



An Economic Assessment of Waste Crime Enforcement in Scotland

A report submitted to the Scottish Environment Protection Agency as part of the Scotland's
Environment Web LIFE+ project

November 2014.

Prepared by Katherine Simpson and Frans P. de Vries

Stirling Management School

Division of Economics

University of Stirling

OFFICIAL

Executive Summary

Environmental crime is the breaking of environmental law by individuals or companies who carry out activities which could have an impact on the environment. Environmental crimes include unlicensed waste operations including transport, storage, treatment and disposal, illegal discharges to the water environment, unauthorised abstractions and illegal emissions to air. In March 2014, Eunomia estimated that waste crime costs the UK economy £567.9 million per year and tax evasion, through the misclassification of waste is thought to cost the HMRC an estimated £157 million per annum. In England and Wales, the Environment Agency spent £17 million tackling waste crime in 2012-2013. With new enforcement powers provided by the Regulatory Reform (Scotland) Act, it is important to understand whether these new powers will be cost-effective and what the likely benefits of increased enforcement are. This report addresses both aspects.

Part 1 of the report provides an introduction to cost-effective and benefit-cost analysis and illustrates how these tools could be applied to compare four enforcement actions for waste crime: inspections, final warning letters, notices and referrals to the Procurator Fiscal. Recommendations include additional reporting of the four enforcement actions and detail of the waste streams affected.

Part 2 of the report applies the benefit-cost analysis method to determine the costs and benefits of waste crime enforcement for three separate Scottish case studies. Applying the Eunomia model developed for waste crime in England and Wales, **the return per pound spent on enforcement and monitoring for three case studies was calculated.** The benefit-cost ratios of 16:1 and 31:1 were significantly higher than the Eunomia ratio of 4:1. These values in the current report offer a different perspective to the Eunomia report, and identify the issues posed by the most serious sites. It is recognised that one of the limitations when applying the Eunomia model to the Scottish case studies is the fact that the waste has remained at the illegal waste site (IWS) has not yet been removed. However, the benefit-cost ratio is still useful and provides an indication of the benefits that accrue from closing the IWS and re-diverting all future waste into the legal waste stream. The fundamental recommendation of this report is to develop a systematic data collection for waste crime enforcement actions. This should include detailed recording of enforcement actions at a given site and significantly more detail on the actual waste at sites and waste streams.

Benefit-Cost Analysis of Two Scottish Case Studies

| | Case Study 1 | Case Study 2 |
|-------------------------------------|--------------|--------------|
| Government Benefits | £8,208,683 | £976,327 |
| Business Benefits | £123,906 | £17,763 |
| Environmental Benefits | £945,403 | £132,801 |
| Costs | £615,856 | £35,793 |
| Government Benefit - Cost Ratio | 13:1 | 27:1 |
| Overall Benefit - Cost Ratio | 16:1 | 31:1 |

Contents

| | |
|--|----|
| Executive Summary | 3 |
| Contents | 5 |
| Glossary..... | 6 |
| Introduction | 8 |
| Waste Crime in Scotland | 9 |
| Part 1: Measuring the Success of Waste Crime Interventions | 11 |
| Introduction | 11 |
| Measuring Programme Success: Cost Effective Analysis and Cost Benefit Analysis | 13 |
| Recommended Method..... | 14 |
| Recommended Analysis..... | 18 |
| Summary and Recommendations | 20 |
| Part 2: Costs and Benefits of Waste Crime Enforcement in Scotland – Case Study Application | 21 |
| Introduction | 21 |
| Eunomia Methodology and Relevant Extensions for the three Scottish Case Studies | 23 |
| Model Application and Results | 27 |
| Case Study 1 | 27 |
| Case Study 2 | 29 |
| Case Study 3 | 31 |
| Discussion | 38 |
| Conclusion and Key Recommendations | 41 |

Glossary

Benefit-cost analysis: An economic method developed to identify and express in monetary terms all the effects of a proposed policy or project. The analysis involves comparing the total expected cost of each option against the total expected benefits. A benefit-cost ratio is calculated by dividing the expected benefits by expected costs. The ratio can be used to compare different projects to offer an insight into which offers the best rate of return. Whilst it is not intended to be the only basis for decision making, benefit cost analysis can be a valuable aid to policymakers.

Compliance: An assessment by SEPA of licence conditions pertaining to licence holders to ensure that the conditions of their licence are being met.

Cost-effective analysis: An economic method to compares the relative costs and outcomes of two or more courses of action. Cost-effectiveness analysis is distinct from benefit-cost analysis as it does not assign monetary values to the measure of effect.

Gate fee: This is the charge levied upon a given quantity of waste received at a waste processing facility. In the case of a landfill it is generally levied to offset the cost of opening, maintaining and eventually closing the site. It may also include any Landfill Tax which is applicable in the region. The organisation WRAP provides information on Gate Fees in the UK.

Illegal waste site (IWS): An illegal waste site (IWS) is a site operating without the appropriate permit for the activity being carried out where multiple loads of waste are deposited, treated, stored or disposed of, and where the activity is, or appears to us to be, taking place in an organised manner.

Materials recovery facility (MRF): A Materials Recovery Facility (MRF) is where recyclable materials that are collected from households are sorted into different types using a mixture of manual and automated methods.

Net Present Value (NPV): Net present value (NPV) is a calculation used to estimate the value of a project over the project lifetime. The formula for NPV requires knowing the likely amount of time (t , usually in years) that cash will be invested in the project, the total length of time of the project (N , in the same unit of time as t), the interest rate (i). The HM Treasury Green Book recommends a discount rate of 3.5% to be applied when calculating NPV.

Sensitivity analysis: This is used to determine how different values of an independent variable will impact a particular dependent variable under a given set of assumptions. Independent variables may include the discount rate, interest rate and project timescale.

Waste crime: An act or omission which directly or indirectly damages the environment (or has the potential to damage the environment) and which constitutes a breach of criminal law.

Waste stream: The waste stream is the complete flow of waste from domestic or industrial areas through to final disposal.

Introduction

Environmental crime is the breaking of environmental law by individuals or companies who carry out activities which could have an impact on the environment. Environmental crimes include unlicensed waste operations including transport, storage, treatment and disposal, illegal discharges to the water environment, unauthorised abstractions and illegal emissions to air¹. Illegal waste crime operations include: illegal landfill sites; unlicensed skip hire operators; large scale and persistent dumping of waste; unlawful collection, storage and breaking of scrap cars; unauthorised collection, storage and export of waste electrical and electronic equipment. Waste sites are defined as illegal if they do not have a permit or meet other legal requirements. Breaching these requirements can lead to pollution and nuisance and companies can be fined for this; for example in 2012 one firm was fined £10,500 for failing to stop offensive odours that were detected off-site². Permits are issued by the national regulator and charges cover the costs of issuing and regulating the permits.

In March 2014, Eunomia estimated that waste crime costs the UK economy £567.9 million per year³. Operating an illegal waste site (IWS) has many financial benefits for the criminal including lack of licensing costs, landfill specific costs, remediation costs and tax evasion. Tax evasion, through the misclassification of waste, is thought to be a significant source of revenue loss for the HMRC, with an estimated £157 million lost per annum in the UK⁴. Other losses to the HMRC include Corporation Tax

¹ SEPA (2013) SEPA Enforcement Report 2012-2013. Online:
http://www.sepa.org.uk/about_us/publications/enforcement_reports.aspx. Accessed 12/20/2014.

² SEPA (2013) SEPA Enforcement Report 2012-2013. Online:
http://www.sepa.org.uk/about_us/publications/enforcement_reports.aspx. Accessed 12/20/2014.

³ Eunomia (2014) Waste Crime, Tackling Britain's Dirty Secret. Online:
http://www.esauk.org/esa_reports/ESAET_Waste_Crime_Tackling_Britains_Dirty_Secret_LIVE.pdf. Accessed 12/10/2014.

