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Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services

Final Report

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Melissa and Stephen Murdoch

Disclaimer:

Eunomia Research & Consulting has taken due care in the preparation of this report to ensure that all facts and analysis presented are as accurate as possible within the scope of the project. However no guarantee is provided in respect of the information presented, and Eunomia Research & Consulting is not responsible for decisions or actions taken on the basis of the content of this report.

Version Control Table

Version	Date	Author	Description
V0.1	19/05/17	Tim Elliott	Internal draft
V0.2	04/06/17	Tim Elliott	First draft (sent to client)
V0.3	15/07/17	Tim Elliott	Client comments on first draft
V0.4	24/08/17	Tim Elliott	Second draft (sent to local authorities)
V1.0	11/10/17	Tim Elliott	Final version

Executive Summary

E.1.1 Introduction

This study is designed to answer the question:

> *'What would be the impacts of the introduction of a deposit refund system for one-way beverage packaging on local authority waste services in England?'*

Evidence from countries where deposit refund systems (DRS) have been implemented for single-use beverage containers indicates that they can deliver a number of benefits. They can increase beverage container recycling rates, improve the quality of the material that is collected and reduce littering. However, implementing and operating a DRS has costs, which must be borne by some or all of the actors involved in the production, sale and consumption of beverages, as well as impacts on those that manage the resulting waste.

There has recently been a good deal of debate in the UK about the introduction of a DRS, and, following a process of evidence gathering and analysis of the likely effects, the Scottish Government announced in September 2017 that it plans to launch such a system. Work previously undertaken in Scotland noted a concern voiced by some stakeholders that such schemes would impose net costs on local authorities. For example, the Convention of Scottish Local Authorities (COSLA) expressed the view that a DRS would remove valuable materials (such as aluminium and the plastic PET) from recycling collections, increasing the net costs to councils of service provision.

However, initial analysis undertaken by Eunomia Research & Consulting Ltd (Eunomia) on behalf of Zero Waste Scotland indicated that a DRS would lead to annual savings to local authorities in Scotland of £4.6 million.[1]

Subsequently, Eunomia was commissioned by Keep Britain Tidy, Campaign to Protect Rural England (CPRE), Surfers Against Sewage, the Marine Conservation Society, Reloop and Melissa and Stephen Murdoch to undertake a detailed study on the financial impacts of a DRS on local authorities in England.

This study focuses on English local authority waste services. It finds that, while it is true that some valuable materials may be removed from existing recycling services, far from leading to additional costs, a DRS would be likely to yield net savings, overall, once other factors such as the likely impact on residual waste arisings are taken into account. Even

[1] Eunomia Research & Consulting (2015) A Scottish Deposit Refund System, Final Report for Zero Waste Scotland, available at http://www.zerowastescotland.org.uk/sites/default/files/ZWS%20DRS%20Report_MAIN%20REPORT_Final_v2.pdf

so, in some situations, the distribution of these net savings is uneven, so that some actors may be affected negatively. Measures discussed below can help ensure the savings available are shared more equitably.

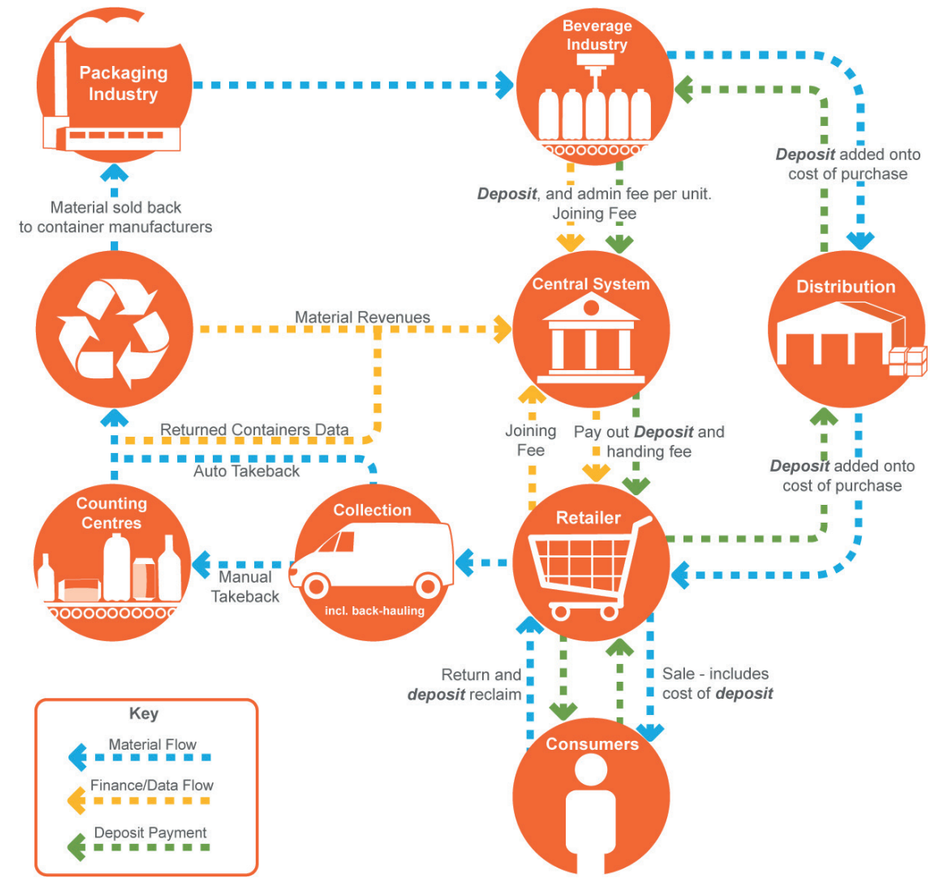
E.1.2 What is a DRS?

A one-way DRS for single-use beverage packaging (e.g. beer cans, soft-drink bottles) is a system that incentivises the return of used packaging through the use of a refundable deposit.

Consumers pay the deposit when they purchase the beverage and receive it back when they return the container to designated collection points, typically located in retail outlets or other centralised locations. If a consumer chooses not to return the empty container, then they lose the deposit. The containers that are collected are recycled.

The overall design of a generic DRS is summarised in Figure 1-1.

Figure 1-1: General Material and Financial Flows in Deposit Refund Systems



Source: Eunomia

E.1.3 What impacts would a DRS have on local authority waste services?

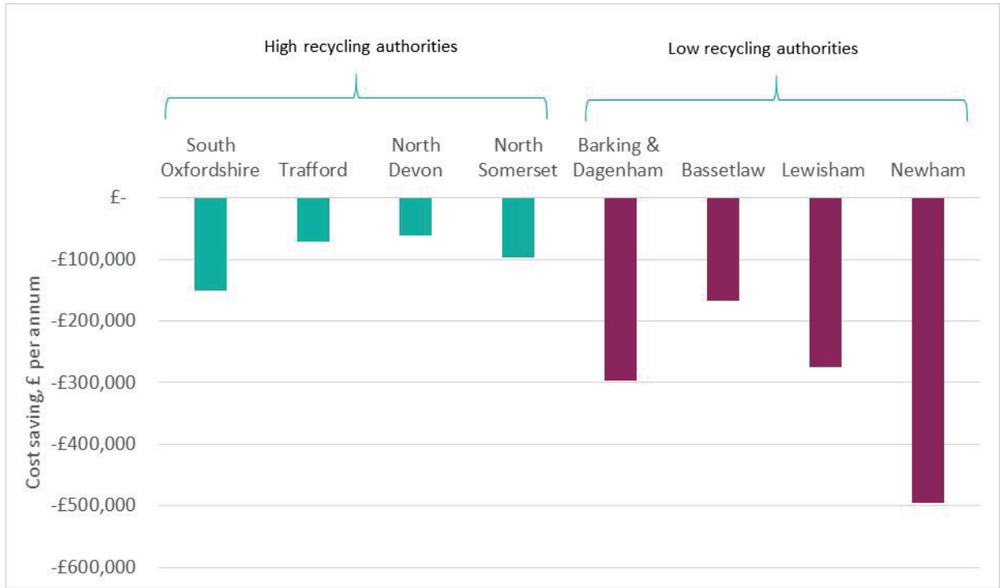
The main concern expressed to date on behalf of local authorities is the potential loss of material revenue. It would thus seem logical that the local authorities that currently achieve high rates of recycling are those that will have the most to lose in the event that a DRS is implemented. Therefore, the main focus of this study is the impact on local authorities already performing well in terms of recycling.

We found that for the high performing recycling authorities assessed in this study, despite the reduced amount of higher value materials in kerbside recycling collections, a DRS still results in net cost savings. This is due in large part to a reduction in residual waste requiring treatment, along with the possibility of reduced material recovery facility (MRF) costs and potential efficiencies in collection. There also appears to be potential for a reduction in street cleansing costs.

Some additional analysis indicates that authorities with low recycling performance could potentially make greater savings since a larger proportion of the materials captured within a DRS are diverted from what is currently collected as residual waste.

The estimated annual savings are summarised in Figure 1-2, and across the local authorities considered, range from £62,000 to £495,000. On a 'per household' basis, the savings range from £0.72 to £4.06 per household. The (unweighted) mean average saving among the 'high recycling authorities' is £1.47 per household, while among the 'low recycling authorities' it is £3.33 per household.

Figure 1-2: Summary of potential cost savings, £ per annum net (Waste Collection Authority and Waste Disposal Authority costs combined)



Source: Eunomia

To put this in context, residual waste and recycling typically costs between £100 and £140 per household per year, depending on geography, demographics and collection frequency.[2]

Assuming, arguably conservatively, that the mean average saving across the high recycling authorities (of £1.47 per household) is replicated across England as a whole, the annual net saving to local authorities under a DRS would be close to £35 million.

If the mean net savings per household across the eight authorities considered (of £2.40 per household) were scaled up to the England level, the annual net savings would be in excess of £56 million.

Impacts on collections

In some circumstances, councils may make savings as a result of having less material to collect at the kerbside. If vehicles fill up less quickly, they will not need to leave collection rounds as frequently to go and unload their contents. Where recycling is sorted from boxes at the kerbside, the reduced amount of material can also reduce the time taken to collect the recycling from each property, accelerating collection operations. The result could be to allow vehicles to serve more households in the same amount of time. These effects can translate into collection efficiencies and a reduction in the amount of vehicle and staff resources required to undertake collection work. Impacts on annual collection costs for the four authorities considered ranged from 'no change', to savings of £152,000. On a per-household basis this equates to savings of up to £1.65 per household.

Impacts on sorting costs

For councils that source-separate recyclables, any reduction in the amount of recycling collected will result in a fall in the amount of income they make from the onward sale of the material. However, many councils collect recyclables in a mixed stream that requires sorting at a MRF. Sending material to a MRF is often a cost to councils (or, equivalently, their contractors), and if a DRS leads to a reduction in the amount of recycling collected, this would reduce the tonnage on which such costs are incurred. On the other hand, if a DRS removes valuable material from local authority mixed recycling, this would be likely to increase MRF gate fees (which should be determined net of revenue from material sales). Nevertheless, the net position resulting from combining an increased unit cost, but a reduced quantity, is found to be a cost saving. The estimated annual savings on sorting range from just £800 up to £220,000. On a per-household level, savings on sorting range from £0.01 to £3.14 per household.

Impacts on material revenue

Lost revenues as a result of a DRS are not as significant as some have expected. A large proportion of relatively low-value glass bottles are removed, while relatively high-value HDPE containers such as milk bottles remain available for collection in local authority recycling systems.[3] The largest streams by weight in local authority recycling collections - paper and card - are largely unaffected.

Lost materials revenue is estimated to range from £58,000 to £160,000. On a per-household basis, losses in material revenue range from £0.67 to £1.63 per household.

Given that material revenues fluctuate, it's worth considering the extent to which they would have to increase in order for the net savings identified to be 'eroded' to zero. For the four high recycling authorities, the ratio of 'all the savings' to 'material revenue losses' varies from 1.8:1 to 3.6:1. That means that for the local authority where net savings are most sensitive to material price changes (having a ratio of just 1.8:1), all else remaining equal, the value of the materials would have to increase by 80% for the net savings for that authority from a DRS to reduce to zero.

The equivalent ratios for the four low recycling authorities range from 2.7:1 to 7:1.

Impacts on residual waste treatment/disposal costs

The extent to which a DRS leads to savings on the costs of treatment/disposal of residual waste depends, in large part, on the proportion of potentially deposit-bearing containers currently found within residual waste. The potential savings are greater for authorities that collect fewer beverage containers for recycling at present.

The estimated annual savings on the costs of treatment/disposal range from £31,000 to £555,000. On a per-household basis, savings on residual waste treatment/disposal range from £0.54 per household to £4.55 per household.

Impacts on street scene services

Cost savings on street scene services could also be realised. The savings mainly result from the opportunity to remove some litter bins in specific areas and a reduced need for manual litter pickers.

