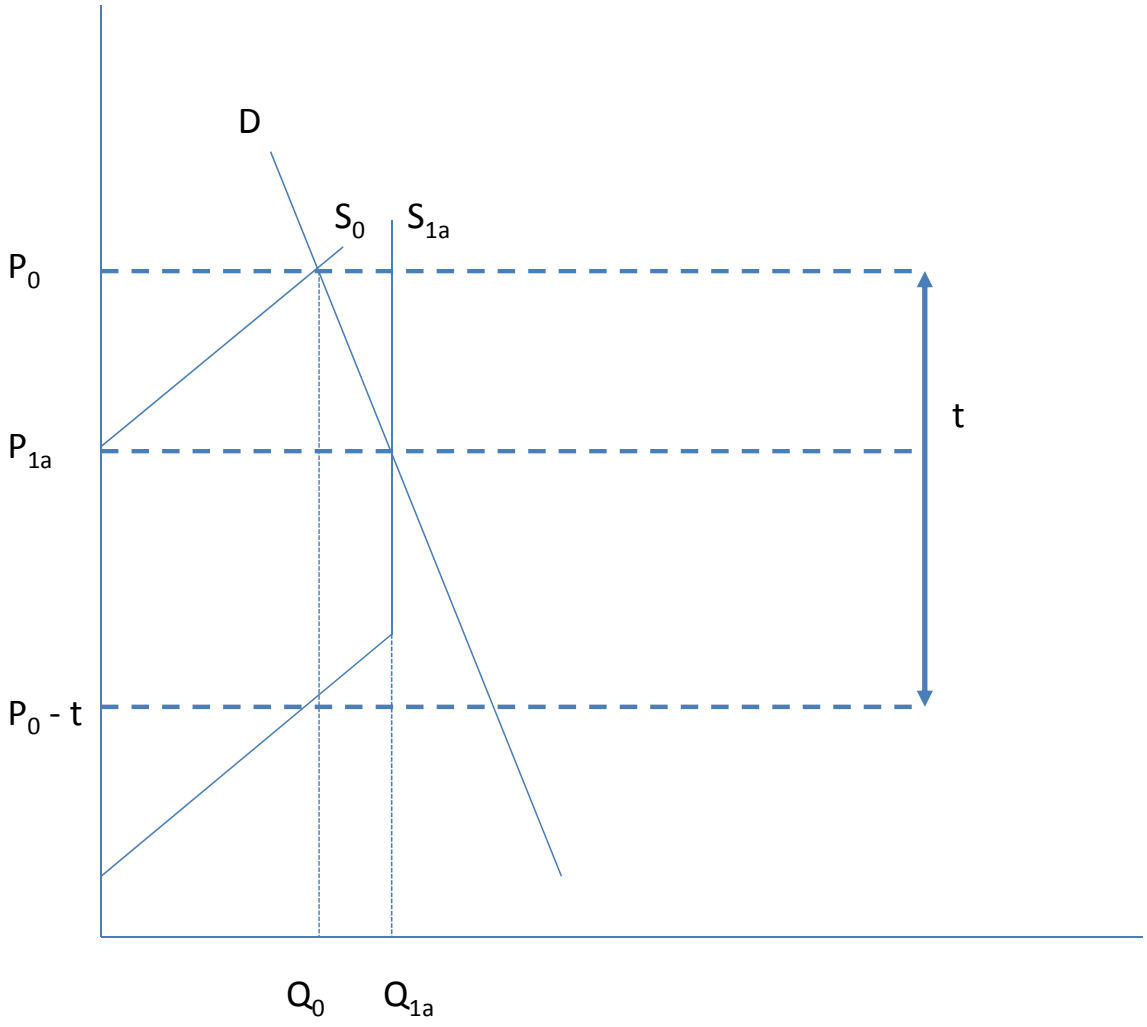
One factor which could serve to increase prices would be a constraint on the supply – in any given year – of landfill services. In

Figure A1-2, we show what could happen if permits limit the supply of landfill void space in a given year. In this case, the supply curve becomes infinitely inelastic above a certain level. The permitted quantity acts like a quota, and would serve to increase prices above levels which might otherwise prevail. This effect would be expected to be alleviated somewhat beyond the short-term as a result of new suppliers entering the market. In this case, the demand for landfill cannot exceed the permitted quantity, and the effect is to limit uptake of disposal services, and increase their price to a higher level, $P_{1a}$, than in the case where supply of void is unrestricted. This is effectively the same result as is achieved by cartels that restrict supply of commodities onto the market.