⁴ Eunomia (2014) Waste Crime, Tackling Britain's Dirty Secret. Online:
http://www.esauk.org/esa_reports/ESAET_Waste_Crime_Tackling_Britains_Dirty_Secret_LIVE.pdf. Accessed 12/10/2014.

and employment related contributions. Waste crime can also create uncertainty for legal operators due to reduced gate fees and, subsequently, loss of revenue and profit.

Waste Crime in Scotland

The Scottish Environment Protection Agency (SEPA) is the national regulator and responsible for ensuring compliance with environmental legislation. For the 2013/2014 financial year, SEPA estimated the financial benefit for waste crime criminals was £27 million⁵. Further to this, it is estimated that 20% of serious organised crime groups are related to the waste sector, based on licensing data and SEPA case reporting⁶. At the start of 2014 a new Waste Crime Team within SEPA was launched to lead investigations directed at tackling the most serious offenders, working in partnership with law enforcement agencies (e.g. Police Scotland) to identify and disrupt serious waste crime, including that associated with organised crime, identified within the waste sector.

In England and Wales the Environment Agency spent £17 million tackling waste crime in 2012-2013 and it is important to understand whether this spending effort is effective at reducing waste crime. In 2014, Eunomia estimated that the 10 year benefit to cost ratio associated with tackling waste crime is between 4:1 and 6:1 (using Environment Agency data).

⁵ SEPA (2014) Justice Committee -Environmental crime and serious organised crime. [Online] Accessed 15/12/2014.

http://www.scottish.parliament.uk/S4_JusticeCommittee/Inquiries/EC3_SEPA.pdf

⁶ SEPA (2014) Justice Committee - Environmental crime and serious organised crime. [Online] Accessed 15/12/2014.

http://www.scottish.parliament.uk/S4_JusticeCommittee/Inquiries/EC3_SEPA.pdf

Report Aims

With new enforcement powers provided by the Regulatory Reform (Scotland) Act 2014, it is important to understand whether these new powers will be cost-effective and what the likely benefits are.

- Part 1 of this report provides an introduction to cost-effective and benefit-cost analysis and how these tools could be applied to compare four regulatory actions for waste crime: site inspections, warning letters, notices and referrals to the Procurator Fiscal.
- Part 2 of the report applies the benefit-costs analysis method to determine the costs and benefits of waste crime enforcement for three separate case studies. To foster transparency in and transferability of cost-effectiveness analyses in the future, this also includes recommendations for improving data collection and reporting by SEPA.

Part 1: Measuring the Success of Waste Crime Interventions

Introduction

The Scottish Environment Protection Agency (SEPA) is responsible for issuing licenses to waste management sites. The majority of waste management sites are licensed under the 1994 Waste Management Licensing Regulations. The objective of the waste management licensing system is to ensure that waste management facilities do not cause pollution of the environment, cause harm to human health or become seriously detrimental to the amenities of the locality⁷. From the regulator's perspective, tax does not currently feature in compliance assessment.

SEPA is an enabling organisation and will seek, according to its policy, to engage, encourage and inform so as to encourage compliance. Where appropriate, however, enforcement will be elevated through a number of stages. Where breaches of the law arise, SEPA will undertake enforcement action in a proportionate manner. In pursuing compliance with environmental legislation, SEPA may use a variety of tools including⁸:

- *Discussion:* Advice may be given on compliance with environmental legislation at meetings and in subsequent written correspondence.
- *Advisory/ warning letters:* These letters are often issued to require action following a site visit where environmental harm can be prevented.

7 SEPA. Waste Management Licence Application Forms [Online]

http://www.sepa.org.uk/waste/waste_regulation/application_forms/waste_management_licence.aspx . Accessed 21/10/2014.

8 SEPA. SEPA Policy Statement on Enforcement Polic Number 5 [Online]

http://www.sepa.org.uk/about_us/policies.aspx . Accessed 21/10/2014.

- *Final warning letters*: These letters are used when there is an obvious breach of environmental legislation or licence conditions which requires immediate action or where there are repetitive breaches of environmental legislation or licence conditions.
- *Notices*: A formal notice may be served by SEPA that requires compliance.
- *Referrals to the Procurator Fiscal*: SEPA can recommend to a Procurator Fiscal that a case be brought. Prosecution will be recommended only where it can be justified in order to punish offenders, to avoid a recurrence and/or to encourage improved compliance with the law.

Table 1 provides an overview of regulatory actions for waste crime in Scotland between 2009 and 2013. The number of referrals to the Procurator Fiscal remained relatively stable over time, although there was a small decrease in the number of convictions in 2012-2013. Total and average fines vary from year to year. As noted in the SEPA 2012-2013 enforcement report, the figures tend to fluctuate each year, which make it difficult to reach a conclusion on cause and effect⁹.

Table 1: Summary of regulatory actions for waste crime in Scotland 2009 – 2013¹⁰

| | 2009-2010 | 2010-2011 | 2011-2012 | 2012-2013 |
|---|-----------|-----------|-----------|-----------|
| Referrals to the Procurator Fiscal | 16 | 17 | 20 | 21 |
| Notices | 37 | 34 | 56 | 47 |
| Warning Letters | 58 | 68 | 74 | 42 |
| Convictions | 18 | 13 | 13 | 9 |
| Total Fines | £42,602 | £109,930 | £42,251 | £220,402 |
| Average Fine | £2,506 | £10,993 | £3,841 | £31,486 |

9 SEPA (2013) SEPA Enforcement Report 2012-2013. Online:

http://www.sepa.org.uk/about_us/publications/enforcement_reports.aspx. Accessed 12/20/2014.

10 Table compiled from SEPA enforcement reports readily available online. SEPA. SEPA Enforcement Reports. [Online] http://www.sepa.org.uk/about_us/publications/enforcement_reports.aspx Accessed 21/10/2014.

It is crucial for SEPA to understand the cost-effectiveness associated with the four regulatory tools — inspections, final warning letters, notices and referrals to the Procurator Fiscal — and to determine whether they are having a higher dividend return compared to the costs invested in waste crime monitoring and enforcement. **The aim of Part 1 of this report is to recommend a data collection strategy and method to assess the relative cost-effectiveness for a variety of regulatory actions against waste crime in Scotland.**

Measuring Programme Success: Cost - Effective Analysis and Benefit - Cost Analysis

Two of the most common approaches for programme evaluation are cost-effectiveness analysis and benefit-cost analysis. Cost-effective analysis considers the different cost inputs to produce a specific outcome or set of outcomes. The project which produces the preferred outcome at the lowest cost is considered the most desirable from a cost-effective analysis perspective. For example, if the objective is to determine the cost per pollution incident avoided (cost per outcome) the calculation would require a quantification of the cost and volume of inputs required to result in the avoidance of the pollution incident. Examples of inputs include site inspections and associated staff costs. For comparisons between alternate waste crime interventions, the interventions must share a common outcome and be measured on a common basis.

Benefit-cost analysis extends cost-effective analysis by attaching monetary values to the outcomes of a programme. After the cost of inputs and benefits of the outcome have been quantified in monetary terms, a comparison of alternate interventions can be made. The result is expressed in terms of a benefit-cost ratio which is calculated by dividing the monetary value of outcomes by the monetary value of the input costs.

Recommended Method

The focus of this methodology is to outline a robust data collection strategy for waste crime interventions that allows a cost-effective analysis to be undertaken at a later date. Measurement of programme success based on outcomes can be considered robust as long as these outcomes can be quantified and compared to a baseline position. The establishment of a baseline position is one of the most fundamental components of being able to measure the impact of an intervention as actions move from the baseline (or current) position to the outcome. *“Where financial impact is being used as a measurement of success or cost effectiveness, data on costs needs to be collected in a systematic way as to enable comparisons to be made at the evaluation stage”¹¹*. The recommended data collection process for future cost-effective analysis is detailed in Table 2.