For more urban authorities, the savings could be in the order of £25,000 to £50,000 per annum (£0.22 to £0.45 per household). Rural authorities may see smaller savings. It's important to note that potential savings on street scene services are *not* included in the above calculations reporting the overall savings to local authorities. Accordingly, any street scene savings realised will be additional.

A summary of the key impacts is presented in the following infographic.

[2] Based on WRAP's ICP Benchmarking Tool, available at http://laportal.wrap.org.uk/ICPTool.aspx

[3] While it is technically possible to include milk containers within a DRS, the decision was taken in this study to assume that they were not included when undertaking our analysis.

*based on the 4 high performing authorities in the report | ** based on all 8 authorities in the report | *** based on interviews with a range of authorities in the report
Range of annual savings/loss of revenue analysed in Eunomia's October 2017 report Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services

E.1.4 Distribution of savings

While there is clear potential for savings to the public purse overall, the two-tier local government structures in place in many parts of England may mean that potential benefits may not be realised by waste collection authorities (WCAs). This means that districts may have good reason to oppose a DRS if the costs directly confronting them will rise, and they feel that the savings to the waste disposal authority (WDA) will not be passed through.

Following introduction of a DRS, where beverage containers would fall in quantity, both in recycling and in residual waste, in a two-tier situation, the WDA will experience a double win from savings associated with the reduction in treatment/disposal, as well as savings associated with reduced requirements to pay recycling credits. The WCA, on the other hand, will experience a loss associated with the reduction in recycling credits received (in addition to loss of potential material income), albeit this may be offset to an extent by reduced collection and sorting costs.[4] Nonetheless, WCAs could be adversely impacted under a DRS, and at risk of being unable to fund the collection services provided, with WDAs benefiting disproportionately.

However, it is possible for revised working practices to be put in place to enable such savings to be shared appropriately. An approach already used in some two-tier authorities is to ensure the WCA is no worse off following changes that would benefit the WDA, and to share the benefits of waste which is not sent for residual treatment/ disposal (i.e. under a 50:50 sharing arrangement, or other such arrangement where the WCA sees some of the benefit of reductions in residual waste).

Such approaches will need to be rolled out more broadly to ensure that WCAs benefit more fully from the introduction of a DRS - a measure that overall will lead to savings to taxpayers.

E.1.5 Policy conclusions

When viewing the overall picture, suggestions that local authorities would be negatively impacted from introducing a DRS in England are unlikely to be valid and, in fact, significant savings may be available. It should be acknowledged that challenges may need to be overcome in certain cases to ensure, specifically, that waste collection authorities do not lose out while waste disposal authorities benefit unduly, but solutions to such hurdles are available. While limitations on the scope of this study mean that definitive conclusions cannot be drawn for all authorities, all scenarios tested in this

[4] Because the recycling credit payment is simply a transfer of funds from one local government department to another, these are not apparent in the overall net costs

analysis show net savings across the services, assuming there is adequate lead-in time for councils to adapt and prepare. Informed and considered government regulatory implementation would also help deliver the savings on offer.

The results of this study are likely to be representative because:

- The modelling results are the product of close collaboration with four diverse local authorities, with high rates of recycling, and based upon a detailed, WRAP-validated collections model Eunomia has developed and improved over the past 15 years;
- The report was peer reviewed by the authorities, as well as other relevant stakeholders such as waste collection companies and MRF operators;
- For many councils, the majority of savings will be on waste disposal, which can be estimated with far greater certainty than savings in respect of collection logistics.

In addition to saving councils money, a DRS would:

- Further the principles of Extended Producer Responsibility, and move the cost burden of waste management away from local authorities.
- Respect the "polluter pays" principle, as those who do not return their beverage container for recycling pay a large proportion of the costs of managing the waste.
- Boost the economy and communities by creating green jobs, as assessed in Eunomia's previous reports on this subject.[5]
- Increases the likelihood that reprocessing investments are made within England, owing to the superior quality of the material that is collected, and the low cost of dealing with any contamination (thereby reducing the competitive advantage of overseas processors benefiting from low cost disposal of more contaminated loads);
- Help to reduce the flow of plastics from rural and urban areas into the marine environment, which is causing major impacts to our environment, and polluting our food and drinking water.

We therefore recommend that, following its evidence gathering process via the Voluntary and Economic Incentives Working Group, the UK Government commits to introducing a DRS for one-way beverage packaging in England, to be designed with input from key stakeholders.

[5] Eunomia Research & Consulting (2011) From waste to work: the potential for a deposit refund system to create jobs in the UK, Final Report for CPRE

Contents

1.0 Introduction

Eunomia Research & Consulting Ltd was asked to carry out a syndicated study for Keep Britain Tidy, Campaign to Protect Rural England (CPRE), Surfers Against Sewage, the Marine Conservation Society, Reloop and Melissa and Stephen Murdoch regarding the potential impacts from the introduction of a Deposit Refund System (DRS) for one-way beverage packaging on local authority waste services in England. This study is of particular importance as there has been much debate about the introduction of a DRS across the UK generally in recent years:

- Firstly with the 'Have we got the bottle?' report by CPRE in 2010, the first cost benefit analysis of a UK-wide DRS;[6]
- This was followed by the 'From waste to work' report prepared for CPRE that assessed the significant overall job creation benefits of a national DRS;[7]
- Then a number of reports from the Scottish Government around the feasibility of deposit return, culminating most recently in the First Minister Nicola Sturgeon announcing on 5 September 2017 that Scotland will introduce a DRS for drinks containers in Scotland;[8,9,10]
- There has been growing interest in Wales, including Plaid Cymru securing majority support in April 2017 for a Waste Reduction Bill that would include legislation on a DRS for Wales;[11]
- Cross-party support with commitments to a DRS from Labour, Plaid Cymru, UKIP, and the Green Party in the 2017 General Election manifestos;[12]
- Coca Cola UK coming out in support of well-implemented DRSs;[13]
- A major waste company, Suez Recycling and Recovery UK, doing the same;

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[6] Eunomia Research & Consulting (2010) *"Have We Got the Bottle? Implementing a Deposit Refund System in the UK."* Report for Campaign to Protect Rural England (CPRE), http://www.cpre.org.uk/resources/energy-and-waste/litter-and-fly-tipping/item/1918-have-we-got-the-bottle

[7] Eunomia Research & Consulting (2011) From waste to work: the potential for a deposit refund system to create jobs in the UK,

[8] http://www.zerowastescotland.org.uk/content/deposit-return-system-feasibility-study

[9] ZWS (2015) *Drinks cash deposit scheme in Scotland – New report explores options*, http://www.zerowastescotland.org.uk/content/drinks-cash-deposit-scheme-scotland-%E2%80%93-new-report-explores-options

[10] Scottish Government (2017) *A Nation With Ambition - The Government's Programme for Scotland 2017-18*; http://www.gov.scot/Resource/0052/00524214.pdf

[11] http://www2.partyof.wales/cab_drs

[12] All manifestos available via http://www.maniffesto.com/

[13] Sky News (2017) *Coca-Cola in u-turn over plastic bottle deposit scheme*, http://news.sky.com/story/coca-cola-in-u-turn-over-plastic-bottle-deposit-scheme-10777393

- In April 2017, the Government launched the *'Voluntary and Economic Incentives Working Group'* as part of its National Litter Strategy, tasking the group to consult and consider the advantages and disadvantages of different types of deposit and reward and return schemes for drinks containers, so as to provide advice by the end of 2017;[14] and
- The Government's Environmental Audit Committee has now relaunched its predecessor's enquiry from March 2017 (dropped in April 2017 as a result of the snap General Election) into the damage being done to the environment by disposable drinks packaging.[15]

Evidence from other countries indicates that clear benefits can accrue from DRSs, in terms of increasing recycling performance, improving the quality of the material that is collected (especially plastics) and reducing litter (the clear evidence for litter reduction is set out in this report). However, there will be impacts from implementing a new waste management system, and additional costs or benefits falling on various actors.

The funders commissioned this work because one of the perceived obstacles to a DRS progressing in countries in the UK, at least in the eyes of policy-makers, has been the concerns raised by local authority representatives that they would incur net costs. In Scotland, representatives from the Convention of Scottish Local Authorities (COSLA) expressed this concern, generally on the basis of the view that a DRS would remove valuable materials from recycling collections, increasing the costs of service provision to local authorities. The assumption is that as household recycling services are well-established, and some high-value materials are removed from the waste stream (PET and aluminium), the net impact would not be positive for local authorities. Indeed, LARAC's response to the call for evidence from the Environmental Audit Committee states that removing plastic bottle from council collection schemes:

> *'…would have the effect of making [them] less efficient…'*

Therefore the question that we were asked to answer during the course of the study was:

> *'What would be the impacts of the introduction of a Deposit Refund System (DRS) for one-way beverage packaging on local authority waste services?'*

The scope was limited to issues surrounding English local authority waste services only. We were not tasked with looking at the wider costs and benefits of a DRS and the distribution of impacts across other affected actors, a matter Eunomia has explored elsewhere.[16,17]

It should be noted that Eunomia has considered this issue in previous work, but in a relatively aggregated form.[18] In England, the impact on local authorities is complicated by the fact that there are often two tiers of government with differing responsibilities for waste collection (the waste collection authority, or WCA) and treatment and disposal (the waste disposal authority, or WDA). This, as well as the nature of the transfers between them, can affect the perspective of the different authorities in England in ways which are not so relevant in Scotland, Wales and Northern Ireland, where all local authorities are unitary authorities.

In order to ensure the outcomes of the study were as robust as possible we engaged with six local authorities from across England, selecting those that were mainly at the higher end of the performance spectrum in terms of recycling. In fact, three of the authorities had the highest recycling rates in 2015/16 for fully commingled, twin-stream and kerbside sort collection services in the country. The intention was to focus on higher performers, since if the argument around 'losing valuable materials' to DRSs carries weight, it is these authorities that may have the least to gain/most to lose from a DRS being implemented.

A detailed modelling exercise was conducted for four of the six participating local authorities (with the remaining two authorities still contributing to the study through the workshops as described below). The aim of focusing the modelling on four of the six authorities was to ensure the modelling could be carried out to an adequate level of detail within the available budget. Moreover, the key characteristics of the systems deemed most relevant could be covered by just four - the key aspects being the different recycling collection types and the density of the housing stock (e.g. urban or rural areas). Input from all six participating authorities occurred through a few key actions:

1) A first workshop, in January 2017, involved Eunomia explaining how a DRS would work, and listening to local authority concerns and/or views as to what changes this would mean for the operation of their waste collection service. On the basis of the workshop a set of research questions were developed with the local authorities, including a view as to what would be the nature of the evidence that

[14] HM Government (2017) *Litter Strategy for England*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/630999/litter-strategy-for-england-2017-v2.pdf

[15] Environmental Audit Committee (2017) *Disposable Packaging: Plastic bottle and coffee cup waste inquiry launched*, https://www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/news-parliament-2017/disposable-packaging-coffee-cups-and-plastic-bottles-17-19/

[16] Eunomia Research & Consulting (2010) *"Have We Got the Bottle? Implementing a Deposit Refund System in the UK."* Report for Campaign to Protect Rural England (CPRE), http://www.cpre.org.uk/resources/energy-and-waste/litter-and-fly-tipping/item/1918-have-we-got-the-bottle

[17] Eunomia Research & Consulting (2013) *Exploring the Indirect Costs of Litter in Scotland,* Report for Zero Waste Scotland, 2013, http://www.zerowastescotland.org.uk/sites/files/zws/Indirect%20Costs%20of%20Litter%20-%20Final%20Report.pdf

[18] Eunomia Research & Consulting (2015) *A Scottish Deposit Refund System,* Report for Zero Waste Scotland

would be required in order to ensure the questions were appropriately answered.

2) A second workshop, in March 2017, involved Eunomia presenting the modelled results to the authorities, and for them to 'sense check' both the assumptions and the findings. After the workshop, feedback was gathered on the extent to which the research questions were answered and whether any further work needed to be carried out in order to ensure the questions were fully answered.
3) The authorities were also invited to review the full draft report, and most provided comments back to the project team. Following the peer review process a number of assumptions were amended to improve the accuracy of the results. Consequently, the estimated savings from changes to kerbside collection services were reduced.

The remainder of the report is structured as follows:

- Section 2.0 outlines how a DRS may affect local authority waste services, by first explaining in more detail what a DRS is, which services are likely to be affected and what the likely magnitude of the effect would be (by considering the relative prevalence of beverage containers in the household waste stream);
- Section 3.0 presents the core findings of the study, in terms of the potential changes in costs for kerbside and street scene services, and the underlying drivers of these changes;
- Section 4.0 sets out how the changes in costs may be distributed, the current conditions (not related to the DRS) that affect the distribution of costs and mitigating actions that could be implemented to ensure savings are more widely shared between WDAs and WCAs; and
- Section 5.0 provides some concluding remarks on the research.