**Figure A1-2:** Static Supply and Demand Analysis of Removal of Tax (constraint on supply)



## A.2 Issues Regarding the Landfill Communities Fund

The LCF is a tax credit scheme that allows operators of landfill sites to contribute up to 5.6% of their landfill tax liability to environmental bodies and reclaim 90% of this contribution as a tax credit.

Funds can be spent on not-for-profit projects within 10 miles of a landfill site if they meet one of the following six objectives:

- Remediation or restoration of land which cannot now be used because of a ceased activity;
- Reduction of pollution;
- Provide or improve a general public amenity;
- Protect or enhance a species or its environment where it naturally occurs;
- Restoration of religious buildings or historic structures; and
- Provision of support services by one organisation enrolled with Entrust to another.

ENTRUST regulates the LCF on behalf of HM Revenue and Customs which has ultimate responsibility for governing the Regulations. ENTRUST conducts its regulatory role through a registration/enrolment system of all organisations that wish to receive funding. ENTRUST is funded by a combination of a levy of 2% on money received by Environmental bodies from landfill operators and fees charged for registration.

The Consultation Document on the Landfill Tax noted:

> *5.8 The Scottish Government believes that the Landfill Communities Fund has played an important role in supporting communities affected by landfill sites as well as to the wider Scottish environment. The Scottish Government proposes to establish a fund for worthy causes and to finance it through a tax credit system.*
>
> *5.9 Furthermore, to enhance the ability of the fund to address a wide range of outcomes for Scotland's environment and economy, the Scottish Government proposes to increase the amount of funding available to projects for the first three years of the scheme by 10% over the current system. At current landfill rates, this would channel an extra £500k toward the fund.*
>
> and
>
> *5.11 The proportion of the Landfill Communities Fund that is currently spent on administration costs by the Environmental Bodies and Distributive Environmental Bodies varies from organisation to organisation. Figures published on ENTRUSTs website would suggest that the proportion spent on administration has been around 11.4% across the UK. In addition, ENTRUST is funded by a combination of a levy of 2% on money received by Environmental Bodies from landfill operators and fees charged for registration.*
>
> *5.12 The Scottish government would like to seek views on opportunities to encourage more efficient use of funds by the environmental bodies or whether other mechanisms should be put in place to reduce administration costs and ensure a greater proportion of funds is allocated to worthy causes.*

The issue of costs and benefits of setting up such a system and administering it raises a very wide range of questions. These include (but are not limited to):

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- Whether the same system of environment bodies and distributive environmental bodies should be retained;
- Whether the funds could be managed by existing bodies with established mechanisms and expertise in place for distributing grants; and
- Whether the objectives of the fund should remain as they are with the LCF.

Over the years, the LCF has not been without its critics. It might be useful, therefore, to consider a range of issues associated with the proposed Fund before finalising its design. We assume here that the scheme functions much as for the UK as a whole at present, and that the allocation of funds follows a similar pattern.

### A.2.1 Administrative Costs

As noted above, the Consultation Document noted that the proportion of the Landfill Communities Fund that is currently spent on administration has been around 11.4% across the UK (see Table A2-1). In addition, ENTRUST is funded by a combination of a levy of 2% on money received by Environmental Bodies from landfill operators and fees charged for registration of Environmental Bodies.

**Table A2-1:** Expenditure under Landfill Communities Fund

| Category of Expenditure | Quantity |
|---|---|
| Donations (contributions from landfill operators to Environmental Bodies) | £1,309,757,310.25 |
| Total spend so far by EBs (spent on Administration and on Projects) (1) | £1,158,734,810.03 |
| Total spend so far by EBs on Projects (2) | £1,026,488,940.80 |
| Administrative costs (assumed to be) | £132,245,869.23 |
| % spend on administration | 11.4% |

Source: ENTRUST, *http://www.entrust.org.uk/home/facts-and-figures*, last accessed 5th April 2013.

On the one hand, one might assume that a separate administrative system might be proportionately more expensive when run for Scotland alone. On the other hand, the scheme could be streamlined. It should also be noted that the tax revenues will dwindle over time, and are anticipated to fall from £143 million in 2015, to £56 million in 2020, and £39 million in 2025. Consequently, the Scottish system should be set up anticipating a decline in revenues to be managed through the scheme (unless further changes are planned to the tax scheme, or the rules regarding tax credits are altered) from a maximum of £8 million in 2015 to a maximum of £2.3 million in 2025. Of the above-mentioned solutions, use of existing bodies with expertise in making grant awards might be a suitable mechanism to explore (so that new, additional administration can be kept proportionate to the expected level of grants to be managed).