First and foremost, a clear understanding of the regulatory process is required in order to determine the input cost and direct outcomes for each regulatory action. Sites are first inspected by SEPA where they will be deemed to be compliant or non-compliant within the relevant licensing conditions. Where sites are compliant no further action is taken. If sites are deemed to be non-compliant sites will first receive warning letters, followed by statutory notices and if they choose to remain non-compliant the case can be referred to the Procurator Fiscal. Only at the point of conviction do non-compliant sites face being fined. For letters and notices there is no fine if the site chooses to continue to be non-compliant, but sites will face a cost of cleaning up their operations (environmental limit cases) or will have to improve their reporting or plant infrastructure (management cases). It is worth noting that in the case of severe crimes, a referral to the Procurator Fiscal will be the starting point for regulatory

¹¹ DG Environment (2000) A Study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste. [Online]
http://ec.europa.eu/environment/waste/studies/pdf/econ_eva_landfill_report.pdf

action. Additionally, from 2015, SEPA will have new powers under the Regulatory Reform Act to issue monetary penalties rather than engage in the enforcement process outlined in this section.

Table 2: Data collection requirements

| Regulatory Action | Summary | Data Required |
|-------------------------------|---|--|
| Stage 1: Inspection | <p>The starting point of the regulatory process is inspection. In 2013/2014 SEPA conducted 3174 visits and some sites are visited more often than others, especially if compliance is poor. Each site is assessed at the beginning of the year and has a predetermined number of inspections allocated against it. The benefits to SEPA of a compliant site are the avoided costs associated with poor environmental management and pollution incidents. The costs to SEPA are those associated with the site inspections, for example staff time and vehicle hire.</p> | <ul style="list-style-type: none"> • The number of sites which were inspected, the date of inspection and the outcome of inspection (compliant or not). In the case of non-compliance what was the reason. Additional information on why the site was chosen to be visited (if visited more than once) or if it was visited randomly. • The amount of waste and waste stream type (i.e. landfill inert or non-inert, recyclable etc) for each site. • Total costs associated with inspecting the sites (divided into those sites which were compliant and non-compliant). |
| Stage 2: Final warning letter | <p>Following inspection, non-compliant sites will receive a warning letter. At this point the firm can either choose to become compliant or choose to ignore the letter and receive a statutory notice. Benefits to SEPA would be the firm becoming compliant and the avoided costs associated with the compliance. Costs include time and staff costs of issuing the notice.</p> | <ul style="list-style-type: none"> • The number of sites which received a final warning letter, date the warning letter was received, the outcome of the letter (return to compliance or not) and what type of incident the letter was in relation to (pollution or management breach). • The amount of waste and waste stream type (i.e. landfill inert or non-inert, recyclable etc) for each site. • Total costs associated with issuing the final warning letter for each site. • An estimate of the time it took from the site from receiving the final warning letter to it becoming compliant. • An assessment of the impact arising from the breach in licensing e.g. scale |

OFFICIAL

| | | |
|----------------------------|---|---|
| | | and type of pollution incident. |
| Stage 3: Statutory notice | Those firms which ignore the final warning letter go on to receive a statutory notice. Again a firm can choose whether to become compliant or ignore the notice with a threat of being referred to the Procurator Fiscal. Benefits to SEPA would be the firm becoming compliant and the avoided costs associated with the compliance. Costs include time and staff costs of issuing the notice. | <ul style="list-style-type: none"> • The number of sites which received a statutory notice, date the notice was issued to the site, outcome of the notice (return to compliance or not) and what type of incident it the notice was in relation to. • The amount of waste at the site and waste stream type for each site. • Total costs associated with issuing statutory notices for each site • An estimate of the time it took from the site receiving the notice to becoming compliant. • An assessment of the impact arising from the breach in licensing e.g. scale and type of pollution incident. |
| Stage 4: Procurator Fiscal | If a firm does not take appropriate action on the previous communication and chooses to remain non-compliant SEPA can refer the case to the Procurator Fiscal. | <ul style="list-style-type: none"> • The number of cases brought to the Procurator Fiscal and the outcome of the cases (conviction and level of fine) • Whether the site continued to operate (presumed legally) and if so data would be required on the amount of waste processed at the site and the waste stream. • Total costs associated with raising the case to the Procurator Fiscal. • An estimate of the time between the first inspection, the referral to the Procurator Fiscal and the outcome of the case. • An assessment of the impact arising from the breach in licensing e.g. scale and type of pollution incident. |

Recommended Analysis

Cost Effective Calculations

To compare the relative effectiveness of each regulatory action (inspections, letters, statutory notices and referral to the Procurator Fiscal) the most straightforward analysis would be to complete a cost-effectiveness analysis. For ease, the unit outcome of the calculation would be based on the number of sites which were compliant following each regulatory action:

- Inspections: sites compliant at the inspection stage/cost to inspect.
- Warning letters: sites compliant after receiving warning letter/total cost of issuing letters.
- Statutory notices: sites compliant after receiving statutory notices/total cost of issuing notices.
- Procurator Fiscal: sites compliant after the each report/cost of each report.

Analysis should take into account the time lag between undertaking the relevant regulatory action and the site returning to compliance. The cost-effectiveness of each measure can then be compared. It is recognised that the calculations are simplistic and does not take into account variations between the waste management firms. An extension of this analysis is to include monetary values for benefits and costs and allows us to undertake a full benefit-cost analysis.

Benefit - Cost Calculation

The analysis could be extended to a full benefit-cost analysis. This would be a more time and data intensive exercise. An outline of the steps included in a benefit-costs analysis is provided in Table 3.

Table 3: Outline of a benefit-cost analysis comparing regulatory measures for waste crime

| |
|--|
| 1) List alternative projects/programmes: <ul style="list-style-type: none"> • Inspections, warning letters, notices and referrals to the Procurator Fiscal. |
| 2) List stakeholders: <ul style="list-style-type: none"> • SEPA, other government agencies, waste management firms, general public. |
| 3) Select measurements and measure all benefit and cost elements: <ul style="list-style-type: none"> • Costs and benefits associated with a site remaining/returning to compliance. • Potential costs: <ul style="list-style-type: none"> ○ Capital costs: one off investments related to monitoring and enforcement. ○ Revenue costs: costs which tend to fluctuate in relation to the amount of project activity being undertaken for example staff costs. ○ In-kind costs: those inputs that are needed in order to make a project. • Potential benefits: <ul style="list-style-type: none"> ○ Fiscal benefits: savings to the public sector e.g. if site is compliant at inspections no need to investigate the site further. ○ Public value benefits (economic and social benefits): primarily expected to be the avoided costs associated with fewer pollution incidents (environmental limit licenses) and reduced environmental management problems. |
| 4) Convert all costs and benefits into a common currency. |
| 5) Apply discount rate: The HM Treasury Green Book adopts a discount rate of 3.5% per annum. |
| 6) Calculate net present value of project options. |
| 7) Perform sensitivity analysis: how do the benefits change under different scenarios? |

Summary and Recommendations

Part 1 of the report has provided an introduction to conducting a cost-effective analysis and a benefit-cost analysis. It outlined how these methods could generally be applied to analysing the effectiveness of waste crime enforcement actions. A reliable assessment relies on a well established baseline and detailed associated data set. It is recommended that SEPA aim to enhance the reporting of waste crime monitoring and enforcement in order to produce a more detailed data set. In particular, it is recommended to support the acquisition of the following data:

- Detail on the number of sites inspected per annum, how often they were visited and why sites were visited;
- Linear information for each site; if a site was found to be non-compliant at inspection how long did it take to become compliant and through what actions;
- Detailed costs associated with enforcement actions at each stage;
- Richer waste stream data from all sites which are inspected.

Part 2: Costs and Benefits of Waste Crime Enforcement in Scotland – Case Study Application

Introduction

Part 1 outlined the use of cost-effective and benefit-cost analysis in determining the effectiveness of various regulatory actions for waste crime. Part 2 aims to extend this by applying benefit-cost analysis to determine the benefits and costs of closing three waste crime sites in Scotland.