2.0 How would a DRS affect local authority waste services?

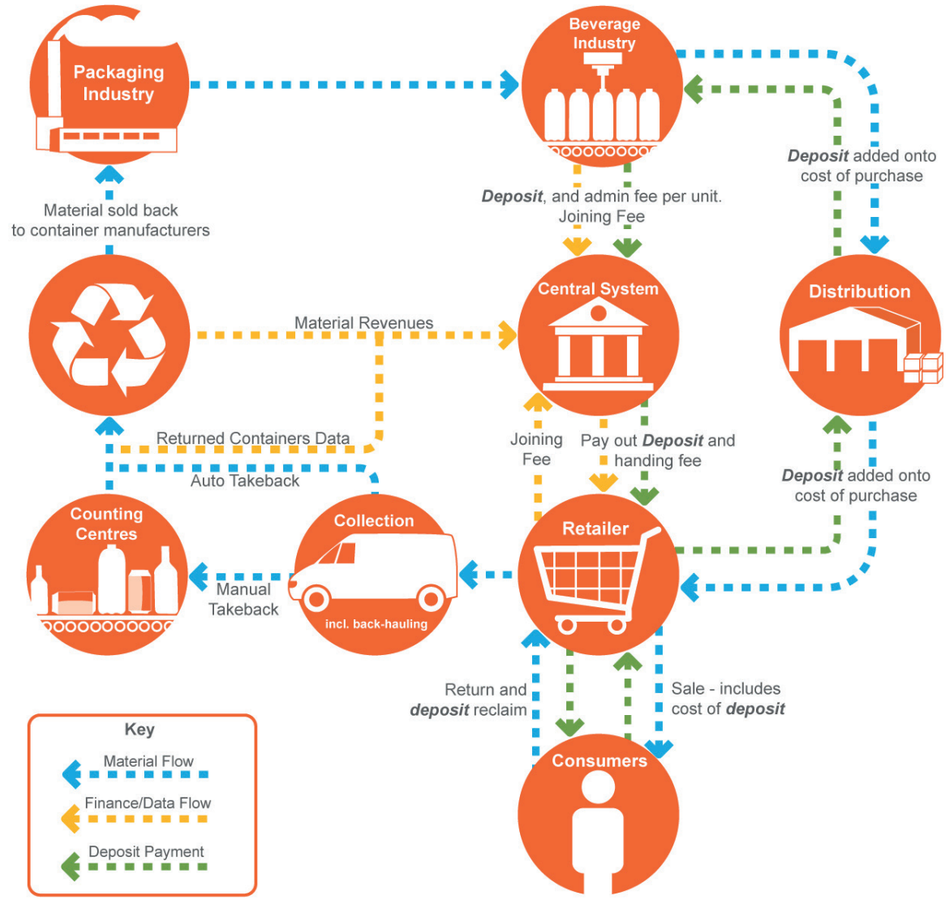
2.1 What is a DRS?

A DRS for one-way beverage packaging (e.g. beer cans, soft-drink bottles) is a system that incentivises the return of the packaging (once the beverage has been consumed) to collection points, through the use of a refundable deposit. Consumers pay the deposit when they purchase the beverage and receive it back when they return the container to one of the designated collection points. If a consumer chooses not to return the empty container, then they lose the deposit.

Collection points are located in retail outlets, for convenience, or centralised locations, where containers can be deposited in bulk. At retail outlets, consumers can return the 'empties' to the shop counter or to automated 'reverse vending machines' (RVMs). The empty containers that are collected can then be recycled into new containers and returned to the beverage packaging industry for filling with new beverages, or used for other manufacturing purposes.

The overall design of a generic DRS is summarised in Figure 2-1. This figure shows the deposit being passed from one actor to the next through the supply chain and onto the consumer at the point of purchase. The deposit passes back to the consumer when the empty container is returned. The process of tracking the deposit through the system, and recording when the deposit is returned to the consumer, is called 'clearing'. Finally, financial transactions are made between different actors in order to ensure that the costs and revenues are distributed appropriately, for example, in line with the contribution made by different parties to the operation of the system. These financial transactions include a handling fee that is paid to retailers in order to compensate them for facilitating the collection (or take-back) infrastructure.

Figure 2-1: General Material and Financial Flows in Deposit Refund Systems



Source: Eunomia

2.2 Which local authority services would be affected?

A range of different local authority waste management services may be affected by the introduction of a DRS. The extent to which beverage containers are present in the waste managed by the different services will drive the magnitude of the effect.

Table 2-1: Scope of Analysis

Service	Presence of Beverage Containers	Included in Analysis?
Recycling collections 	Reasonably significant depending on the level of recycling	Yes, this would be the main route for collection of beverage containers collected for recycling
Refuse collections 	Reasonably significant depending on the level of recycling	Yes, this would be the main route for beverage containers collected for residual waste treatment or disposal
Residual waste treatment / disposal 	Reasonably significant depending on the level of recycling	Yes, this would be the main route for beverage containers for residual waste treatment or disposal
Street scene / beach cleaning 	Reasonably significant proportion of beverage containers in material being collected through street scene or beach cleaning services	Yes, the flows may not be as significant as through kerbside services, but the services are relatively (on a tonne for tonne basis) expensive so it is important to analyse this
Bulky waste collections 	Unlikely to be any beverage containers at all in material collected through bulky waste services	No, near zero flows take place through this route so no need to analyse effects on this service
HWRCs 	Some HWRCs do have bottle banks, but the amounts are quite small compared to kerbside services	No, unlikely to be a significant change in cost (from less frequent filling and collection of bottle banks) so not included
Clearing fly tipped waste 	Some beverage containers might be present in mixed wastes	No, contribution is likely to be small so not included ('litter' is included in scope of street scene / beach cleaning – see above)

Table 2-1 outlines the main local authority waste services, the likely significance of beverage containers within the waste stream and, consequently, whether the waste stream was considered appropriate for analysis.

2.3 What is the likely scale of the effects?

To provide some context, and understanding of the likely magnitude of the effects to waste services, we present here the proportion of beverage containers relative to the overall waste stream (by material category). However, in order to understand the contribution of beverage containers in the total, we first need to set out what type of beverage containers are 'in scope' of the DRS. Following discussions in previous work, for the purposes of this study, we have assumed that the following container types are in scope (brands shown are indicative, not exhaustive). The scope is essentially to include all beverages sold in metal cans, PET or HDPE bottles, glass bottles or beverage cartons:[19]

In scope:

It is important to note that milk is generally excluded from DRSs, so HDPE milk bottles would not be included, and so would still be present in the local authority waste streams:

Not in scope:

[19] Eunomia (2015) *A Scottish Deposit Refund System*, Final Report for Zero Waste Scotland, http://www.eunomia.co.uk/reports-tools/a-scottish-deposit-refund-system/

In addition, the scale of the effect is dependent upon how much material is diverted from the household services to the DRS, which is, in turn, driven by the return rate of the system itself. Return rates in best performing European DRSs are in the order of 90% and above, and this is what was assumed for this study. Some stakeholders have suggested the return rate would not be as high in England as there are many convenient kerbside services in place across the local authorities. However, in Germany, where there are also convenient kerbside recycling services that could be used, the return rate is 98.5%. The deposit value is higher than most other systems, but it shows that the presence of other convenient recycling services is not a barrier to high return rates, and that the value of the deposit does motivate high rates of return: consequently, we see no clear reason for a return rate lower than 90%, and, indeed, it should be the objective of the scheme to achieve such a high rate.

A DRS should also lead to a substantial reduction in littering of deposit-bearing beverage containers, as there is a clear economic incentive for the containers to be returned. Even if they are dropped by the initial consumer, the deposit acts as an incentive for them to be picked up and returned by someone else, so that the deposit can be claimed. This would reduce land-based litter and marine litter as many plastics bottles are washed into drains and rivers, and make their way to the sea. In this study we assume an arguably conservative reduction in littering of such beverage containers of 80%, although, as shown in Appendix A.3.0, one might reasonably expect reductions in excess of 95%.

For collected household waste, the following graphs show the baseline composition and the change following the introduction of a DRS, with the proportion of each material category that is beverage containers clearly identified. The figures show the combined data of the four local authorities that were subject to detailed modelling.[20] Data on waste generation and recycling were obtained from each authority. In addition, some assumptions regarding the proportion of beverage containers in higher level material categories (e.g. the amount of plastic bottles in 'plastics' or the amount of plastic drinks bottles in 'plastics bottles') were taken from a detailed waste composition produced by Resource Futures for Defra[21], and figures quoted in the Valpak study for Zero Waste Scotland on options for a DRS in Scotland[22].

The data compiled across the four successive charts seeks to tell the story of how much beverage packaging exists today in our household waste streams, as well as what would be expected to occur following introduction of a DRS.

[20] The four authorities modelled were North Devon, North Somerset, South Oxfordshire and Trafford.
[21] Resource Futures (2013) *Defra EV0801 National compositional estimates for local authority collected waste and recycling in England 2010/11*, Report for Defra http://randd.defra.gov.uk/Document.aspx?Document=11715_EV0801ReportFINALSENT05-12-13.pdf
[22] Valpak (2015) *Scottish Packaging Recovery Note Feasibility Study*, Report For Zero Waste Scotland http://www.zerowastescotland.org.uk/sites/default/files/SPRN_0.pdf

Key observations are:

- The highest proportion of a given material stream that is made up of beverage containers is found in the case of glass, followed by aluminium;
- The baseline capture rates are generally higher for the beverage container stream, except for beverage cartons, where the overall recycling rate for cardboard is higher;
- The beverage container capture rates shown here (within Figure 2-3) are higher than the average rates seen across England as a whole, due to the modelling being conducted on some of the highest performing local authorities in the country. Average capture rates across the country would not reach these levels. Furthermore, loss rates following collection, especially for plastics, from kerbside services can be high, whereas they are very low through a DRS. In any case the capture rates from a DRS would lead to an increase in overall recycling for these very high performing authorities, as well as leading to litter reduction (which high capture rates from kerbside services do not guarantee – due to different incentives being in place); and
- By weight, the most significant transfer of material from local authority services to the DRS is likely to be for glass. However, by volume (which is often what dictates changes in collection efficiency for recycling) the most significant transfer is for plastics, which have one of the lowest average recycling rates in the country.