### A.2.2 Project Types and Distribution of Spend

Historically, ENTRUST gives data on the funds disbursed and how they have been distributed across the project types. This data is shown in Table A2-2, and the average level of spend on each project type is also shown, based on the revenues committed and number of projects undertaken. Category CC projects are no longer supported.

**Table A2-2:** Projects Supported by ENTRUST and Average Project Size

| Type of Project | Total Funds Committed | Average Fund per Project |
|---|---|---|
| **The remediation of land (Object A)** | £20,114,068.28 | £127,304.23 |
| **The prevention of pollution (Object B)** | £2,148,746.14 | £67,148.32 |
| **The reduction of waste (Object C)** | £245,662,547.18 | £145,276.49 |
| **The recycling of waste (Object CC)** | £4,782,814.83 | £217,400.67 |
| **Public parks and public amenities (Object D)** | £630,079,167.49 | £22,713.74 |
| **Biodiversity conservation (Object DA)** | £48,524,623.13 | £20,034.94 |
| **The restoration of places of worship and historic buildings (Object E)** | £72,838,972.61 | £13,609.67 |
| **The provision of services to other EBs (Object F)** | £2,338,001.15 | £89,923.12 |

Source: ENTRUST, *http://www.entrust.org.uk/home/facts-and-figures*, last accessed 5th April 2013.

In order to give a more current picture of the types of project supported, we used ENTRUST data on the types of project currently underway (Table A2-3). We would assume a similar pattern of allocation to projects by type. Using the average size of project as a guide to the commitment of revenues, this gives an allocation of the fund as per Table A2-4.

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**Table A2-3:** Projects Currently Underway under the LCF

| Project Type | Number Currently Underway | % of Total Projects in Progress |
|---|---|---|
| **The remediation of land (Object A)** | 13 | 0.2% |
| **The prevention of pollution (Object B)** | 6 | 0.1% |
| **The reduction of waste (Object C)** | 21 | 0.3% |
| **Public parks and public amenities (Object D)** | 6,007 | 77.2% |
| **Biodiversity conservation (Object DA)** | 1,094 | 14.1% |
| **The restoration of places of worship and historic buildings (Object E)** | 634 | 8.2% |
| **The provision of services to other EBs (Object F)** | 2 | 0.0% |

Source: ENTRUST, *http://www.entrust.org.uk/home/facts-and-figures*, last accessed 5th April 2013.

**Table A2-4:** Assumed Distribution of Total LCF

| Project Type | Assumed % of Total Funding |
|---|---|
| **The remediation of land (Object A)** | 1.0% |
| **The prevention of pollution (Object B)** | 0.2% |
| **The reduction of waste (Object C)** | 1.8% |
| **Public parks and public amenities (Object D)** | 79.2% |
| **Biodiversity conservation (Object DA)** | 12.7% |
| **The restoration of places of worship and historic buildings (Object E)** | 5.0% |
| **The provision of services to other EBs (Object F)** | 0.1% |

Source: Eunomia calculation based on ENTRUST data

## A 2.3 Benefits from LCF Projects

There is no study, as far as we are aware, of the benefits, in economic terms, of the LCF. Some case studies highlight benefits in a qualitative sense.

Other things being equal, it would seem most important to understand the benefits derived from those projects likely to receive most support. From the above analysis, these are projects in the following three areas (estimated to account for around 97% of funds committed to ongoing projects):

- Public parks and public amenities (79%);
- Biodiversity conservation (13%); and
- The restoration of places of worship and historic buildings (5%).

A further difficulty with trying to understand the types of benefits that may be derived from projects under each of these categories is that each category covers a diverse range of projects. Furthermore, some deliver benefits across categories.

In reality, the benefits of using funds in this way ought to be considered against the appropriate counterfactual, the most likely of which is that the funds simply find their way into the public purse. Generally, it is not considered to be sound fiscal policy to ear-mark tax revenues for specific purposes. Much of the rationale for this stems from the view that if the purposes for which revenue is ear-marked are appropriate for fiscal support, then that case should be made on its own merits. The corollary of this is that ear-marking might not always deliver an efficient outcome.

In the specific case under consideration here, there are some differences to conventional ear-marking:

- The funds are a limited proportion of the tax revenues generated;
- The award making body, or bodies, are independent of central government; and
- Since the tax credit is for 90% of the amount of funding offered, then it might be argued that the scheme leverages in (at least) 10% of the financial support made available through the LCF.

In principle, 2) could mean that the scheme gives better outcomes than in the case where a similar scheme was administered by the public sector. Equally, there are circumstances where the opposite might be the case since those schemes that are supported might be those which align with the interests of the funders. In respect of 3., the administrative costs may or may not be higher than they would be in the public sector.