In 2014, Eunomia developed a model to examine the marginal benefit of an additional £5 million increase of expenditure on waste crime enforcement in England and Wales¹². The primary assumption underlying the model was that closing an illegal waste site (IWS) would result in waste previously disposed of at that site re-entering the legal waste stream, thus accruing additional benefits to government, businesses and the environment. The principle costs in the model were those related to waste crime enforcement and monitoring needed to close an IWS. These included staff costs, business overheads, legal costs, vehicle hire, science costs, excavation, and engineering costs. Benefits were calculated based on the assumption that waste from the IWS would need to be removed from the premises in order to enter the legal waste stream. The legal waste site would receive additional gate fees, which in turn increases the legal sites profits. The Government benefits through additional Landfill Tax revenue as well as receiving Corporation Tax and employment related taxes from the legal waste site. By transferring waste into the legal sector it is expected there would be environmental benefits in the form of reduced air and water pollution as legal waste sites are more likely to remain compliant. The reporting year for the Eunomia model (applying to England and Wales) was 2013 with results discounted over a ten year time horizon. The modelling scenario is summarised in Figure 1.

¹² Eunomia (2014) Waste Crime, Tackling Britain's Dirty Secret. Online: http://www.esauk.org/esa_reports/ESAET_Waste_Crime_Tackling_Britains_Dirty_Secret_LIVE.pdf Accessed 12/10/2014.

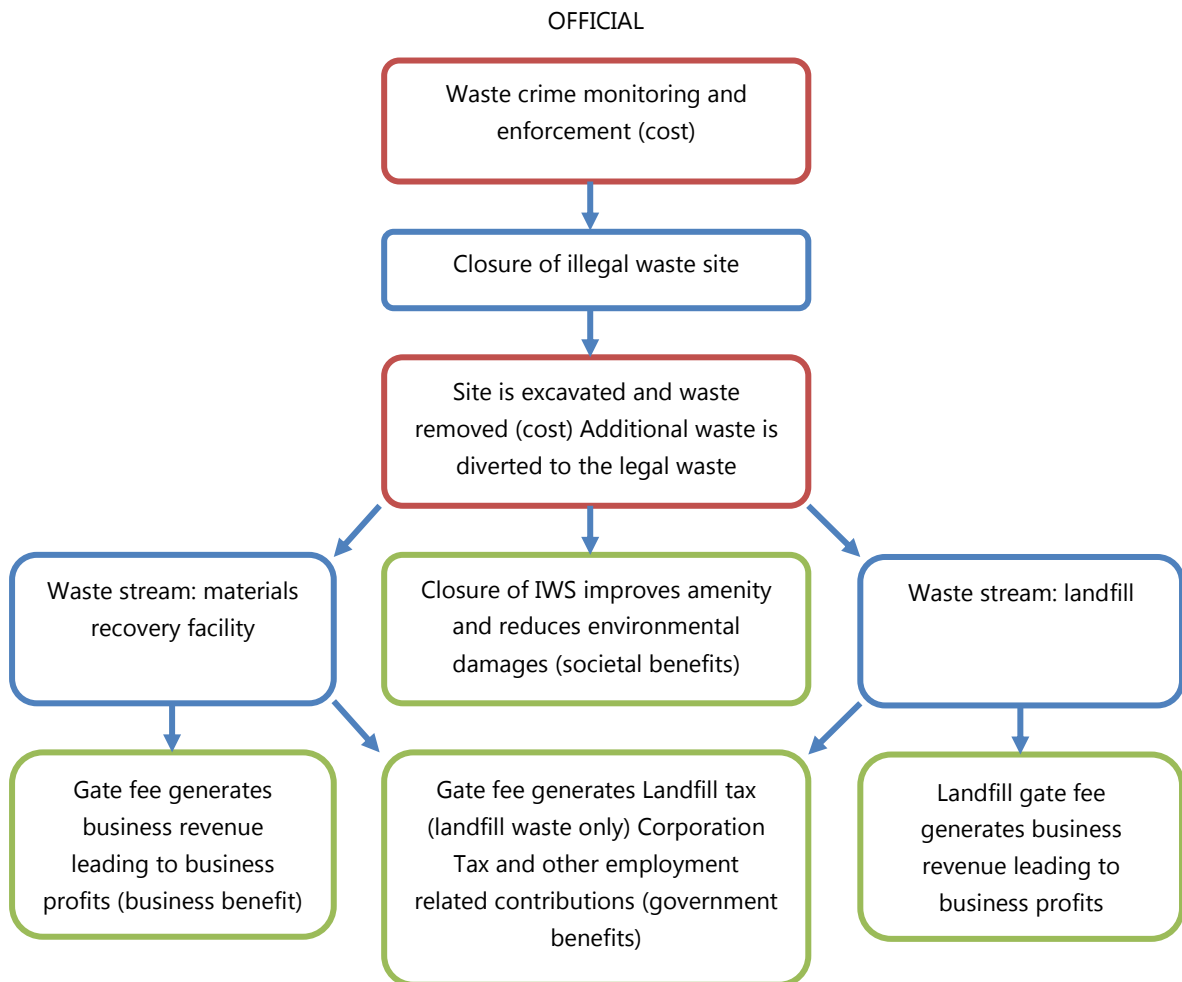


Figure 1: Simplified model of costs and benefits of waste crime enforcement (adapted from Eunomia, 2014)

In this report we aim to apply the Eunomia model to three case studies in Scotland in order to determine the return per pound spent on enforcement and monitoring for that particular case study in a given year. Two case studies are considered to be serious organised crime waste sites whilst one is considered a standard IWS. Criminal benefit from waste crime in these case studies includes: no licensing costs; reduced infrastructure costs (for example access roads, weigh bridge, pest control and security); reduced landfill specific costs (including appropriate engineering for drainage, capping material and gas capture systems); and tax avoidance (Landfill Tax, Corporation Tax and employment related taxes).

Eunomia Methodology and Relevant Extensions for the three Scottish Case Studies

A core aspect of the model is to determine the benefits based on the changes in the waste stream i.e. identifying and removing waste from the IWS, transferring it to a legal waste site and determining the waste type (Figure 2). The tonnage transferred between the sites forms the basis for the benefit calculations. All monetary values detailed below are for 2013/14 and will need to be adjusted when applied to different years.

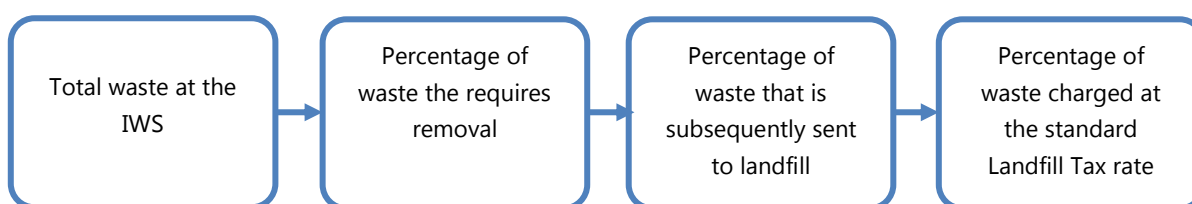


Figure 2: Summary of waste stream data

Stage 1: Identification of Total Tonnage

The first stage of the model requires an estimate of the tonnage at the illegal waste site. The Eunomia model, for England and Wales, applied a figure of 85.6% for the amount of waste which would need to be excavated from the IWS and transported to a legal waste site, thus re-entering the waste stream. This figure was based on Environment Agency data. For this report, where possible, the actual tonnage at each waste site has been used.