Figure 2-2: Baseline total waste composition, %

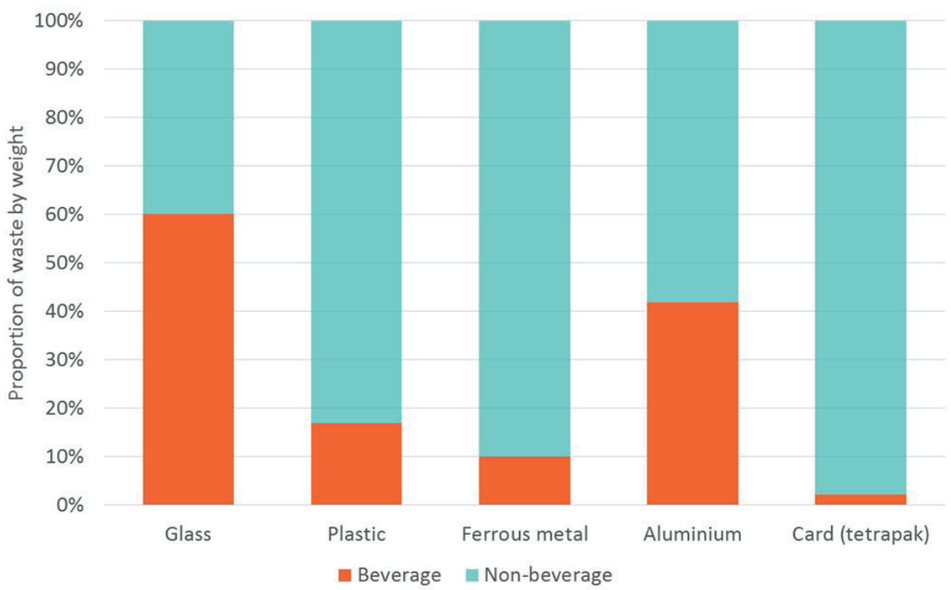


Figure 2-3: Baseline capture rates, %

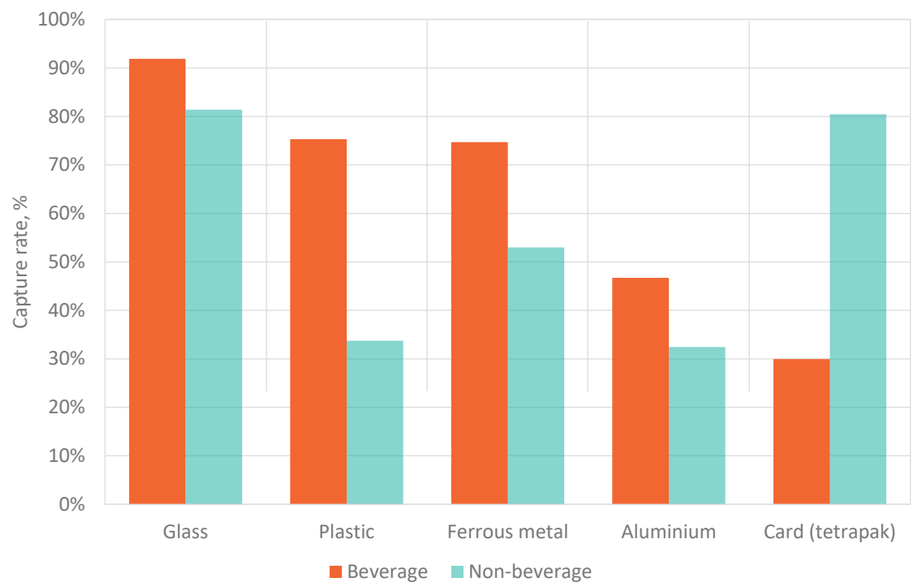
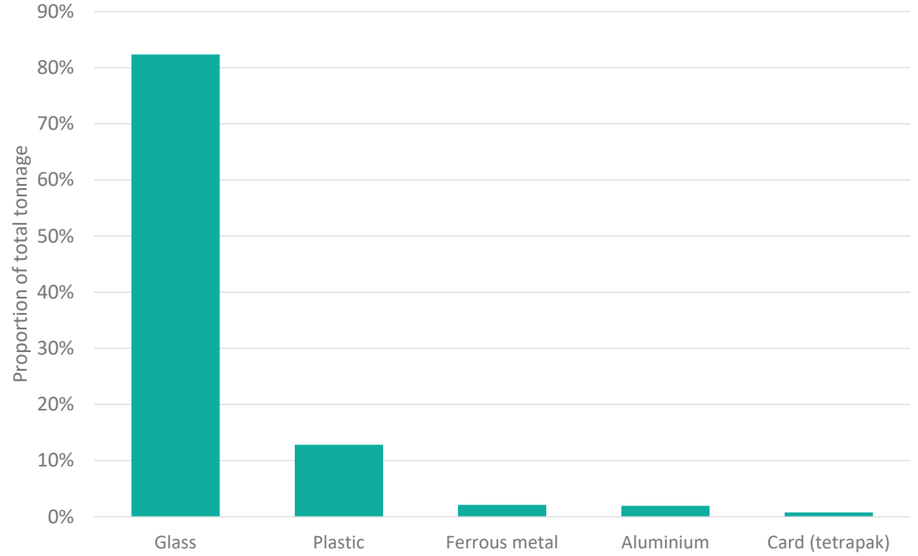
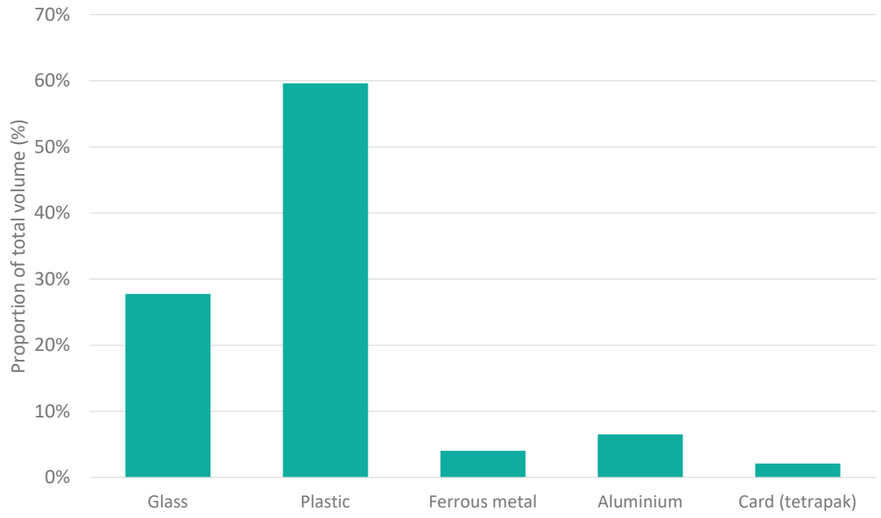


Figure 2-4: Material transferred from local authority kerbside recycling to DRS, by weight



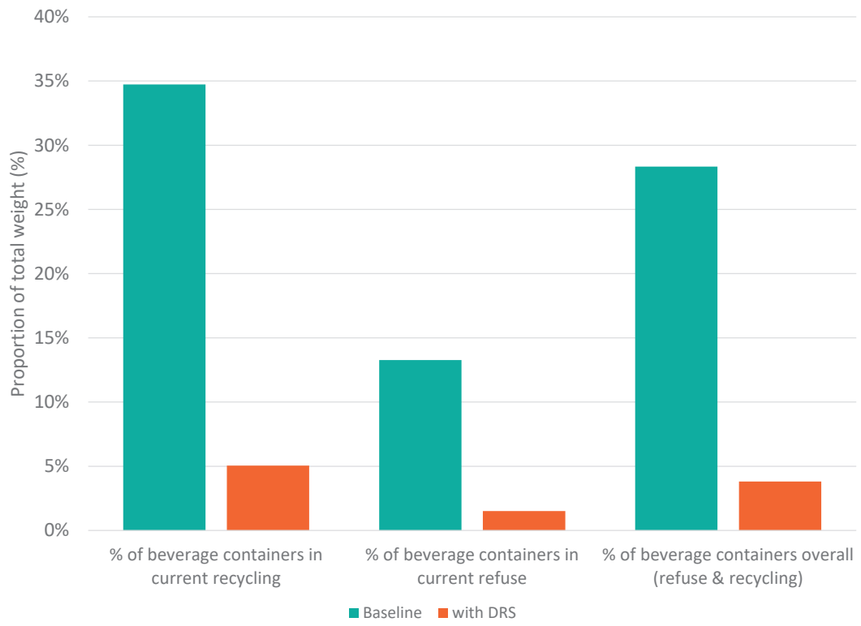
Note: The impact on local authority collected dry recycling due to a beverage container deposit system is modelled as 22% overall reduction by weight, or 19% by volume, within the four case study authorities.

Figure 2-5: Material transferred from local authority kerbside recycling to DRS, by volume



Note: The impact on local authority collected recycling due to a beverage container deposit system is modelled as 22% overall reduction by weight, or 19% by volume, within the four case study authorities.

Figure 2-6: Change in proportion (by weight) of local authority waste streams that is beverage containers



3.0 What might the impacts be?

In this section we present the core results of the analysis, firstly outlining the impacts from changes to kerbside services, then considering the effects on street scene operations and, finally, taking into account other issues that have been considered.

3.1 Household kerbside services

3.1.1 How are collection services likely to be affected?

Within this section, the costs and savings expected to result from a DRS are outlined, as related to household kerbside refuse and recycling services. Following the introduction of a DRS, the amount of refuse and recyclables collected by, or on behalf of, local authorities is expected to fall as consumers instead return beverage containers to retailers or other locations (depending on the system design of the DRS). This can be expected to result in consequential impacts upon collection systems, as well as changes in the costs of managing the collected materials.

Regarding the collection operations, the reduction in material passing through household waste collection systems could result in savings. In broad terms, less material requiring collection can result in reduced work for collection staff and emptier vehicles. Such effects are depicted in the stylised illustration in Box 1.

With less material being collected from the kerbside following introduction of a DRS, in certain circumstances the propensity for vehicles to reach capacity may reduce. In such cases, the vehicles will not need to leave collection rounds as frequently to go and unload their contents. In the case of recycling, if this is sorted from boxes at the kerbside, the reduced amount of material can also reduce the time taken to collect the recycling from each property, further hastening collection operations. The resultant effects could allow vehicles to serve more households in the same amount of time.

These effects can translate into collection efficiencies and lower numbers of vehicles required to undertake collection work each day. In a case where the required amount of collection work would decrease by one day per week, this will result in reduced fuel use and lower requirements for staffing. In a case where the collection service can operate with fewer collection vehicles overall, more significant cost savings will be achieved. The extent to which this happens is likely to depend on the scale of an authority's operations (where an authority operates only a small number of vehicles there is less chance of taking whole vehicles off the road than for an authority operating large numbers of vehicles).

Also regarding collection services, it may be noted that one further effect was considered within the study. It was postulated that reduced volumes of material and emptier bins means there may be a slight decrease in the total number of householders putting their recycling or residual waste containers out on collection day (the 'setout rate' reduces). This may occur where remaining capacity in a bin is sufficient to wait until the next collection. In this case, collection crews would be able to clear a street more

quickly, leading to savings. However, local authority stakeholder feedback on the draft report suggested that this effect is not certain, and thus the modelling was amended to omit this aspect, and thus the results as presented below have been moderated.

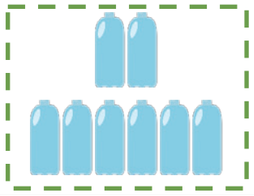
Local authority feedback also indicated that reducing the number of vehicles operating on any collection day is likely to require numerous changes to collection days throughout the week to compress the rounds and eliminate a whole day's work. It was highlighted that this has costs and practicalities associated with it. In such cases where the costs or practicalities are prohibitive, it may be necessary to wait until rounds are redesigned for other reasons (such as contract end dates or as part of wider service reforms). Such issues around transition and the time at which savings may be realised are addressed in Section 0.

Regarding the management of collected materials, less residual waste will result in savings from a lower bill for treatment or disposal. In addition, less collected recyclables can (on the one hand) lead to a reduction in costs associated with sorting of collected mixed recyclables, but (on the other hand) also lead to a loss in income derived from the recyclable materials, which are segregated either during collection or at a materials recovery facility (MRF).

Box 1: Effects of a DRS on kerbside sort collection systems

Effect 1: *Fewer containers means less space is taken up in waste and recycling containers.*

Today: (showing only containers)



With DRS: (showing only containers)

Effect 2: *In the case of recycling, if this is sorted from boxes at the kerbside, the reduced amount of material can reduce the time taken to service each property, hastening collection operations.*

Effect 3: *In cases where vehicles do not need to leave the collection round to unload as frequently, this will also allow vehicles to serve more households in the same amount of time.*

Effect 5: *As a result of the above, it may be possible to reduce the number of vehicles that are needed to collect from households each day.*

Today:

With DRS:

3.1.2 Local authority case studies

How a DRS would impact an individual local authority will differ from situation to situation. Much depends on the types of collection system operated. For instance, a local authority that collects co-mingled recycling will not experience the same range of effects as an authority that operates a kerbside sort collection operation. This is because of the different ways in which staff interact with the collected material and what happens to it after it is collected. In addition, diversity in how services are organised (i.e. whether the local authority operates the collections itself, or whether the services are contracted out to a private sector waste company), as well as different local governance structures (i.e. single or two-tier local government administration), will also lead to different distributions of costs and benefits. Finally, whether local authority recycling performance is high or low will affect the outcome as this will determine the relative quantity of material diverted from recycling or refuse collections following introduction of a DRS.

To investigate the real world expected impacts, a detailed modelling exercise was conducted focused on specific local authorities using Eunomia's proprietary collection cost model, Hermes. Hermes is a powerful collection resource and financial appraisal tool, which has been continually developed over a period of 15 years, and used in more than 150 projects supporting local authority collection service changes during this time, and is approved by WRAP as fit for purpose. The approach taken for each local authority was to establish a baseline model reflecting the existing services in terms of resources and performance, which is set up in order to calibrate the model. The changes anticipated following introduction of the DRS are then applied to the baseline models for each authority so as to model the impact on the day-to-day collection operations, and on overall waste service costs.

The results of this modelling are presented in two parts within this report. Firstly, the overall net financial impacts to the local authorities are summarised below. The distribution of costs are then discussed in Section 4.3 in order to identify how costs and benefits fall between the different actors, as well as to outline how any imbalances can be mitigated.

In total, detailed collection cost and performance modelling was performed for four local authorities. Many of the considerations taken into account within the modelling were informed by the engagement with the local authority stakeholder group, which provided information through the course of the project, including through participation in two workshops.[23] The authorities that were modelled, their characteristics, and the collections systems currently operated, are detailed in Table 3-1.

[23] The six contributing authorities include the four modelled, plus Calderdale Metropolitan Borough Council and London Borough of Camden.

Table 3-1: Local authorities selected for modelling

	Urban	Rural	Current Recycling Rate	Collection Type
North Devon DC		✓	44%	Kerbside sort / multi-stream (box collection)
North Somerset Council	✓		60%	Kerbside sort / multi-stream (box collection)
Trafford MBC	✓		62%	Co-mingled twin stream –containers and fibres (wheeled bin collection)
South Oxfordshire District Council		✓	63%	Co-mingled single stream (wheeled bin collection)

Under the Government's 2011 Rural-Urban Classification, North Devon = "Largely Rural", North Somerset = "Urban with Significant Rural", Trafford = "Urban with Major Conurbation", South Oxon = "Mainly Rural".[24]

In general terms, higher performing authorities would appear to have both the least to gain and the most to lose from a DRS. They gain little under a DRS as fewer beverage containers will be diverted from residual waste collection and treatment/disposal, and (in the case of kerbside sort) they lose most revenue under a DRS from the containers being diverted from recycling. For this reason, for the local authorities selected for the modelling, a main focus was on high performing councils, in addition to selecting those operating different collection systems and in both urban and rural settings. It was felt that the authorities achieved a good balance of aspects relevant to a transition to a DRS, given that this group includes:

- 2 rural and 2 more urban authorities;
- 2 kerbside sort, 1 single stream comingled, and 1 twin-stream comingled (containers and fibres) scheme;
- A range of recycling performance – 3 high performing and 1 middle performing.