Strictly speaking, it is difficult to make a clear judgement as to whether the net benefits (the benefits minus the costs) of the LCF are higher or lower than what might be achieved by allowing the money to accrue to the public purse. Evidently, the LCF would need to achieve something different, and more valuable, than what is achieved through public spending. It is, perhaps, of interest that public spending does already support projects in the main areas supported by the LCF (i.e. public parks and public amenities, biodiversity conservation and the restoration of places of worship and historic buildings). There may be some value derive from the local nature of the projects, and there may be value derived by landfill operators through the reputational utility attached to the funding of ‘good causes’, but these are difficult to estimate.

It could be that the restricted form of the availability of funds might actually reduce the average ‘net benefit’ which could be derived from an unrestricted (in terms of the radius from landfills within which schemes have to fall) scheme, although the analysis of disamenity would tend to indicate that most Scottish households could indeed fall under the scheme (though this does not imply, for example, that all possible biodiversity projects would be eligible under the scheme).

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Finally, the reality of some schemes may be that they simply replace public funding which might otherwise be required. In such cases, the argument that there is little additional benefit over and above what might be achieved in the absence of the scheme might appear more compelling. This depends, to a degree, on the extent to which public spending, at the margin, achieves outcomes which are better, or worse, than those related to the scheme.

### A.2.4 Summary

Given the uncertainties implied by the above discussion, we assume no net benefits over and above what might occur under general taxation. In principle, the additional benefits from leveraging in 10% of funds (the element over and above tax credits) are likely to be offset by the costs of administering the fund, at least to some degree. Consequently, we have assumed no net benefit relative to the counterfactual scenario of the fund accruing instead to the public purse.

## A.3 Disamenity Related to Waste Management

Disamenity, in the context of waste management, covers the localised nuisance associated with waste management activities, including visual intrusion, noise, the nuisance created by dust, odour, wind-blown litter, vermin and, potentially, the perception of increased health risks (although it might be argued that studies should seek, as far as possible, to exclude these from the analysis).

For the purposes of this analysis, the noise and congestion impact of waste trucks accessing the waste facilities is excluded. These are typically considered as part of transport-related externalities, and these are already internalised by fuel duty.

### A.3.1 Landfills

As with aggregates facilities, there are good arguments to believe that the externalities of landfill are, to a considerable degree, fixed, and related to the existence of the facility itself (consider, for example, the visual intrusion). This is worth consideration since, whilst, as we shall see, most studies seek to derive a dismaenity-related externality related to each tonne of waste, it may well be that the externalities are related more strongly to the number of sites in operation.

Disamenity studies typically resort to hedonic pricing or contingent valuation approaches. The former tend to be focused on econometric studies of variations in house prices associated with proximity to landfills, with the magnitude and statistical significance of the variable 'distance from a site' used as the basis for assessing the landfill's impact.

COWI, in work for the European Commission,[20] used the meta-analysis of Pearce and Brisson, relating house price reductions to proximity to a landfill.[21] The analysis was based on a number of studies and derived a linear function relating changes in the house price to the distance from the site (see Table A3-1).

[20] COWI (2000) A Study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste. Final Report to DG Environment, the European Commission, August 2000.

[21] Brisson, Inger, and David Pearce (1995) *Benefits Transfer for Disamenity from Waste Disposal*, CSERGE Working Paper WM 95-06, London: CSERGE.

**Table A3-1**: Effect of Distance from Landfill on House Prices

| Distance from the site | House Price Reduction (in %) |
|---|---|
| **0** | 12.8% |
| **1** | 9.0% |
| **2** | 5.2% |
| **3** | 1.4% |
| **3.4** | 0% |

Cambridge Econometrics and EFTEC carried out a major hedonic pricing study which estimated the disamenity associated with landfilling.[22] This was based upon a hedonic pricing study, examining the effect of proximity to landfills on house prices. The Enviros and EFTEC study updated the estimates from the previous study (inflating the estimates in line with house price inflation), giving a range for landfill disamenity of between £2.50 and £3.59 per tonne.

The study analysed 11,300 landfill sites in Britain (of which, 6,100 were operational) and 592,000 mortgage transactions (containing information on house prices, housing characteristics and location) during the period 1991-2000. Regressions were performed on a county-by-county basis to help separate different property markets across Britain. The study found firm evidence of a statistically significant fixed disamenity impact at the aggregate British level, though this is statistically significant only within a half-mile of a landfill site. However, there was found to be significant variation across individual regions. Of particular interest for this study is that the results for Scotland saw house price reductions of 41.3% within a 0.25 mile radius of the landfill, compared to a British average of 7%. The effect on house prices was a reduction of 7.73% for the interval 0.25-0.5 miles (2% for GB), a reduction of 3.01% in the interval 0.5-1.0 miles, a reduction of 2.67% in the interval 1.5 to 2.0 miles in the interval beyond 2 miles. The study also noted that the Scottish housing market was stable in the period concerned and suggested that this made the effects easier to discern.