Stage 2: Identification of the Waste Stream

The Eunomia report estimated that 73.1% of waste would be disposed of at a landfill site (64.3% lower estimate, 85.4% upper estimate) based on AMEC Waste Crime reports¹³. Legal landfill operators charge a median gate fee of £21 per tonne. Waste entering landfill sites is either charged at £80 per tonne (standard) or £2.50 per tonne for inert waste. Eunomia estimates that a minimum of 80% of the

¹³ AMEC Environment & Infrastructure UK Limited (2012) The Economic Impact of Illegal Waste, Report for Environment Agency, December 2012

waste is charged at the standard rate of £80 per tonne (90% median, 100% maximum). The report also estimates that 35.7% (14.4% lower estimate, 35.5% upper estimate) of waste would be recycled at a Materials Recovery Facility (MRF). The median MRF gate fee is £9 per tonne with no additional tax. For this report, where possible, the actual tonnage of landfill waste versus recyclable has been estimated for each of the Scottish case studies and used for the analysis.

Stage 3: Identification of Legal Site Operators Benefits

The legal operator's revenue is based on the amount of waste entering the site and the relevant gate fee (identified in Stage 2). The profit margin is estimated to be 5% of the total revenue based on Apex's (2013) Waste Market Insight report¹⁴.

Stage 4: Identification of Government Benefits

Government benefits are received in the form of Landfill Tax, Corporation Tax and employment benefits. The Landfill Tax is calculated based on the upper and lower bands that the waste stream falls into (as detailed in Stage 2). The Corporation Tax is calculated as a proportion of revenue from the legal waste supplier who now receives the gate fee. According to Environment Agency reports¹⁵ it will take one year from an IWS closure to the government receiving benefits. As such, the tax rate should be chosen based on the year after closure. For instance, if an IWS site would be closed in the 2013/2014 financial year, then the waste would not re-enter the legal waste stream until 2014/15 financial year, so a Corporation Tax rate of 21% would be used for the analysis¹⁶. Additional taxes arise in the form of employment taxes including employer and employee National Insurance

14 Apex Insight (2013) UK Waste Management – Market Insight Report, February 2013

15 Eunomia (2014) Waste Crime, Tackling Britain's Dirty Secret. Online:

http://www.esauk.org/esa_reports/ESAET_Waste_Crime_Tackling_Britains_Dirty_Secret_LIVE.pdf. Accessed 12/10/2014.

16 HMRC (2014) Corporation Tax and Relief Rates. Online <https://www.gov.uk/corporation-tax-rates>. Accessed 12/10/2014.

contributions and Income Tax. According to the Eunomia report, 39.6% of the legal waste sites revenue is spent on employment, with 28.4% of this figure going to the government in the form of employment taxes.

Stage 5: Environmental Benefits

The environmental benefits estimated by Eunomia comprise of the reduced environmental damage with the waste being removed from the IWS (£1.83 per tonne) and the reduction in disamenity (£6.02 per tonne). These figures are based on two reports submitted to Defra; one by Cambridge Econometrics, Eftec and WRc regarding the Disamenity of Landfill in Great Britain and a second by Enviro Consulting Ltd and EFTEC on the Costs and Benefits to Health of Waste Management Options^{17,18}.

Stage 6: Estimation of Costs

Costs of monitoring, enforcement and closure of the IWS have been provided by SEPA for each of the Scotland case studies. It is anticipated this will include costs related to staff time on the project, overheads, vehicle hire, science costs, excavation, and engineering costs. The Eunomia figure of £7,591 marginal cost to close a waste site is not relevant for our case studies as SEPA have supplied the actual costs associated with each waste site closure.

Stage 7: Benefit – Cost Calculation

According to Eunomia the benefits from closure of the IWS will take place one year after the site is closed. Due to this the benefits are discounted by one year using the HM Treasury Green Book

17 Cambridge Econometrics, EFTEC, and WRc (2003) A Study to Estimate the Disamenity Costs of Landfill in Great Britain, Report for DEFRA, February 2003.

18 Enviro Consulting Ltd, and EFTEC (2004) Valuation of the External Costs and Benefits to Health and Environment of Waste Management Options, Report for the Department for Environment, Food and Rural Affairs, December 2004.

recommended discount rate of 3.5% per annum¹⁹. The preferred modelling scenario would take into account changes in the waste stream over time and how much waste continues to be re-diverted into the legal waste stream following the site closure allowing for analysis over a longer time horizon (the Eunomia report uses 10 years). It is recognised that this is not possible for the Scottish case studies at present as there is not sufficient data regarding changes in the waste stream over time.

¹⁹HM Treasury (2013) The Green Book: Appraisal and Valuation in Central Government. Online: <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>. Accessed 10/10/2014.

Model Application and Results

Case Study 1

The first case study is of a serious organised crime waste site where monitoring and enforcement were undertaken in 2011. An initial analysis by SEPA indicated that the criminal benefit attained for the Case Study was in the region of £36,000,000²⁰. The majority of this benefit was tax avoidance, avoided licensing costs and avoided land remediation costs. This report seeks to develop this analysis further by applying the Eunomia methodology to determine the government, business and environmental benefits of this site being closed and the waste being returned to the legal waste sector.

SEPA estimated that there was 150,000 tonnes of waste at the site. Based on the Eunomia methodology it is estimated that 85.6% of this waste requires removal from the site. This implies that 128,400 tonnes of waste will re-enter the legal waste stream. Of this it is deemed that all the waste will be sent to landfill at the higher tax rate of £60 per tonne (2011 figure).

SEPA estimated that their monthly average monitoring costs were £76,982. Over an eight month project lifespan the total costs are estimated at £615,856. Since the enforcement and monitoring were undertaken during 2011, the values outlined in the methodology have been adapted for 2011 (using relevant market reports from 2011). Estimations and assumptions used for Case Study 1 are shown in Table 4.

²⁰ SEPA Enforcement Support Team, October 2015

Table 4: Modelling estimations, Case Study 1

| Waste Stream | | Data / Figures | Value |
|------------------------------|--|----------------|------------|
| 1 | Illegal waste site tonnage | 150,000 | 150,000 |
| 2 | Percentage of waste from IWS that requires removal | 85.6% | 128,400 |
| 3 | Waste that is land filled | 100% | 128,400 |
| 5 | Waste that is recycled | 0.0% | 0.00 |
| Land filled Waste | | | |
| 6 | Gate fees from landfill (per tonne) | £20.00 | £2,568,000 |
| 7 | Corporation Tax | 20% | £513,600 |
| 8 | Revenue spent on employment costs | 39.6% | £1,016,928 |
| 9 | NIC and Income Tax | 28.4% | £288,808 |
| 10 | Profits | 5.0% | £128,400 |
| 11 | Landfill tax rate (per tonne) | £60.00 | £7,704,000 |
| Environmental Benefit | | | |
| 12 | Disamenity with illegal site (per tonne) | £5.85 | £751,140 |
| 13 | Reduced environmental damage associated with waste being sent to landfill rather than being in an illegal waste site (per tonne) | £1.78 | £228,552 |

Table 5 summarises the modelling results, outlining the key impacts to the government, businesses and wider society. The benefit to the government of the closed site is estimated at a £8,208,683 return in the form of increased Landfill Tax and other taxation with a benefit-cost ratio of 13:1 (one pound spent on enforcement has yielded a £13.33 return). Taking into account business and environmental benefits, this increases to a marginal return of £15.26.

Table 5: Benefit-cost analysis, Model 1

| | |
|--|-------------|
| Government Benefits | £8,506,408 |
| Business Benefits | £128,400 |
| Environmental Benefits | £979,692 |
| Costs | £615,856 |
| Government Benefits (1 year NPV) | £8,208,683 |
| Government Benefit - Cost Ratio | 13:1 |
| Business Benefits (1 year NPV) | £123,906 |
| Environmental Benefits (1 year NPV) | £945,403 |
| Overall Benefit - Cost Ratio | 15:1 |

Case Study 2

An initial analysis undertaken by SEPA indicated that the criminal benefit attained from the IWS was in the region of £1,427,175. This included Landfill Tax avoidance and estimated profits. This report seeks to develop this analysis further by applying the Eunomia methodology to determine the government, business and environmental benefits of this site being closed and the waste being returned to the legal waste sector.