The overall results of the modelling are summarised in Table 3-2 (with detailed results provided and discussed in Appendix A.1.1). For all four case studies, being mid to high performing authorities in relation to recycling already, the collection-related savings focussed on recyclables collections; the effects on residual waste collection were assumed not to result in realisable savings. In authorities where beverage containers are found in higher proportions within residual waste, this may also/instead result in residual waste collection savings.

[24] Defra (2011) *2011 Rural-Urban Classification of Local Authorities and other geographies*, https://www.gov.uk/government/statistics/2011-rural-urban-classification-of-local-authority-and-other-higher-level-geographies-for-statistical-purposes

Table 3-2: Summarised results of kerbside collection modelling exercise

	South Oxfordshire	Trafford	North Devon	North Somerset
COLLECTION RELATED SAVINGS (focussing on recycling collection because of the high performing case studies)				
Volume of recycling collected per year	-18%	-32%* / -14%**	-28%	-15%
Weight of recycling collected per year	-20%	-46%* / -22%**	-26%	-21%
Percentage change in average number of properties per day recycling vehicles can service	No change modelled	+4%	+5%	+5%
Change to number of days of work to collect recyclables once from all properties	No change modelled	-3 (from 65, 4 weekly collection)	-3 (from 75, weekly collection)	-6 (from 135, weekly collection)
Impact on number of recycling vehicles required	No change modelled	One vehicle not used 3 days per 4 weekly cycle	One vehicle not used three days per week	Reduction of one vehicle, and one additional work day /week
Total miles driven per annum collecting recyclables, percentage change	No change modelled	-35%***	-6%	-4%
Overall collection costs, £/annum	**-**	**-£23,000**	**-£68,000**	**-£152,000**
SORTING OF RECYCLABLES				
Weight of material requiring sorting, tonnes	-3,500	-4,900	-400	-500
Overall sorting costs	**-£179,000**	**-£10,000**	**-£800**	**-£1,000**
MATERIAL SALES				
Materials revenues (positive values represent a net loss of income)	**+£58,000**	**+£80,000**	**+£67,000**	**+£114,000**
RESIDUAL WASTE				
Weight of residual waste collected	-2%	-2%	-3%	-2%
Treatment/disposal costs (negative values = saving)	**-£31,000**	**-£120,000**	**-£61,000**	**-£56,000**
TOTAL				
Total impact (negative = saving), £/annum	**-£151,000**	**-£72,000**	**-£62,000**	**-£96,000**

**Amount within container recycling stream. ** Amount within total dry recycling.*
****As relevant to container recycling collections.*
Note that the way in which these costs and benefits fall on individual actors is discussed in Section 4.0.

As previously introduced in Table 3.2, the reduction in volume of material placed out for collection is at least 15% in all cases, and more than 30% for the beverage container bin in the Trafford two-stream situation. This would be expected to lead to households placing bins out for collection less frequently (a lower set-out rate), and vehicles typically filling up less quickly. As a result, collection crews have less work to do and can thus service a greater number of properties per day. Collections activity across the complete vehicle fleet is thus completed more quickly, resulting in a reduction in the number of working days that vehicles and their crew are needed. Cost savings are generated accordingly from the reduction in fuel usage and personnel costs.

In addition, for the two authorities where recycling is sorted at the kerbside (North Devon and North Somerset), once deposit containers are diverted to the DRS, the reduction in the amount of recyclables generated will also improve the sorting time per property. In these cases, the result is that not just fewer collection days are needed, but

fewer whole vehicles are required for recycling collections, and therefore the cost savings are more significant. In the two cases where fewer collection days per week are required (South Oxfordshire and Trafford), cost savings of £27,000 to £46,000 are seen. In the cases where fewer vehicles overall are required (North Devon and North Somerset), more significant cost savings of £103,000 to £234,000 are seen.[25]

In relation to the collection cost impacts presented above, the time at which collection savings can be realised is a relevant factor to consider. Any reduction in collection resource required may not necessarily be realisable on day 1 of the DRS. For instance, in order to realise the savings in practice – collection rounds would need to be reconfigured (potentially to include optimisation between recycling and refuse in cases where these are collected by the same vehicle fleet on alternate weeks). Collection round optimisation is only done intermittently when there is a good reason to do so, often only when collection contracts are being re-procured or major service changes are being introduced. Were this to be brought forward, then additional re-routing costs may be incurred.

As a result, collection cost savings presented here may be considered longer term savings, i.e. beyond a procurement lifecycle, or that smaller savings may be experienced in the shorter term. That being said, were a DRS to be announced with – say – a three-year advanced forewarning before implementation, this would limit the number of authorities likely to be affected, and it would also provide time for adaptation. As such, the savings as modelled would be more likely to be directly realisable in practice. It may also be possible in the longer term to create additional collection cost savings though optimisation of vehicle design for the reduced and altered mix of materials being collected.

The other effects relevant to the local authority modelling relate to what happens to the waste and recycling after it is collected – i.e. sorting, material sales and residual waste treatment/disposal:

- **Sorting:** For three of the four local authorities, sorting operations involving beverage containers are restricted to separation of plastics from cans. In these cases, only minor processing cost savings are achieved (£800 to £10,000 per annum) relating to a reduction in energy use and consumables for the sorting operation. In the case of South Oxfordshire, where recyclables are fully co-mingled, materials sorting is a larger and more commercialised operation. In this case, the DRS will change the remaining material mix affecting the sorting process itself, marginally increasing the sorting cost per tonne as a result.[26] However, the absolute reduction in recycling tonnage will significantly reduce the sorting fees payable, and cost savings of £179,000 per annum are expected.
- **Material sales:** Due to the majority of beverage containers being in recycling, the DRS takes potentially valuable container packaging away from the local authority systems, reducing the revenue that can be derived from sales of material. For the four case study authorities, reductions in material income between £58,000 and £114,000 per annum are seen.
- **Residual waste treatment/disposal:** Any material diverted from residual waste to the DRS results in direct cost savings due to not needing to treat or dispose of the waste. The savings seen for the case study local authorities range between £31,000 and £120,000 per annum. Because the focus of the modelling is on authorities with higher performing dry recycling systems, residual waste savings under a DRS will be at the low end of the spectrum for local authorities generally. Greater residual waste savings may be seen under a DRS in lower performing authorities.

Overall, although these case study represent authorities less likely to experience overall cost savings, all four cases lead to an overall improvement in the financial outcomes following the introduction of a DRS. In order to account for the different sizes of the authorities, we also, in Table 3-3, present these impacts on a per household basis.

Table 3-3: Impacts on a per household basis – high recycling authorities

	South Oxfordshire	Trafford	North Devon	North Somerset
Households*	56,925	100,405	41,224	94,192
Collection Savings	0	£0.23	£1.65	£1.61
Sorting Savings	-£3.14	-£0.10	-£0.02	-£0.01
Lost Material Revenue	£1.02	£0.80	£1.63	£1.21
Residual Waste Savings	-£0.54	-£1.20	-£1.48	-£0.59
Net savings per household**	-£2.65	-£0.72	-£1.50	-£1.02

** Using ONS Household Data, available at https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections **May not sum due to rounding*

[25] The cost savings for North Somerset (2 fewer vehicles) are more than double the savings for North Devon (1 fewer vehicle) since the standard number of crew members on each vehicle is higher in North Somerset.

[26] The MRF modelling was reviewed with two MRF operators who agreed with the methodology taken. They did indicate that the effects would vary reasonably significantly between different MRFs depending on configuration and location, for example, but even suggested our figures for increased processing costs might be pessimistic since significant reductions in glass run through the MRF would lead to maintenance cost savings which would not be insignificant. Both operators wished to remain anonymous for commercial reasons.

3.1.3 Assessment in the case of low recycling performance

With high performing local authorities expected to have most to lose and least to gain from a DRS, low performing local authorities ought to see greater benefits from a DRS. To test whether this is indeed true, the mini analysis below looks at four of the lowest performing local authorities in England from the latest nationally published data (as ranked by the NI192 recycling rate). A detailed modelling exercise of the collection systems has not been conducted for these authorities, so it has not been possible to estimate any collection cost savings which might arise – whether for recycling collection or for residual waste collection. Nonetheless, as shown by the change in costs associated with materials management in Table 3-4, the net position in all authorities is a positive one, and the outlook would only be improved were collection efficiencies possible and the cost savings to be included in the analysis.

Table 3-4: Supplementary investigation for low recycling authorities

	Barking & Dagenham	Bassetlaw	Lewisham	Newham
COLLECTION RELATED SAVINGS				
Volume of recyclables collected per year	-11%	-13%	-9%	-11%
Percentage change in average number of properties vehicles can service each day	Collection cost modelling not undertaken, potential savings unknown.			
Change to number of days of work to collect residual waste or recyclables once from all properties				
Impact on number of residual waste or recycling vehicles required				
Total miles driven per annum, percentage change				
Overall collection costs, £/annum				
SORTING OF MATERIALS				
Weight of material requiring sorting, tonnes	-278	-292	-3,234	-328
Overall sorting costs	-£19,000	-£20,000	-£220,000	-£22,000
MATERIAL SALES				
Materials revenues (positive values represent a net loss of income)	+£72,000	+£66,000	+£160,000	+£82,000
RESIDUAL WASTE				
Weight of residual waste collected per year (assuming 90% of beverage containers are diverted from residual under a DRS)	-7%	-14%	-3%	-7%
Treatment/disposal costs (negative = saving)	-£350,000	-£215,000	-£215,000	-£555,000
TOTAL				
Total impact, £/annum (negative = saving)	**-£297,000**	**-£168,000**	**-£275,000**	**-£495,000**

For low performing authorities where beverage containers are more likely to be found in residual waste, the introduction of a DRS would affect quantities of residual waste more significantly than quantities of recycling. Therefore, as may be expected in such cases, very high treatment/disposal cost savings will result, as is seen in the results presented in Table 3-4.

Lewisham is the only authority of the above four currently collecting glass in kerbside recycling collections, as is evident from the much greater change in quantity of material requiring sorting compared to the other three authorities. Lewisham thus achieves lower treatment/disposal cost savings compared to the other authorities, but greater benefits from the reduction in material requiring sorting.

Although detailed collection modelling has not been conducted for these authorities to seek to understand potential collection cost impacts, the fact that in these cases beverage containers are currently less likely to be recycled means that collection impacts are more likely for the residual stream. Nonetheless, the overall weight reduction within residual waste is shown in the most extreme case to be just 14%; this may be insufficient to materially affect collection operations that would bring about collection cost savings. Therefore, in a base case assessment for low performing authorities, the assumption can be taken that a DRS may have no impacts on collection costs, or only small impacts on day-to-day operations that are difficult to translate into cashable savings.

Overall, even without collection cost savings taking effect, the total net impacts for these low performing authorities are at least as significant as for the high performing case study authorities. In order to account for the different sizes of the authorities, we also, in Table 3-5 we present these impacts on a per household basis.

Table 3-5: Impacts on a per household basis – low recycling authorities

	Barking & Dagenham	Bassetlaw	Lewisham	Newham
Households*	78,629	49,637	131,815	122,066
Sorting Savings	-£0.24	-£0.40	-£1.67	-£0.18
Lost Material Revenue	£0.92	£1.33	£1.21	£0.67
Residual Waste Savings	-£4.45	-£4.33	-£1.63	-£4.55
Net savings per household**	-£3.78	-£3.38	-£2.09	-£4.06

** Using ONS Household Data, available at https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections **May not sum due to rounding*

3.2 Street scene

Our approach to identifying possible savings to local authority street cleansing teams was to speak with the six participating local authorities and further individuals consulted within this current study to understand what the expected reductions in beverage container litter would mean for their operations, and whether any likely cost savings were likely to result (and if so, what could be identified).

It is important to distinguish between those cost savings that would be linear in nature (i.e. reduced expenditure on residual gate fees that will decline in proportion to the drop in litter weight) and those that would be non-linear. An example of the latter would be where, for example, a reduction in staffing level, or bin provision and servicing requirements could be envisaged. Such a reduction could only typically be achieved once a certain level of reduction in litter takes place.

For our discussions with individuals, although a 95% reduction in littering of beverage containers under a DRS is likely, we conservatively indicated the likely effects of DRS as being an 80% reduction in littering of deposit-bearing items leading to an overall reduction in litter volume of circa 30%.[27]We then asked them to identify possible responses to this.