The unit disamenity was derived in the study by calculating the 95% confidence interval estimate of the present value of the fixed disamenity effects of landfill and estimating the disamenity per tonne under assumptions regarding the average flow of waste over a specified lifetime, and a specified discount rate.

The study also indicated a “life cycle” effect whereby disamenity costs tend to be highest around the opening of new sites and level off after some time when local residents adjust to the presence of the landfill. For properties at distances up to or equal to 1 mile from a landfill site in England and Wales, house prices were about 10% lower for sites that have opened within the last ten years relative to sites that have been operational for 20 – 30 years.

[22] Cambridge Econometrics in association with EFTEC and WRc (2003) *A Study to Estimate the Disamenity Costs of Landfill in Great Britain*, London:Defra, February 2003.

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Another study, Bartelings *et al.* (2005), used benefit transfer from this Cambridge Econometrics study in order to achieve appropriate Dutch values. They took the headline result from the UK - £2.50 to £3.59 per tonne of waste (in 2003 sterling) – and adjusted it for currency, income and housing density differences. See Bartelings *et al.* (2005, p. 91) for details. The figures thus adjusted, they found that the disamenity costs per tonne of landfilled waste in the Netherlands might be 39 percent to 50 percent larger than for the UK average.

ESRI used an approach based on that of Cambridge Econometrics came up with a much higher figure for the disamenity from landfill (€10.64 to €21.29 per tonne). The approach followed is described below:

1 Current average house prices (from the Permanent TSB/ESRI House Price Index) were disaggregated into county averages using the most recent data on relativities at the time (for 2006). The effects of a 7% and 2% reduction in prices for each county was then estimated (these being the reductions suggested by Cambridge Econometrics' work for houses within a 0.25 mile radius of the site, and in the ring between circles of radii 0.25 and 0.5 miles from the site).
2 Using the An Post Geodirectory and GIS software, the number of active residential addresses located within specified distances of the boundaries of existing landfills was identified. The number of houses was multiplied by the average estimated reductions calculated in the first step;
3 A total fixed disamenity value was thus estimated to be €215,000,000 for Ireland (see Table A3-2).
4 Adjusting for waste landfilled and the rental yield on the fixed (or capital) value, this produced an annualised disamenity value of €10.64-21.29 per tonne.

Step 4 in the calculation appears only to have considered waste landfilled over one year. As such, notwithstanding other issues related to benefits transfer, this appears to overstate the externality per tonne, noting that a given site might accept material over a period of several years (the derivation of the unit disamenity figure is quite different to the Cambridge Econometrics approach, which seems more reasonable to us).

**Table A3-2:** Calculation of Landfill Disamenity in Ireland

| Distance from landfill | % reduction in price | Number of Houses | Fixed Disamenity Value (2009€) |
|---|---|---|---|
| **0-0.25 miles** | -7.06 | 6,466 | 120,000,000 |
| **0.25-0.5 miles** | -2.00 | 17,984 | 95,000,000 |
| **Total** | | 24,450 | 215,000,000 |

A study by Ham et al found that the discernible impact of active and historical landfill sites on house prices extends over a different geographical range: 0-3 km for active landfill sites and 0-1 km for historical landfill sites.[23] Importantly, they found that historical landfill sites continue to depress property prices more than 20 years after their closure.

The work by Ham at al also suggested that compared to the Cambridge Econometrics work, the average reduction in property prices due to landfill disamenities was of the order 2.6 percent within 3 kilometres, rather than the 7 percent reduction within 0.25 miles and further 2 percent reduction within 0.25-0.5 miles of operational landfills. In essence this suggests a moderate impact over a larger area, or as the authors put it:

[23] Yun Ham, David Maddison and Robert Elliott (ud) The Valuation of Landfill Disamenities in Birmingham.

*whereas our estimates point to a reduction of 2.6 percent over an area of 28.3 km2 the Cambridge Econometrics et al. (2003) study suggests a reduction of 7 percent over an area of 0.5 km$^2$ and a reduction of 2 percent over a further area of 1.5 km$^2$.*

Their estimates for the effect from historical landfill sites, for which no United Kingdom based comparator studies are available, indicate an impact of 2.4 to 3.4 percent over a geographical area of 3.1 km$^2$ depending on how long ago the landfill closed.