SEPA estimated that the IWS contained 40,480 tonnes of waste: however 20,000 tonnes were permitted under license conditions giving an estimated volume of illegal waste disposal of 20,480 tonnes. Based on the Eunomia methodology it is estimated that 85.6% of this waste requires removal from the site, implying that 17,531 tonnes will re-enter the waste stream. SEPA estimated that 70% of this waste will be charged at the higher Landfill Tax band and 30% in the lower band. SEPA monitoring and enforcement costs were estimated to be £35,792. The enforcement and monitoring of this IWS was undertaken in 2013. Table 6 summarises the estimations and assumptions used for Case Study 2.

Table 6: Modelling estimations Case Study 2

| Waste Stream | | Data / Figures | Value |
|------------------------------|--|-----------------------|--------------|
| 1 | Illegal waste site tonnage | 20,480 | 20,480 |
| 2 | Percentage of waste from IWS that requires removal | 85.6% | 17,531 |
| 3 | Waste that is landfilled | 100% | 17,531 |
| 5 | Waste that is recycled | 0.00% | 0.00 |
| Land filled Waste | | | |
| 6 | Gate fees from landfill (per tonne) | £21.00 | £368,148 |
| 7 | Corporation Tax | 20.0% | £73,630 |
| 8 | Revenue spent on employment costs | 39.6% | £145,787 |
| 9 | NIC and Income Tax | 28.4% | £41,403 |
| 10 | Profits | 5.0% | £18,407 |
| 11 | Landfill tax rate (per tonne) higher | £72.00 | £883,556 |
| 12 | Landfill tax rate (per tonne) lower | £2.50 | £13,148 |
| Environmental Benefit | | | |
| 13 | Disamenity with illegal site (per tonne) | £6.02 | £105,536 |
| 14 | Reduced environmental damage associated with waste being sent to landfill rather than being in an illegal waste site (per tonne) | £1.83 | £32,082 |

Table 7 summarises the modelling results, outlining the key impacts to the government, businesses and wider society. The benefit to the government of the closed site is estimated at a £976,327 return in the form of increased Landfill Tax, as well as employment related contributions with a benefit-cost ratio of 27:1, each pound spent has yielded a £27.28 return. Including the benefits to businesses and wider society this increases to a marginal return of £31.48.

Table 7: Benefit-Costs analysis, Case Study 2

| | |
|--|-------------|
| Government Benefits | £1,011,738 |
| Business Benefits | £18,407 |
| Environmental Benefits | £140,247 |
| Costs | £35,793 |
| Government Benefits (1 year NPV) | £976,327 |
| Government Benefit - Cost Ratio | 27:1 |
| Business Benefits (1 year NPV) | £17,763 |
| Environmental Benefits (1 year NPV) | £132,801 |
| Overall Benefit - Cost Ratio | 31:1 |

Case Study 3

Case Study 3 (CS3) is very different to case studies one (CS1) and two (CS2), and reflects the smallest scale of waste crime. Compared to CS1 and CS2, the major difference when analysing CS3 is the **lack of data on waste levels at the specific site**. This means the standard application of the Eunomia model is inherently more difficult. As a consequence, the analysis below relies heavily on assumptions for waste levels at the IWS. The analysis is based on known revenue accrued by the IWS over six days. SEPA have estimated that the company earned revenue of £153,077 in one year. This is based on the company accruing £3630.29 in six days, operating for 253 working days over the year and assuming the business activity at the site remains constant. The site had known operations for two years, resulting in revenue of approximately £306,154 over the two year period. SEPA indicated that the total costs for monitoring and enforcement were £16,720.

Due to the uncertainties surrounding the total waste at the site three different models were calculated to estimate waste levels.

- Model 1 uses the Eunomia assumptions regarding average landfill waste and recyclables and divides the estimated yearly revenue by this split. The appropriate gate fees are then used to derive approximate waste levels at the site. This model assumes the gate fee does not include

Landfill Tax which is why a company may deposit waste with them as they are cheaper than legal sites. This gives an estimate of total waste at the site between 17,417 and 21,518 tonnes.

- Model 2 is a cruder estimation, presuming that all waste on the site would be landfill waste. It also assumes that the company depositing at the site believes the site is legal and is charged Landfill Tax, alongside the standard gate fee. This gives a lower estimate of waste at the site of 3,031 tonnes.
- Model 3 is similar to Model 2 by presuming all waste at the site was destined for landfill. However it assumes the company depositing waste is aware the site is illegal and does not pay Landfill Tax. Therefore, approximate waste is calculated using revenue and gate fees alone. This gives an estimate of waste at the site of 14,579 tonnes.

Model 1

A crude estimate of total waste at the site was calculated using the approximate revenue accrued by the IWS, estimations on waste contained in IWS provided by the Eunomia report and WRAP Gate Fees. Eunomia assume between 64.3% and 85.4% of waste at an IWS will be classified as landfill. Applying these percentages to the revenue intake at the IWS means between 64.3% and 85.4% of their revenue will be acquired by charging the Landfill Gate Fee of £21 per tonne. Between £196,857 and £261,456 of the IWS revenue is approximated to be from landfill waste and dividing these figures by the gate fee (£21 per tonne) estimates landfill waste at the site between 9,374 and 12,450 tonnes.

This step is then repeated for the approximate waste which would be sent for recycling (between 14.6% and 35.7% according to Eunomia estimations). This gives revenue from recycling between £44,968 and £109,297 and dividing by the mean gate fee (£9 per tonne) gives an approximate recycling tonnage between 4,966 and 12,144 (Table 8). The standard Eunomia methodology is then applied to calculate the costs and benefits of enforcement (Table 9).

There is one key concern associated with Model 1. Total revenue is made up of between 64% and 83% from landfill waste based on the Eunomia method. Working these calculations through gives a much greater tonnage of recycled waste compared to landfill, i.e., the central estimate is 10,000 tonnes of landfill waste and 9000 tonnes of potentially recycled waste. Based on the Eunomia model, the central estimate should be 70% landfill to 30% recycled.

Table 8: Waste Approximation, Model 1 Case Study 3

| | | | |
|--|----------|----------|----------|
| Approximate Known Revenue | £306,154 | | |
| Landfill Gate Fee (per tonne) | £21 | | |
| MRF Gate Fee (per tonne) | £9 | | |
| | Min | Central | Max |
| Landfill Waste (LW) Revenue | £196,857 | £223,799 | £261,456 |
| Approximate Tonnage (LW Revenue/LW Gate Fee) | 9,374 | 10,657 | 12,450 |
| Recyclable Revenue | £109,297 | £82,355 | £44,698 |
| Approximate MRF Tonnage | 12,144 | 9,151 | 4,966 |
| Approximate Total Waste at Site (tonnes) | 21,518 | 19,808 | 17,417 |