It is worth noting that the examples provided below are illustrative of the local authorities with whom we spoke. We therefore do not attempt to scale up such savings across England as a whole (apart from avoided treatment/disposal costs). Each local authority is different, and potential savings may manifest themselves in different ways. It's also important to acknowledge that the insights provided by local authority street cleansing representatives are based solely on their professional judgement. Without knowing precisely how a DRS would affect littering behaviour in their area, it is difficult to work through the full potential response. A message received during discussions was that once such a scheme 'beds in', and the impact in different locations becomes clearer, the response in terms of reconfiguring rounds, and bin placement and collection, for example, could be more fully developed.

3.2.1 Avoided costs from reductions in residual waste

As indicated in Appendix A.2.1.1, at a residual waste gate fee of £100/tonne, we estimate that the current disposal/residual treatment cost to English local authorities from beverage containers in litter (both placed in litter bins and dropped on the ground) is circa £8 million per annum. Assuming that beverage container litter reduces by 80%, this would lead to a saving of £6.4 million per annum. A reduction of 90% would mean an annual saving of £7.2 million per annum for English local authorities.

[1] In the feasibility study on DRS carried out by Eunomia for the Scottish Government (see above), a literature review was carried out which concluded that around 40% of the litter, by volume, is beverage containers. If the reduction in beverage containers is estimated at 80%, then the reduction in the overall volume of litter will be 40% x 80% = 32%.

3.2.2 Reductions in litter bin provision

Discussions with LB Camden contractors indicated that one likely response would be to enable the removal of bins from specific areas. While they noted the possibility under a DRS of removing bins from parks and some residential areas, they were more certain that some of the bins on high streets could be removed. Specifically, they estimated that if a 30% reduction in litter volume were achieved, then 15-20% of the bins on high streets could be removed while maintaining required standards for cleanliness.

The annual cost of collecting from each bin is £640, and there are 219 bins on high streets in Camden at present. If between 33 and 44 of these were removed (representing 15% and 20% of the total respectively), the annual saving would be between £21,000 and £28,000.

Camden has 2,249 litter bins in place at present. If reductions in the number of bins could be achieved, not only would the annual cost of emptying each bin be avoided, but also the replacement cost. The replacement cost for a bin for Camden is currently £120 (not including installation costs).

This is similar to the cost for replacement bins in South Oxfordshire, reported to be £125 per 90-litre bin and £155 for a 120-litre bin, with installation costs of £130 to £200 per bin depending on the location and whether a new concrete base is required.[28]

Note, these are somewhat lower than costs reported for some other authorities. A brief review of documents available online suggests that the cost to Herefordshire Council is £550 to purchase and install a bin, and the cost to Solihull MBC associated with installing a new bin is in excess of £800, albeit these figures might not be directly comparable as they refer to new bins, and replacing existing bins might be somewhat cheaper.[29,30]

It is considered likely that removal of specific bins, particularly in town centres/high street locations in more urban areas, is something that could well be achieved by other local authorities if a DRS were implemented. In the second workshop it was reported by Trafford MBC that there might be savings through removing 'recycling on the go' (ROTG) bins. Under a DRS, providing such bins for beverage containers was thought to be unnecessary. However, it was not possible to obtain details of the financial savings that

[28] Personal communication with Mark Watson, Waste Team Leader, South Oxfordshire District Council, March 2017

[29] Herefordshire Council (2015) Litter Bin Management – Summary Guidance, available at http://www.bordergroup-pc.org/wp-content/uploads/2015/09/condensed-litter-bin-procedure-280815.pdf

[30] Solihull Metropolitan Borough Council (2017) Litter and Dog Waste Replacement Plan, 24th January 2017, available at http://eservices.solihull.gov.uk/mginternet/documents/s44647/Report%20from%20the%20Environmental%20Services%20Manager.pdf

might accrue through the removal of such bins, and the reduced costs of servicing them.[31]

A further potential saving identified by North Devon District Council was the removal of council-operated bring banks for beverage containers at supermarkets. However, no indication of the avoided costs associated with this was provided.

3.2.3 Reduced requirement for street sweepers

It was further estimated for Camden as a whole that a 30% reduction in the volume of litter would mean that one less FTE street sweeper would be required. This would lead to an annual saving of circa £25k. Such a saving might also be possible for other London Boroughs and, indeed, in other large urban areas.

3.2.4 Savings to parks

While town centres may see a relatively steady stream of litter through the year, for parks and other green spaces (and indeed for beaches), the level of litter is hugely dependent on the weather. Sunny days in the warmer months can bring large numbers of people to parks. On busy days, the park warden for Castle Park in central Bristol reportedly spends his entire day picking up litter.[32] His view was that a DRS could have a dramatic impact as most people have alcoholic or soft drinks with them.

This view was backed up by the street scene manager for Blackpool, who estimated that over 50% by volume of litter in parks during sunny weather is from beverage containers.[33] Significantly, he felt that the effect of a DRS would be to reduce the 'peaks' of littering - and thus, the scale of the required street cleansing response – associated with drinking in parks and green spaces when it is warm and sunny. However, it was not possible to put a figure to such a saving. Instead, it was thought this would simply mean enhanced service provision.

3.2.5 Resulting service improvements

A number of other possible service improvements were identified through discussion with local authority street cleansing representatives. Feedback from Camden was that sweepers on high streets, with the avoided requirement to pick up so many beverage containers, could sweep 'headways' (i.e. a couple of car lengths up streets branching off from high streets). Furthermore, Camden noted that half of the caged vehicles currently focus on emptying litter bins, with the other half on fly-tipping and uncontrolled waste. It was also suggested that any reduction in the number of bins to be emptied could mean an improved response to fly-tipping incidents.

[31] This may have the effect, depending on location, of improving the perception of the street scape by removing what some consider to be "clutter".
[32] Personal communication with Castle Park Warden, Bristol City Council
[33] Personal communication with Jez Evans, Street Scene Manager, Blackpool Council

3.3 Other Issues

A number of other issues were reviewed as part of the study. These were either highlighted by the study research group during the first workshop, or during feedback after presentation of results at the second workshop, or from feedback on the draft report:

- After the introduction of the DRS, if beverage containers were still placed in the kerbside recycling containers, local authorities could potentially claim the deposits as a source of revenue if the containers were extracted from the other recyclables and sent to a DRS counting centre (where the deposits could be 'cleared' from the central database).[34] If evidence of clearing could not be achieved it is unlikely the deposit revenue could be claimed.
- Where recycling credits are currently claimed by local authorities for beverage containers, these would not be able to be claimed in future by the authorities for the recyclables diverted into the DRS. [35]
- It is unlikely that existing local authority collection vehicles could be used to run services under the DRS. However, local collection contracts might be let by the DRS system operator to logistics contractors, which could include additional services provided by the local authorities, if they choose to diversify. In this case, some existing infrastructure, such as depots and transfer stations, could potentially be shared with DRS collection services in order to minimise costs. In addition, there is no reason in principle why waste companies could not operate counting centres, which share some features with MRFs;
- There are no statutory recycling targets for local authorities in England, so a reduction in material collected by them would not result in any related penalties. Moreover, the DRS could increase overall household and similar waste recycling rates, thus reducing the pressure on authorities to improve rates of capture for recycling in other areas while funding is tight (i.e. this cost – a contribution towards meeting the recycling targets – would be borne by the private sector).
    - Notwithstanding the above, a local authority stakeholder within the peer review process for this report highlighted that there may be a public relation concern associated with any reduction in local authority recycling rates where containers are moved outside local authority control. Should this issue arise in practice, there may be a case to use data from the DRS to attribute a proportion of container recycling back to local authorities. With a DRS achieving higher container recycling rates than traditional kerbside systems, this would result in an overall increase in local authority

[34] Such as is done in New South Wales.
[35] A financial payment from waste disposal authorities (typically county councils) to waste collection authorities (typically district councils) for each tonne of waste collected for recycling, and which therefore does not go to disposal (saving money for the disposal authority). It therefore acts as an incentive payment to encourage the collection authority to recycle, and is an income stream for them.

recycling rates, once adjusted. Even so, this issue is likely to be more pronounced in Wales or Scotland where mandatory targets are in place for local authorities, and less so for England. An alternative in these administrations would be to reduce targets to account for the container packaging no longer directly contributing to local authority collected recycling.

- Although not taken into account within the modelling for this report, with deposit materials removed from the household waste recycling stream, this will free up space within recycling receptacles - potentially affecting how householders segregate other materials for recycling. The case study modelling indicates a DRS may take out up to or over 30% of the volume within recycling receptacles following its introduction. It is thus conceivable that this relaxation of constraints on recycling capacity may lead to additional capture of non-deposit recycling materials and this could, in turn, provide further benefits to local authorities.
- The higher quality of materials collected through a DRS can be expected to result in a higher proportion of the collected quantity of material being successfully recycled, when compared to kerbside collected materials.
- The market for home deliveries of groceries in England is now significant. It was suggested that this may act as a barrier to implementing a DRS as consumers would not be returning to the shops themselves if they were ordering on-line. However, many consumers still do purchase groceries in addition to on-line shopping from local stores on an ad hoc basis and, moreover, grocery delivery companies may, in fact, start to offer a take-back service (utilising sealable bags or compartments in the vehicle to eliminate the potential for contamination) as a means to attract and retain customers. Such innovations could operate in a similar way to systems already operated by certain shopping delivery services for returning unwanted items and plastic shopping bags. It is possible, therefore, that the DRS could stimulate new innovation and opportunities in the grocery sector.[36]

[36] Two existing systems - in Norway and Germany - already make provision for those people who want to return some or all of their empty drinks containers via a home delivery service provided by retailers. In Norway close to 1% of returns are via home delivery. Infinitum, the system operator, provides the bags free of charge, which are embedded with a code underneath the barcode which tracks the bag and its contents. When considering how an English system could be designed, retailers will be able to learn from their counterparts in other countries as to how home deliveries can become part of the system. Of course there are additional benefits, in that integrating home delivery trucks into the DRS ensures there aren't trucks driving around empty.

4.0 What existing conditions may affect the distribution of costs?

There are a number of existing arrangements in place that will affect how the financial impacts of a DRS are distributed across different actors, and which are not a result of the DRS itself. A possible concern is that the existing arrangements may lead to an uneven distribution of costs and benefits across parties following introduction of a DRS. Nonetheless, these effects could be mitigated though changes made to contracts and agreements, as is discussed in the subsections below.

4.1 Two-tier administrative structures

Two-tier local government structures create a divided system where responsibility for waste collection is dealt with at a district/ borough level (the waste collection authority or WCA), and responsibility for waste treatment and disposal rests with county councils (the waste disposal authority or WDA).

Traditionally, a WCA is compensated by the WDA for collecting recycling through the recycling credit scheme. Introduced under the Environmental Protection Act 1990 (EPA), the scheme provides an incentive for recycling in two-tier areas through payment from the WDA to the WCA of a fixed price per tonne of collected recycling. Under this situation:

- WCAs fund the collection of waste (whatever the approach) through Council Tax and Revenue Support Grant;
- WDAs fund treatment and disposal through Council Tax and Revenue Support Grant; and
- WCAs receive, from WDAs, recycling credit payments in lieu of savings made by WDAs from avoided disposal for all materials that are collected for recycling. However, the recycling credit does not always reflect the full avoided cost of disposal (weakening, incidentally, the incentive of WCAs to invest in recycling).

Within the UK, this situation is unique to certain local authorities in England (27 two-tier counties and six metropolitan counties). This is not relevant to local authorities in Wales, Scotland and Northern Ireland – which are all organised as unitary authorities. Indeed this approach is not seen in the same manner anywhere in Europe and, in itself, presents some particular challenges.

Under a two-tier local government structure, neither of the two tiers is confronted by the whole system cost of collecting, treating and disposing of waste. As a result, even where the balance of costs and savings of managing waste may be favourable overall under a DRS, the costs and savings may fall unevenly across the WCAs and WDAs.

Following the introduction of a DRS, where beverage containers would fall in quantity, both in recycling and in residual waste (see Figure 2-6), in a two-tier situation, the WDA will experience a double win from savings associated with the reduction in

treatment/disposal, as well as savings associated with reduced requirements to pay recycling credits. The WCA, on the other hand, will experience a loss associated with the reduction in recycling credits received (in addition to loss of potential material income), albeit this may be offset to an extent by reduced collection and sorting costs. Because the recycling credit payment is simply a transfer of funds from one local government department to another, these are not apparent in the overall net costs depicted within Section 3.0. Nonetheless, without the use of alternative financial mechanisms, WCAs could be adversely impacted under a DRS, and at risk of being unable to fund the collection services provided, with WDAs benefiting disproportionately. Fortunately, changes to legislation have paved the way for improving the distribution of costs, as is highlighted in Section 4.4.1.