### *A.3.1.1 Our Estimate*

For the purposes of this study, like many other studies, we have chosen to base the estimate on the Cambridge Econometrics work. However, we have used the house price reductions relevant for Scotland only. As noted above, these give higher levels of reduction than for the UK as a whole, reflecting what (at the time) was a tendency for Scottish landfills to be located in areas of higher housing density than in the UK as a whole.

**We have not gathered new data concerning the proximity of Scottish households to landfills and have used the figures from the original Cambridge Econometrics study, which are as shown in Table A3-3. Evidently, the figures may have changed considerably over time as new landfills may have opened and old ones may have closed. Furthermore, the number of dwellings has increased since the time when the original study was conducted. The latest data suggests there are 2,360,000 dwellings in Scotland, split according to**

Table A3-4. It would be unusual for new housing to be developed in close proximity to landfills, though that being said, one might have imagined the same with regard to the pre-existing housing stock. Nonetheless, this clearly limits the validity of the analysis.

**Table A3-3:** Distribution of Dwellings in Scotland According to Distance from Landfill

| Distance from Landfill (miles) | % of Dwellings |
|---|---|
| **0-0.25** | 5.3% |
| **0.25-0.5** | 14.9% |
| **0.5-1.00** | 35.1% |
| **1.50-2.00** | 35.1% |
| **>2.00** | 9.6% |

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**Table A3-4:** Nature of Dwellings in Scotland

| Dwelling type | Proportion of total dwellings |
|---|---|
| **Flats** | 38% |
| **Terraced** | 21% |
| **Semi-detached** | 20% |
| **Detached** | 21% |
| **Unknown** | 1% |

**One would expect the price of a property, and perhaps, the average price also, to vary according to the nature of the dwelling (as set out in**

Table A3-4). Ideally, one would understand the value of properties in relation to their location relative to a landfill. No such data has been gathered for this study. We have taken, therefore, the average value for a Scottish dwelling to be £153,501.[24]

**The total disamenity from landfills has been calculated assuming the above housing distribution and the house price reductions found to be applicable to Scotland from the Cambridge Econometrics study (see**

Table A3-5).

**Table A3-5:** Calculation of Total Disamenity from Scottish Landfills

| Distance from Landfill | Proportion of Dwellings in Given Radius | Reduction in Dwelling Value from Landfill | Contribution to Total Disamenity |
|---|---|---|---|
| **0-0.25** | 5.30% | 41.30% | £7,929,560,798 |
| **0.25-0.5** | 14.90% | 7.73% | £4,172,429,184 |
| **0.5-1.00** | 35.10% | 3.01% | £3,827,338,060 |
| **1.50-2.00** | 35.10% | 2.67% | £3,395,014,159 |
| **>2.00** | 9.60% | | |
| **TOTAL DWELLINGS** | 2,360,000 | | |

[24] See http://www.ros.gov.uk/pdfs/ros_statistical_report_apr-jun2012.pdf.pdf .

| | | |
|---|---|---|
| **TOTAL PRESENT VALUE OF DISAMENITY** | | £19,324,342,201 |

The present value of disamenity was converted to a unit disamenity value (£ per tonne) on the basis of the following assumptions:

1 The present value was converted to an annuity on the basis of a 25 year period and a discount rate of 6% (above the social discount rate and reflecting the higher time preference for money likely to be expressed by householders); and
2 The annualised value was converted to a unit value on the basis of amounts currently being landfilled.

This gave a central figure of £22.90 per tonne.

Evidently, this value is based on a number of assumptions, the accuracy of which could only be tested through more detailed analysis. It also relies upon the validity of the approach to benefits transfer applied to derive the total disamenity value. Notwithstanding these assumptions, within the available time and resources for the study, the values derived reflect approaches applied in earlier studies.

It should be noted that we conducted a similar analysis using the more recent assumptions from the Ham et al paper, and using the same distribution of dwellings according to distance from landfills. This leads to a figure of £10.90 per tonne for the disamenity. It should be noted, however, that the Ham et al study was based on analysis in an area which, in the Cambridge Econometrics study, was fairly representative of the UK as a whole. If the Scottish situation is prone to deliver higher disamenity values, it might be expected that the Ham et al study would deliver lower values than might prevail in Scotland.