Table 9: Benefit-cost analysis results, Model 1 , Case Study 3

| Waste Stream | | Data / Figures | Min | Central | Max |
|--|--|----------------|-------------|-------------|----------|
| 1 | Illegal waste site tonnage | | 21,518 | 19,808 | 17,417 |
| 2 | Waste that is land filled | | 9,374 | 10,657 | 12,450 |
| 3 | Waste that is recycled | | 12,144 | 9,151 | 4,966 |
| Land filled Waste | | | | | |
| 6 | Gate fees from landfill (per tonne) | £21.00 | £196,857 | £223,799 | £261,456 |
| 7 | Corporation Tax | 20.0% | £39,371 | £44,760 | £52,291 |
| 8 | Revenue spent on employment costs | 39.6% | £77,955 | £88,624 | £103,536 |
| 9 | NIC and Income Tax | 28.4% | £22,139 | £25,169 | £29,404 |
| 10 | Profits | 5.0% | £9,843 | £11,190 | £13,073 |
| 11 | Landfill tax rate (per tonne) higher | £72.00 | £674,938 | £767,309 | £896,419 |
| Recycled Waste | | | | | |
| 12 | Gate Fees from Recycled waste (per tonne) | £9.00 | £109,297 | £82,355 | £44,698 |
| 13 | Corporation Tax | 20.0% | £2,429 | £1,830 | £993 |
| 14 | Revenue spent on employment costs | 39.6% | £4,809 | £3,624 | £1,967 |
| 15 | NIC and Income Tax | 28.4% | £1,366 | £1,029 | £559 |
| 16 | Profits | 5.0% | £607 | £458 | £248 |
| Environmental Benefit | | | | | |
| 12 | Disamenity with illegal site (per tonne) | £6.02 | £129,538 | £119,244 | £104,850 |
| 13 | Reduced environmental damage associated with waste being sent to landfill rather than being in an illegal waste site (per tonne) | £1.83 | £17,154 | £19,502 | £22,784 |
| Benefit Cost Calculations | | | | | |
| Government Benefits | | £740,244 | £840,098 | £979,666 | |
| Business Benefits | | £10,450 | £11,647 | £13,321 | |
| Environmental Benefits | | £146,693 | £138,746 | £127,634 | |
| Costs | | £35,793 | £35,793 | £35,793 | |
| Government Benefits (1 year NPV) | | £714,335 | £810,694 | £945,378 | |
| Government Benefit – Cost Ratio | | 20:1 | 23:1 | 26:1 | |
| Business Benefits (1 year NPV) | | £10,084 | £11,240 | £12,855 | |
| Environmental Benefits (1 year NPV) | | £141,559 | £133,890 | £123,167 | |
| Overall Benefit – Cost Ratio | | 24:1 | 27:1 | 30:1 | |

Model 2

Model 2 assumes that all the waste at the site is landfill and would be charged at the standard gate fee of £21 per tonne. It also assumes that the waste carrier believes the site is legal and pays Landfill Tax as part of the gate fee. The total waste at the site can therefore be calculated as:

$$\textit{Tonnage} = \frac{\textit{Total Revenue}}{\textit{Gate Fee} + \textit{Landfill Tax}}$$

The waste approximation for Model 2 is outlined in Table 10 and the benefit-costs calculations are given in Table 11.

Table 10: Waste Approximation, Model 2, Case Study 3

| | |
|---|----------|
| Approximate known Revenue | £306,154 |
| Landfill Gate Fee (per tonne) | £21.00 |
| Landfill Tax Rate (per tonne) | £80.00 |
| Total charged to consumer | £101.00 |
| Approximate Tonnage (approximate known revenue / total charged to consumer) | 3031 |

Table 11: Benefit-cost analysis results, Model 2, Case Study 3

| Waste Stream | | Data / Figures | Min |
|--|--|----------------|------------|
| 1 | Illegal waste site tonnage | | 3,031 |
| 2 | Waste that is land filled | | 3,031 |
| Land filled Waste | | | |
| 6 | Gate fees from landfill (per tonne) | £21.00 | £63,656 |
| 7 | Corporation Tax | 20.0% | £12,731 |
| 8 | Revenue spent on employment costs | 39.6% | £25,208 |
| 9 | NIC and Income Tax | 28.4% | £7,159 |
| 10 | Profits | 5.0% | £3,183 |
| 11 | Landfill tax rate (per tonne) higher | £80.00 | £218,248 |
| Environmental Benefit | | | |
| 12 | Disamenity with illegal site (per tonne) | £6.02 | £18,267 |
| 13 | Reduced environmental damage associated with waste being sent to landfill rather than being in an illegal waste site (per tonne) | £1.83 | £5,546 |
| Benefit – Cost Ratio | | | |
| Government Benefits | | | £238,139 |
| Business Benefits | | | £3,183 |
| Environmental Benefits | | | £23,813 |
| Costs | | | £35,793 |
| Government Benefits (1 year NPV) | | | £229,804 |
| Government Benefit - Cost Ratio | | | 6:1 |
| Business Benefits (1 year NPV) | | | £3,071 |
| Environmental Benefits (1 year NPV) | | | £22,980 |
| Overall Benefit - Cost Ratio | | | 7:1 |

Model 3

Model 3 assumes that all the waste at the site is landfill and would be charged at standard gate fee of £21 per tonne. It also assumes that the waste carrier knows the site is illegal and therefore does not have to pay landfill tax. Therefore the waste at the site is calculated using the following equation:

$$\text{Tonnage} = \frac{\text{Total Revenue}}{\text{Gate Fee}}$$

The waste approximation for Model 3 is outlined in Table 12 and the benefit-costs calculations are given in Table 13.

Table 12: Waste Approximation, Model 3, Case Study 3

| | |
|---|----------|
| Approximate known Revenue | £306,154 |
| Landfill Gate Fee (per tonne) | £21 |
| Landfill Tax Rate (per tonne) | £80 |
| Total charged to consumer | £21 |
| Approximate Tonnage (approximate known revenue / total charged to consumer) | 14,579 |

Table 13: Benefit-cost analysis results, Model 3, Case Study 3

| Waste Stream | | Data / Figures | Min |
|--|--|----------------|-------------|
| 1 | Illegal waste site tonnage | | 14,579 |
| 2 | Waste that is land filled | | 14,579 |
| Land filled Waste | | | |
| 6 | Gate fees from landfill (per tonne) | £21.00 | £306,154 |
| 7 | Corporation Tax | 20.0% | £61,231 |
| 8 | Revenue spent on employment costs | 39.6% | £121,237 |
| 9 | NIC and Income Tax | 28.4% | £34,431 |
| 10 | Profits | 5.0% | £15,308 |
| 11 | Landfill tax rate (per tonne) higher | £80.00 | £1,049,671 |
| Environmental Benefit | | | |
| 12 | Disamenity with illegal site (per tonne) | £6.02 | £87,766 |
| 13 | Reduced environmental damage associated with waste being sent to landfill rather than being in an illegal waste site (per tonne) | £1.83 | £26,680 |
| Benefit – Cost Ratio | | | |
| Government Benefits | | | £1,145,333 |
| Business Benefits | | | £15,308 |
| Environmental Benefits | | | £114,445 |
| Costs | | | £35,793 |
| Government Benefits (1 year NPV) | | | £1,105,246 |
| Government Benefit - Cost Ratio | | | 31:1 |
| Business Benefits (1 year NPV) | | | £14,772 |
| Environmental Benefits (1 year NPV) | | | £110,440 |
| Overall Benefit - Cost Ratio | | | 34:1 |

There is a high degree of uncertainty around the benefit-cost calculations for CS3. The lack of finite waste figures meant several assumptions were used to derive estimates of waste at the site. These generated a benefit-cost ratio of between 7:1 and 34:1, depending on the model applied. Estimates of waste at the site varied between 9,000 and 14,000 tonnes and based on discussions with SEPA it is unlikely that there is this amount of waste at the site currently. This implies that the waste has either been treated or disposed of correctly, or illegally dumped elsewhere. Also, there is likely to be a mix of material at the site; some landfill waste, some recycling and other valuable materials which would have been extracted. Ultimately there is too much conjecture in this case study for the results to be treated in a reliable and robust manner.

Discussion

The benefit-cost ratios of 15:1 and 31:1 for case studies one and two, respectively, are substantially higher than the benefit-cost ratio of increased spending on waste crime enforcement in the Eunomia report (4:1). However, the Eunomia report covers a wide variety of waste crime throughout England and Wales and this generates an average value which takes into account all waste crimes from the minor through to more serious cases. The case by case methodology used in this report offers a different perspective to the Eunomia report and focuses on the most serious sites. The scale of the results highlight the serious nature of the "invisible problem" that is waste crime.