4.2 Wide variation in governance and contract specifications

When looking at the variation in the governance of waste services, and the contracts that underpin them, it is clear that approaches can differ quite considerably. For example, there is a range of ways in which services can be governed, notwithstanding the two-tier issues mentioned above. Services can be run 'in-house' or contracted out to third parties, or shared between local authorities. Governance arrangements can be different again under large-scale PFI initiatives (such as Greater Manchester Waste Disposal Authority) with some services undertaken by the WCAs, and some by the WDA.

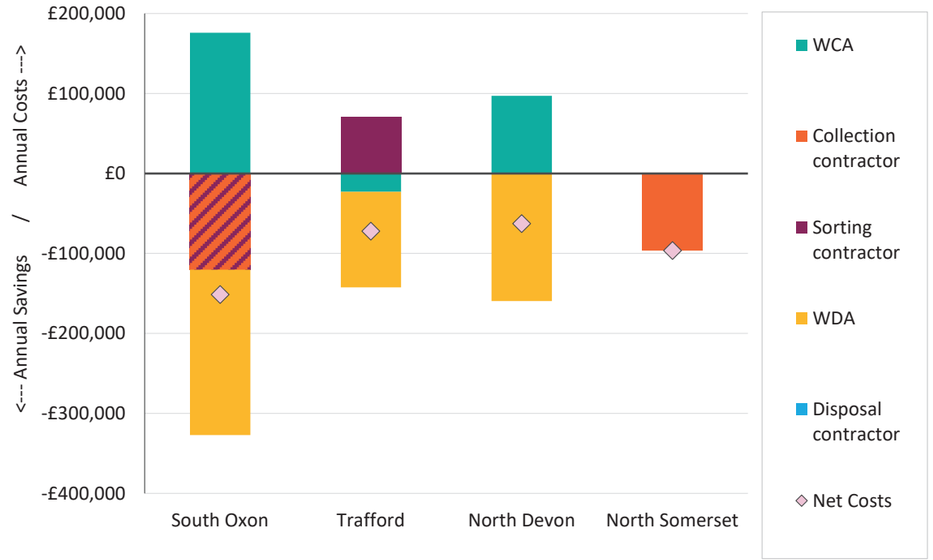
In terms of the contractual arrangements, these differ significantly as well. Some have benefits sharing clauses, others do not (although even here, the outcome may be varied depending on how the contractors communicate savings i.e. there is a moral hazard not to do so). Contracts are also negotiated, which brings a further level of differentiation: some local authorities may derive better value deals from companies than others. Those that have the worst deals may end up in unfavourable contractual positions, sometimes without knowing, which can also affect the distribution of any costs and benefits following services changes that might arise after the introduction of a DRS.

These varied contractual situations can, inevitably, result in varying outcomes. However, it is important to note that change in law clauses within contracts would mostly likely be triggered, meaning that contracts could be renegotiated, giving rise to the potential to reduce the extent of any perverse effects that may arise (such as a WCA losing recycling credit without realising any cost savings elsewhere, but the WCA's collection contractor benefiting from reduced collection requirements). There would be an additional cost associated with contract renegotiation, but this might fall away if the lead-in time is sufficient for the renegotiation to happen as contracts change as a matter of course, after the intention to implement a DRS was announced by the Government. There might also be the potential to reduce any costs of renegotiation by issuing clear guidance as to the relevant issues, and the likely consequences for existing contracts of varying forms.

4.3 Cost distribution under current conditions

Under existing contractual conditions and without any change to local government financing arrangements, a summary of how costs would fall on the different parties is shown in Figure 4-1. Although the overall results show an improvement in net costs in all cases, what is observed is a somewhat imperfect and imbalanced distribution of costs and benefits between the individual entities.

Figure 4-1: DRS net impacts – distribution of costs under current conditions



Note: Collection and sorting contractor are the same entity in the South Oxfordshire case, hence banded colouring.

Because North Somerset is a unitary authority, the two-tier local government situation is not relevant for the council. In general, some quite significant benefits are seen by WDAs. However, WCAs are financially worse off in two of the three cases. A primary reason for this relates to recycling credit payments. Only in the case of Trafford, which is funded by the WDA under an alternative levy payment system rather than through recycling credits, is the WCA not left out of pocket by a DRS. Trafford also gains from the fact that the PFI contract includes benefit transfer clauses so that the collection cost savings are realised by the WCA.

In North Devon, although collection services are operated in-house, the loss in recycling credit and material revenues are not sufficiently offset by the collection cost savings and the WCA experiences an increase in costs.

In the South Oxfordshire case, the loss of recycling credits is felt by the WCA, with no other benefit arising since savings on collection and MRF processing accrue to the collection contractor and the sorting contractor.

In the case of North Somerset, the local authority itself may expect to see overall very limited net change to its waste budgets because of contracts already signed. Within the collections contract, a risk share agreement is in place on recyclate, and thus reductions in tonnage and income are shared 50:50 with the contractor. In this case, the reduced income to the authority from lost material revenue is almost exactly the same as the modelled avoided disposal benefits, resulting in the authority being just a few hundred pounds better off following introduction of a DRS.

In general, these examples show that the way costs and benefits of a DRS fall for these four example authorities may not necessarily be considered fair given that in all cases, the overall system cost falls. Furthermore, it serves to highlight that there are factors that may lead to some variation in the distribution of costs and benefits in different situations across the country. The fact that the distribution of costs and benefits is uneven explains why district councils, as WCAs, might be concerned by such a development, not least in such financially straitened times. There are, however, ways to mitigate these problems, which are discussed in the following section. Fortunately, many of these approaches would be sensible to undertake irrespective of the introduction, or otherwise, of a DRS (and many leading authorities are adopting these strategies already).

4.4 How could these barriers be mitigated?

4.4.1 Mitigating two-tier administrative structure effects

Following proposals outlined in Section 49 of the Clean Neighbourhoods and Environment Act 2005, key changes to the principles of the recycling credit scheme (as set out in the EPA 1990) were introduced through the Environmental Protection (Waste Recycling Payments) Regulations 2006. This increased the flexibility of payments from WDAs to WCAs in two-tier areas by giving authorities the option to agree alternative arrangements. It also provided the Secretary of State with powers to set the calculation of recycling credits through secondary legislation. The Regulations have also led to a revision of the relevant paragraphs in the EPA 1990, allowing for arrangements to be concluded between a WCA and a WDA such that the existing mechanism can be fully replaced if the WCA and WDA agree to do so.

An increasing number of two-tier local authorities around England are now taking up this opportunity. Although the arrangements, and precise calculation methods, differ from one situation to another, the typical approach is to ensure the WCA is no worse off following changes that would benefit the WDA, and to share the benefits of waste that is not sent for residual treatment / disposal (i.e. under a 50:50 sharing arrangement, or other such arrangement where the WCA sees some of the benefit of reductions in residual waste). Such a mechanism would put the WDA and WCA on a more equal footing under a DRS, with both parties sharing in the windfall benefits of reduced residual waste treatment/disposal. A number of two-tier authorities have gone further than simple cost-sharing arrangements by setting up Local Authority Waste Partnerships where a single client takes responsibility for organising waste collection and treatment/disposal. Eunomia's experience in supporting the Somerset Waste Partnership, Devon Waste Partnership, Surrey Waste Partnership and others is that savings typically of several million pounds per annum can be achieved between a WDA and constituent WCAs.

Using either cost-sharing arrangements or Local Authority Waste Partnerships, it is thus possible to mitigate imbalances between WCAs and WDAs. The net cost distribution from a DRS for the four case study local authorities, as shown in Section 4.3, is reproduced under optimised conditions – including a 50:50 share on avoided disposal – in Section 4.5.

A final notable point on this issue raised during the peer review process was that implementation of a DRS is likely only to arise through government action on producer responsibility requirements. Government may, therefore, also take action to update and rectify shortcomings in the regulations regarding Waste Recycling Payments (recycling credits) at such a time.

4.4.2 Mitigating variation in contract specifications

Typically, collection, sorting and treatment contracts signed by local authorities contain change in law clauses that allow for contracts to be renegotiated where a significant change is made, such as the introduction of a DRS. Although, in principle, this would allow for fair outcomes to be negotiated, some cost and risk applies to this.

What could help mitigate this impact is a set of template clauses developed by government alongside the legal drafting of the DRS to outline what should be in place to ensure costs and benefits are fairly distributed. The intention would be that the local authority (who may stand to lose from a DRS) sees a fair proportion of the savings witnessed by collection, sorting, or disposal contractors.

It should be noted, however, that not all deposit systems are statutory in nature. The Swedish and Norwegian schemes are voluntary, but motivated by other laws that make the DRS a sensible strategic response from industry. Here, again, some guidance from Government might be sensible.

In preparation for tackling this aspect in advance of a DRS, Government is advised to consult with the Chartered Institution of Wastes Management (CIWM) and WRAP in the first instance. CIWM is often asked to assist with contractual disputes, and CIWM and WRAP are already working together under the Harmonisation project to draft templates for contracts. Such expertise could help to foresee and navigate common contractual hurdles that may be experienced, decreasing costs and increasing the likelihood of successful contractual renegotiation.

In practice, it is likely to transpire that where the costs of altering or renegotiating contracts are low [and the benefits meaningful] then local authorities may pursue such a course of action. If the costs are higher, then authorities may choose to wait until contract expiry or break points.

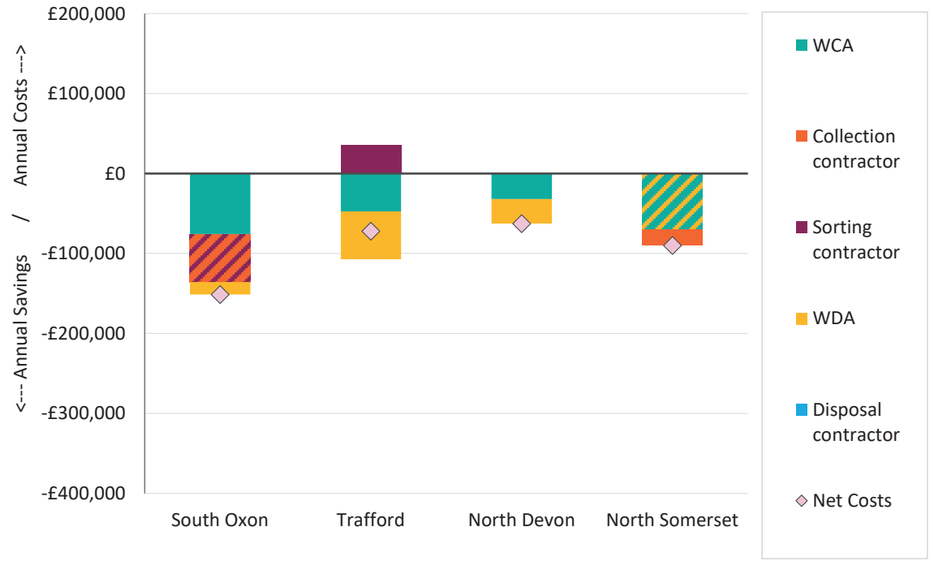
4.5 Cost distribution following mitigation

Based on the above mitigating measures, the previously shown cost distribution chart (Figure 4-1) is reproduced as Figure 4-2 with the savings redistributed in a more equitable manner. The approach taken has been as follows:

- Recycling credit payments are assumed fixed at the total payment amount prior to introduction of the DRS (since a common principle behind cost-saving sharing mechanisms is that WCAs are no worse off following service changes that benefit the WDA). As a consequence, the WDA does not witness a windfall benefit associated with a reduction in recycled beverage containers, but the WCA does not experience this as a loss;
- All residual waste treatment/disposal cost savings that result following introduction of the DRS are shared 50:50 between the WDA and WCA;
- All collection, sorting and disposal contractor cost impacts are shared 50:50 with the relevant local authority (collection and sorting cost impacts shared with the WCA, and disposal cost impacts shared with the WDA where relevant).

What this shows is that applying some realistically achievable mitigating measures would allow for costs and benefits to be equitably shared between the relevant parties, and for the outlook to be generally favourable to all parties. The only instance where one party is found still to be in deficit is the sorting contractor in Trafford. The reason for this relates to the Greater Manchester PFI that gives rise to fixed infrastructure payments incurred on the plastics and cans sorting operations (by the contractor) but without the ability to acquire material from other markets following introduction of the DRS (the PFI contract precludes the sorting facility from becoming a merchant operation). Such a situation is not believed to be the norm for local authority contracts with sorting facilities so this seems likely to affect only a small number of authorities.

Figure 4-2: DRS net impacts – distribution of costs under optimised conditions



Note: Collection and sorting contractor are the same entity in the South Oxfordshire case, hence banded colouring. North Somerset is a unitary authority so owns both WCA and WDA functions – also shown with banded colouring.