### A.3.2 Incineration

The Kiel and McClain study is one of relatively few hedonic price studies of incineration available in the literature. It examined the impact of an incinerator in North Andover, Massachusetts, over the course of its lifetime (from the pre rumour stage, through to the rumour stage, through the construction phase, the online phase, and later years of operation).[25]

By looking at a dataset spanning 19 years and 2,593 house sales, they concluded that the impact of an undesirable land use on house prices is not constant over time. Their study suggests that house prices increase by 1.7 – 2.3% per mile away from the incinerator (and only in the final three stages). Because of the nature of the regression they performed (double log regression), it was impossible to isolate a point when disamenity impact stops, but during the last three phases - the only stages where they found price changes to be statistically significant - the maximum distance effect is reached at roughly 3.5 miles (5.6km).

[25] Kiel, K.A., and McClain, K.T. (1995), House Prices during Siting Decision Stages: The Case of an Incinerator from Rumour through Operation. *Journal of Environmental Economics and Management* 28, 241-255.

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COWI, in work for the European Commission, used the meta-analysis of Pearce and Brisson, relating house price reductions to proximity to a landfill, and assumed the same relationship applied to houses located near incinerators.[26] COWI used a population density around the typical incinerator of 120 per square mile. Yet incinerators are rarely located in such sparsely populated areas.

Eunomia et al suggested that the population densities are typically an order of magnitude larger. They suggested if COWI had used a figure of 1,200 households per square mile (469 per square kilometre), the values derived for a 200,000 tonne site, with the annual disamenity being set at 8% of the total, is around €75 per tonne. On the basis of this, they suggested that the importance of the housing density should not be under-estimated in the modelling of incinerator-related disamenity, and that further work was urgently needed in this area.[27]

It is clear that both the COWI and Eunomia studies derived figures which were dependent upon the transferability of a relationship derived for landfills to the incinerator context. Neither study used the disamenity estimate derived in their ultimate analysis. It seems possible, however, that disamenity values could be considerable for these facilities.

Bartelings *et al.* used Kiel and McClain's study and using some specific geographic information on housing levels to make their figures more realistic, they found that starting at 5.5 km from the site, the house price drops by approximately €9,500 (2005 prices) with every kilometre approaching the incinerator. The study estimated minimum and maximum values for disamenity of €9.1 - €9.9 per tonne (approx £6.50-7.00 per tonne).

Enviros and Eftec also interpret Kiel and McClain.[28] By adjusting for inflation and currency they calculate a value of £21 per tonne of waste incinerated (in 2003 sterling). However, they opted not to use the figure. At one level, the decision not to use the study's findings was understandable. It was, after all, carried out in the United States and the transferability of the results would be questionable. However, the reasoning given is interesting. It was noted:

> *'When this [the disamenity from the incinerator] is compared to the average disamenity cost of landfill from the Defra study of between £551,000 to £789,000 when converted to 2003 prices using house price index changes, the results of Kiel and McClain seem disproportionately large. For this, and also given the fact that the study is from the US, this estimate is not recommended for use in the UK context'.*

The reasoning suggests a normative view as to how the results should look, which somewhat discredits the reasoning itself. This view is also very different to that taken by Bartellings et al:[29]

> *Given these findings, we assume that the disamenity effects differ between landfilling and incineration. First, the reduction in house prices seems to be more pronounced with incineration. This may be due to the fact that incineration is mainly disliked because of the perception of air pollution. In the Netherlands, since the negative publicity of the emissions of the highly toxic dioxins in the early 1990s, people are more reluctant to live near an incinerator. Even if the legal standards are met, the fear will not disappear immediately. Second, due to the importance of air emissions and the height of the stack, the impact area of an incinerator is significantly larger than the area affected by a landfill site. Therefore, the area of affected houses around the landfill site is limited*

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[26] COWI (2000) A Study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste. Final Report to DG Environment, the European Commission, August 2000.

[27] Eunomia Research & Consulting, Scuola Agraria del Parco di Monza, HDRA Consultants, ZREU and LDK ECO on behalf of ECOTEC Research & Consulting (2002) *Economic Analysis of Options for Managing Biodegradable Municipal Waste*, Final Report to the European Commission.

[28] Enviros and EFTEC (2004) *Valuation Of The External Costs And Benefits To Health And Environment Of Waste Management Options* Final Report for Defra, December 2004.

[29] Bartelings, H., P. van Beukering, O. Kuik, V. Linderhof, F. Oosterhuis, L. Brander and A. Wagtendonk (2005) *Effectiveness of Landfill Taxation*, R-05/05, Report Commissioned by Ministerie von VROM, November 24, 2005.