The greatest benefit that the government can derive from closing an illegal waste site (IWS) is in terms of tax revenues from Landfill Tax, Corporation Tax and employment related taxes (Figure 4). Societal and business benefits are significantly smaller than government benefits when using the Eunomia modelling approach. Part 1 of this report recommends analysing the societal benefits in terms of the "replacement cost approach". This approach is based on the assumption that, if people incur costs to replace damages caused for example by pollution, then a cleaner environment must be worth at least what people paid to restore it. There is potential to expand the benefit-cost modelling in Part 2 of the

report by applying the replacement cost approach on a site-by-site basis. This will require detailed information on the scale and degree of pollution incidences associated with the breach in permit and an indicative cost associated with cleaning up the breach.

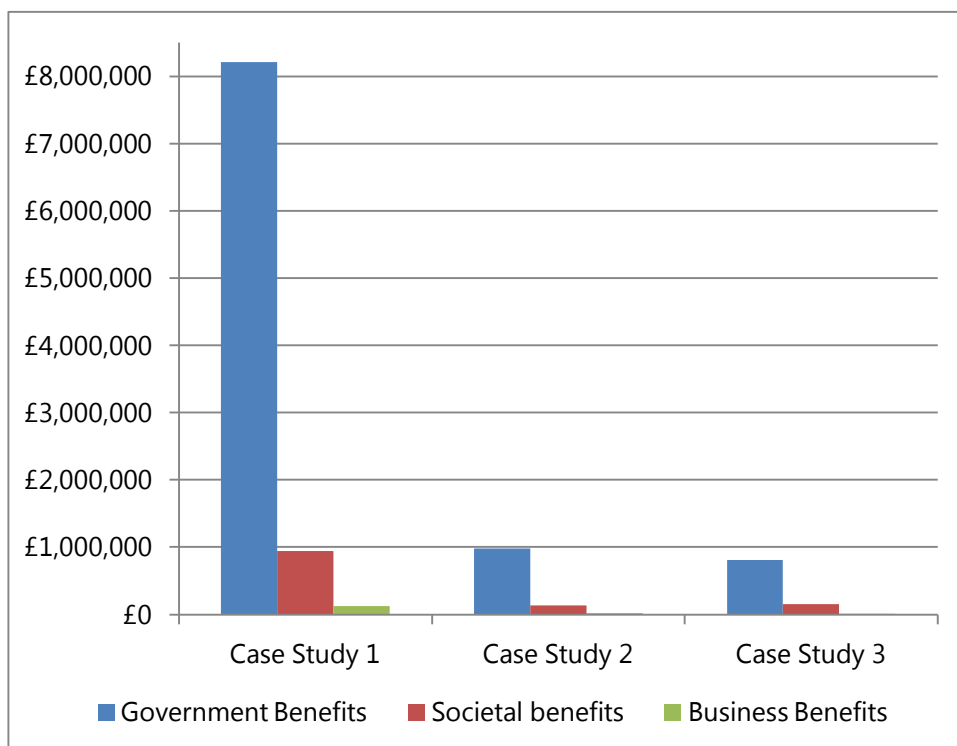


Figure 3: Comparison of benefits (central estimates) for the three case studies

One of the key issues associated with the modelling presented in the analysis is the quality of the data regarding the waste stream at the IWS. As outlined in Part 1, a key element to support benefit-cost analysis is a robust baseline at which to assess changes and a systematic data collection strategy is also warranted. Case studies one and two did have an estimate of the waste at the site, but this could have been extended further by including data on the *types* of waste at the site e.g. landfill (inert or non-inert) or recyclable etc. A further enhancement would have been data on how the waste stream at the IWS developed over time. The Eunomia method is based on waste from an IWS re-entering the waste stream through excavation and waste which would have been previously disposed of at the IWS now being diverted into the legal waste sector. For the Scottish case studies it would have been

worthwhile knowing whether waste was re-diverted and if so how much and over what time scale. This would have allowed sensitivity analysis to be undertaken over a longer time period. It is also recognised that one of the limitations when applying the Eunomia model to the Scottish case studies is the fact that the waste has remained at the IWS and has not yet been removed. However, the benefit-cost ratio is still useful and provides an indication of the benefits that accrue from closing the IWS and re-diverting all future waste into the legal waste stream.

A further refinement of the model would have been the inclusion of excavation and haulage costs associated with the removal of waste from an IWS and transport to a legal waste site. It is recognised that there would be costs associated with this for the regulator, but there would also be benefits for the haulage company. These figures were not included in the analysis but were included in the model outline (see Figure 1).

From case study three it is clear that monitoring is incomplete for a smaller IWS and sites which do not require a permit. The data provided for the analysis was based heavily on estimations from one revenue figure based on one week in two years. A lack of data makes it inherently difficult to compare across case studies and enforcement approaches. Where possible, more detail would be required on the waste at the site and the associated waste streams to allow reliable and robust comparisons to be made.

An improvement in data collection and reporting would allow future cost-effective analysis and benefit-cost analysis, such as those outlined in Part 1 of the report, to be conducted more efficiently and robustly. If SEPA is aiming to compare future enforcement programmes, more systematic data collection would be required on (i) number of inspections, (ii) the number of warning letters and notices received by each waste site, as well as (iii) detail on the waste stream at sites. The ideal scenario, from an economic modelling perspective is that all sites would be visited once per annum. Theoretically, this increases the willingness of sites to comply with regulation as the risk of being

found to be breaking the law is higher. This follows the recommendations in the Eunomia report, "the reduction of waste crime through greater deterrence must be at the heart of any set of recommendations... the prospect of being investigated and ultimately prosecuted can heavily offset the perceived profitability of an illegal waste activity"²¹. If there were data available on the number of inspections prior to the set annual inspections and associated compliance information, it would be possible to determine the actual effect of annual inspection on compliance.

Conclusion and Key Recommendations

This report has aimed to 1) provide an introduction to cost-effective and benefit-cost analysis and illustrate how these tools could be applied to compare four enforcement actions for waste crime: inspections, final warning letters, notices and referrals to the Procurator Fiscal and 2) apply a benefit-cost analysis to determine the costs and benefits of waste crime enforcement for three separate Scottish Case studies.

Benefit-cost analysis for case studies one and two derived marginal returns of enforcement of £15.26 and £31.48 respectively. The greatest benefits of increased enforcement were to the government in terms of increased Landfill Tax and other employment related taxes. Additional benefits accrued to legal waste site operators in the form of increased profits and for wider society in terms of improved environmental conditions.

In both Parts 1 and 2 of the report the key recommendation was that reliable assessment relies on a well established baseline and a detailed associated data set. It is recommended that SEPA aims to enhance its reporting of waste crime monitoring and enforcement to allow future cost-effective and benefit-cost analyses to be conducted more efficiently and robustly.

²¹ Eunomia (2014) Waste Crime, Tackling Britain's Dirty Secret. Online: http://www.esauk.org/esa_reports/ESAET_Waste_Crime_Tackling_Britains_Dirty_Secret_LIVE.pdf. Accessed 12/10/2014.

Recommendations for future data collection include:

- Waste stream data: for all waste sites (legal and illegal) a comprehensive estimate of tonnage at the site and the *types* of waste at the site e.g. landfill (inert or non-inert) or recyclable etc. If possible an annual assessment of the waste stream at each site and how these changes would further enhance future analysis and allow more reliable and robust comparisons to be made between sites.
- If SEPA is aiming to compare future enforcement programmes, more systematic data collection would be required on (i) number of inspections, (ii) the number of warning letters and notices received by each waste site, as well as (iii) detail on the waste stream at sites. For example:
 - Additional detail regarding the number of sites inspected per annum, how often they were visited and why sites were visited.
 - Linear information for each non-compliant site; if a site was found to be non-compliant at inspection how long did it take to become compliant and through what actions.
 - Detailed costs associated with enforcement actions at each stage of the regulatory process.
 - Richer waste stream data from all sites which are inspected.