> *to a buffer of 1 kilometre around the site. The impact area of incinerators in the Netherlands is assumed to reach as far as 5 kilometres from the actual site.*

A French study carried out a contingent valuation study to assess disamenity at incineration plants.[30] The authors of this study created surveys based on three different scenarios for local residents living near a modern incinerator. They concluded that the best range to use for WTP was €40-54 per household per year over ten years and referred to WTP to close the incinerator (the sample number equalled 465 people who lived within 2km of the incinerator). They multiplied this by the number of households in the affected zone to get a total cost for the disamenity (in their case €311,000-420,000 per year). This was divided by the amount of waste the incinerator dealt with (85, 000 tonnes) to get a final range of €3.7-4.9/tonne waste incinerated. The study suggested that these levels were likely to include some estimate (from residents) of the impacts of air pollution. Consequently, it hinted that these might be high estimates for externalities related to disamenity alone. The *relatively* low value in the French study (compared with other estimates) may be explained by the fact that the incinerator chosen for the study was in an area of relatively low population density (3km from a city of 50,000 inhabitants), dealing with 85,000 tonnes from 52 communes. As such, the disamenity per tonne of waste might be lowered by the relatively low density of housing stock affected by the facility.

Another French study is worth reporting. Rabl et al intended to carry out a contingent valuation study in France, however, these plans did not materialise:

> *Initial plans of our research project had been to carry out a contingent valuation in France. However, at none of the sites suitable for a case study were the authorities willing to let us survey the opinions of the population. The projects were too controversial, and the authorities were afraid of anything they perceived as potential outside interference.*[31]

The authors went on to explore attitudes of households to different cost and benefit profiles in an area where facilities were still being discussed.

ESRI adopted a questionable approach by taking the WTP estimates from the French study without inflating them and applying these to proposed incinerators in Ireland but using only a 2km radius as the area of influence. Their results are presented in Table A3-6 below. The average figures are €3.27 - €3.92 per tonne, but this appears to be based on households in an area only 44% of that which might be influenced by the presence of the facility. The results for individual facilities were €4.22-€5.07 for Poolbeg and €0.42 - €0.50 for Carranstown, the former being in the more densely populated area.

[30] O. Arnold and S. Terra (2006) *Consentement Local a Payer et Localisation d'un Incinerateur*, Serie-Etudes 05-E10, Ministere de l'Ecologie et du Developpement Durable.

[31] A. Rabl et al (1999) Impact Assessment and Authorization Procedure for Installations with Major Environmental Risks, Contract ENV4-CT96-0236, DG XII European Commission, July 1999.

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**Table A3-6:** Disamenity due to Incineration, per tonne, Ireland, 2009

| | Low Range | | High Range | | Average | |
|---|---|---|---|---|---|---|
| **Discount Rate** | 10% | 5% | 10% | 5% | 10% | 5% |
| **Total Fixed Disamenity (2009€)** | 2,230,000 | 2,670,000 | 3,010,000 | 3,610,000 | 2,620,000 | 3,140,000 |
| **Disamenity/tonne incinerated 120** | 2.78 | 3.34 | 3.76 | 4.51 | 3.27 | 3.92 |

Source: ESRI

Some land agents / estate agents have conducted surveys based on a willingness to pay concept. Few of these are reliable as few consider counterfactuals (or control for influential variables in any other way).

### *A.3.3.1 Approach in this Study*

In our view, it would be reasonable to expect significant disamenity from incinerators as measured through hedonic pricing for the simple reason that the density of housing stock is likely to be greater around incinerators than around landfills. Quite how the disamenity effects of incineration, as measured through contingent valuation approaches, would compare with landfill in the UK is still unclear (and likely to vary with location).

To the extent that population densities are important, the fact that incinerators are usually in urban or peri-urban locations would suggest that the disamenity would be larger (simply because more households would be affected). On the other hand, we have only limited knowledge from studies seeking to elicit the disamenity associated with municipal waste incineration so do not know the speed at which the disamenity experienced falls with distance (and whether it varies with capacity, and if so how?). Brisson and Pearce suggest 4 miles as the domain of influence for landfills. It could be that this is less in the case of incinerators, though the Dutch study cited above assumed it was 5km.[32] It could also be the case that where residents derive some benefit from the facility (such as heating), this might affect their perception of the facility, at least as expressed through willingness to pay, though the impact observed through hedonic pricing might be somewhat less. Defra has committed, in the past, to investigate the matter but to our knowledge, no such research has been forthcoming.

For the purposes of this study, and recognising that there are relatively few incinerators in Scotland, we have opted to choose a nominal figure for incinerator disamenity of £6 per tonne.

## A.3.3 Mechanical Biological Treatment (MBT)

We are not aware of any studies on disamenity conducted for MBT facilities.

[32] Brisson, Inger, and David Pearce (1995) *Benefits Transfer for Disamenity from Waste Disposal*, CSERGE Working Paper WM 95-06, London: CSERGE.

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