4.6 Lack of funding for waste services from producer responsibility schemes

It is worth reflecting, briefly, on the concept of Extended Producer Responsibility (EPR), and how the way in which it is implemented for packaging in the UK[37] underpins the key concern from local authorities that a DRS would impact on their costs (i.e. that they are currently responsible for funding the majority of household services, and therefore feel exposed to measures that may impact on their finances).

EPR is defined by the OECD as:[38]

> *'An environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle'.*

[37] Common *"Producer Responsibility Obligations (Packaging Waste) Regulations"* apply to England, Wales and Scotland. Northern Ireland has its own separate regulations. However, in both cases the implications upon local authorities finance and waste management systems is the same.
[38] OECD (2001) Extended Producer Responsibility: A Guidance Manual for Governments

The practical implications of this approach are that responsibility for collecting or taking back used goods, and for sorting and treating for their eventual recycling lie with producers. Such responsibility may be simply financial or, additionally, organisational.

In the UK, the fee from producers is estimated to cover only about 10% of the total cost of the system, whereas in many other schemes in European countries, 100% of net costs are covered.[39] In reality, little if any of this reaches local authorities so, in practice, in the UK, virtually all of the costs of dealing with waste packaging are covered by local authorities (i.e. by taxpayers) rather than producers (and, in turn, consumers).

This point bears consideration in respect of local authority concerns - and indeed packaging industry bodies' reiteration of such concerns - about loss of material income from bottles and cans being diverted from the kerbside system under a DRS.[40]

At present, local authorities are bearing a cost that arguably should, and in many other EU Member States, already is, being borne by producers. Accordingly, while the question of lost material revenue is a legitimate concern under the current situation, a bigger question might be why it is that the status quo should have persisted for so long, particularly against a backdrop of increasingly straitened local authority finances. In any discussions around packaging producer responsibility reform, local authorities would be justified therefore not simply in considering marginal changes to their waste service budget, but also to seek to address the lack of financial support they receive from the packaging industry generally to cover costs of collecting and managing their products once they become waste.

[39] Bio by Deloitte (2014) Development of Guidance on Extended Producer Responsibility, Final Report to DG Environment of the European Commission

[40] See http://www.letsrecycle.com/news/latest-news/deposit-scheme-hit-councils-warns-vanston/

5.0 Concluding remarks

We have assessed the impacts on local authority services in a number of previous studies, but not to the extent, or in the level of detail, that we have conducted the analysis here. The work has benefited greatly from critical input from a number of local authority waste officers providing valuable advice and feedback.

We make a few concluding remarks:

- Within the household collected waste streams, local authorities currently achieving high levels of recycling may have greater concerns over a DRS than counterparts achieving lower levels of performance. This concern may arise from the expectation that a DRS would largely reduce a valuable council revenue stream – this being income generated from packaging collected for recycling. Local authority case study modelling conducted for this report revealed this indeed to be the case, with a loss in revenues across four authorities ranging from £58k to £114k per annum. Despite this, significant benefits were also seen across other aspects of the management of collected household waste – collection cost savings, avoided sorting costs on collected recyclables, and savings on residual waste disposal. The net impacts of a DRS on kerbside waste service budgets for the four case study authorities was found through the modelling to be overall cost savings between £62k and £151k per annum. Although it might not always be possible to realise these savings immediately (for instance, unlocking collection cost savings would typically require a re-routing of collection rounds, contractual constraints may need to be overcome, and/or two-tier local government financing arrangements may require reform), providing time between announcement and implementation of a DRS would help minimise the number of authorities who would face such challenges (related to natural expiry of contracts/vehicle lifetimes etc.) as well as enabling a transition period where any such barriers could be tackled.
- An assessment was also conducted for four local authorities currently achieving low levels of recycling. In these cases, the overall calculated savings were more significant due to more pronounced savings on residual waste disposal. The overall figures ranged between the authorities from £168k to £495k per annum.
- On a 'per household' basis, the savings range from £0.72 per household to £4.06 per household. The (unweighted) mean average saving among the 'high recycling authorities' is £1.47 per household, while among the 'low recycling authorities' it is £3.33 per household. To put this in context, weekly residual waste and fortnightly recycling costs between £100 and £140 per household per year, depending on geography, demographics and collection frequency.
- Assuming, arguably conservatively, that the mean average saving across the high recycling authorities (of £1.47/household) is replicated across England as a whole, the annual net saving to local authorities under a DRS would be close to £35 million. If the mean net savings per household across the eight authorities

considered (of £2.40 per household) were scaled up to the England level, the annual net savings would be in excess of £56 million.

- In relation to street scene services, the reduction in litter (both placed in litter bins and dropped on the ground) expected under a DRS may lead to further savings of between £6 million and £7 million per annum.
- Potential perverse outcomes, in terms of unequal distribution of costs or benefits between different bodies in two-tier local authorities (i.e. WCAs and WDAs), could be mitigated by using either cost-sharing arrangements or Local Authority Waste Partnerships. There are already many examples of two-tier authorities in England who have implemented such arrangements, which can provide a good model for others to follow.
- In summary, the analysis in this study shows that the fears about loss of efficiency of local authority collection services, and greater financial burdens on them from a loss of material revenue, have some basis as a consequence of contractual and local government structural realities. However, allowing time for transition and implementation of mitigating measures can result in the benefits being shared more equitably. Overall, the work suggests that implementing a deposit refund system can reduce financial burdens on local authorities across the country, and the regulatory changes would place more of the burden of responsibility for managing beverage packaging wastes on the producers.

Appendix

A.1.0 Modelling methodology and results

A.1.1 Modelling of household kerbside services

Upon introduction of a DRS for container packaging, depending on the existing services offered by local councils, the reduction in material within household collection systems can be expected to result in the following. The first is relevant to all collection system types. The second is distinct to kerbside sort recycling collection:

- A reduction in quantities of both waste and recycling can mean collection vehicles will be marginally less full. This can improve collection efficiencies in the following cases:
    a. Where the reduced quantity of waste collected means vehicles can work later in the working day before being full and having to go to unload;
    b. Where the reduced quantity of waste collected means the number of times vehicles need to unload per day is reduced;

  In both of these cases, the additional time available for collecting from households allows a greater number of properties to be collected per vehicle per day, lowering the overall collection resource requirements.
- In kerbside sort recycling systems a further potential benefit is that less material will be placed out for collection, and thus sort times per property will improve. Again this can increase the number of properties that can be collected per day, and reduce the overall collection resource requirement (and associated costs).

A lightening of the collection workload can lead to lowered overtime costs payable to staff, or to less vehicle collection days required to complete the collections (and thus reduced staff costs), or potentially to whole vehicles being taken off the road or dedicated to other duties [or not needing to be purchased].

Additional potential benefits, not accounted for within the modelling, were also highlighted by local authority stakeholders in the course of the project. In the case of kerbside sort collection systems, the local authority stakeholders considered that the reduction in material being collected on recycling vehicles could create an opportunity for collection of additional waste materials – such as black plastics that may be able to be collected as a separate material stream.

A.1.1.1 The impact of a DRS in South Oxfordshire

The modelling outcomes for South Oxfordshire are presented across three tables below. The first, Table A. 1, breaks down the factors influencing the collection operations and provides the costed net impact. The second, Table A. 2, explores the changes resulting to the management of materials including sorting operations, income from materials, recycling credit payable, and treatment/disposal costs. The third, Table A. 3, provides the combined net financial impacts. In all cases, a step-by-step set of explanations are provided to highlight and explain what is giving rise to the observed effects.

It should be noted that the costs presented in the following tables (and similarly across all Appendices A.1.1.1 to A.1.1.4) do not distinguish between who experiences the particular costs and benefits identified. The intention here is to present the overall net impacts. How the costs and benefits fall on individual parties is instead documented in Appendix A.1.1.5.

Table A. 1: Impacts on collection – South Oxfordshire

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
Volume of recycling collected per year, m^3/year	150,757	123,164	**-27,593**	The DRS leads to an 18% reduction in volume of recycling within wheeled bins.
Setout rate* as modelled	65.0%	65.0%	-	The reduction in volume is not modelled to result in any decrease in households putting their bin out for collection.
Average number of properties per day recycling vehicles can service	936	936	-	No change modelled
Resultant number of days of collection work per collection cycle	31	31	-	No change modelled
Total fuel used for recycling collection, gallons	20,829	20,829	-	No change modelled
Miles driver per annum	83,966	83,966	-	No change modelled
Overall collection cost	**£2,715,627**	**£2,715,627**	-	**No change modelled**

**Setout rate is defined as the percentage of households putting their bin out for collection on any collection day.*

Table A. 2: Impacts on the management of materials – South Oxfordshire

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
COSTS OF SORTING				
Total MRF input, tonnes	17,746	14,221	**-3,525**	The DRS leads to a 20% reduction in weight of recycling collected.
MRF processing cost, £/t	£68	£72	**£4**	The change in material mix into the sorting plant means less material is expected to be able to be processed per hour, and MRF costs per tonne increase. Spare capacity generated in the MRF is taken up by material from other sources in this case.[41]
Total MRF processing cost, £	£1,206,728	£1,028,092	**-£178,636**	With a large reduction in tonnage of collected recyclables, the overall costs of sorting materials reduces by 15%.
INCOME FROM MATERIALS				
The 'basket price' revenue for mixed recycling, £/t	-£45	-£52	**-£7**	With reduction in containers in collected recycling, the remaining recyclate is higher value per tonne.
Total revenue, £	-£795,566	-£737,138	**£58,428**	Although the basket price figure increases, the absolute reduction in tonnage leads to a net loss in material revenues.
RECYCLING CREDIT				
Total recycling covered by credit, tonnes	17,746	14,221	**-3,525**	As above, the DRS leads to a 20% reduction in weight of recycling collected.
Recycling credit, £/t	£50	£50	**£0**	The payment per tonne from the WDA to the WCA is considered unchanged.
Total recycling credits paid by WDA, £	£885,880	£709,906	**-£175,975**	The lower quantity of recycling collected leads to a reduction in the recycling credit transfer from the WCA to WDA. However, since this is a transfer, it has no net effect.
Total recycling credits received by WCA, £	-£885,880	-£709,906	**£175,975**	
RESIDUAL WASTE				
Residual waste collected, tonnes	15,050	14,740	**-310**	Limited change in collected residual waste is observed, due to the current high recycling.
Treatment/disposal cost, £/t	£100	£100	**£0**	A typical cost for residual waste is assumed, with no change under the DRS situation.
Total treatment/disposal cost, £	£1,504,986	£1,473,977	**-£31,010**	A minor change in costs for dealing with residual waste is seen in this situation. Much greater benefits may, however, be seen for lower performing authorities.
TOTAL				
Total materials management cost, £	**£1,916,148**	£1,764,931	**-£151,217**	**Overall £132k/annum saving on management of materials. Avoided disposal and MRF processing cost savings exceed the loss in material revenues.**

[41] This was corroborated through interviews with MRF operators who agreed that costs associated with reduced total inputs would not be passed back to the authorities, and further contracts would be sought to fill capacity. However, the price of those new contracts might vary from what would have been charged prior to the introduction of the DRS, although the operators did not say whether the price would go up or down as it would depend on how the plant could be reconfigured to process a different input composition (i.e. the price could go down, it was not certain it would go up). Therefore, no additional change in cost to MRF operators or future suppliers was modelled as this was deemed too speculative to determine. This impact is highly unlikely to significantly affect the results, however.

Table A. 3: Net results – South Oxfordshire

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
Total materials management cost, £	£1,916,148	£1,764,931	**-£151,217**	Savings on management of materials. Avoided disposal and MRF processing cost savings exceed losses in material revenues.
Overall collection cost	£2,715,627	£2,715,627	**-**	No change modelled
OVERALL TOTAL	**£4,631,775**	£4,480,558	**-£151,217**	**Net cost savings of £151k/annum expected.**

A.1.1.2 The impact of a DRS in Trafford

In the same manner, modelling results for Trafford are broken down across the following three tables, with annotated explanations of individual relevant effects within the right hand columns.

Table A. 4: Impacts on collection – Trafford

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
Volume of container recycling collected per year, m^3	109,422	74,873	**-34,549**	The DRS leads to a 32% reduction in volume of container recycling within wheeled bins
Weight of container recycling collected per year, tonnes	10,706	5,821	**-4,885**	The DRS leads to a 46% reduction in weight of container recycling within Trafford's black wheeled bins (acknowledging cartons are with paper and card in the blue wheeled bins)
Container bin setout rate* as modelled	76.0%	76.0%	**-**	The reduction in volume in container recycling bins is not modelled to result in any decrease in households putting their bin out for collection
Average number of properties per day container recycling vehicles can service	1,415	1,469	**+54**	Vehicles do not need to unload as often each day (typically once rather than twice per day), resulting in more properties that can be collected per vehicle per day
Resultant number of days of collection work per collection cycle	65	62	**-3**	In each 4 weekly (20 day) collection cycle, 3 days of collection work are avoided, which reduces staff and vehicle operational costs.
Total fuel used per vehicle, gallons	9,092	6,015	**-3,076**	A reduction in fuel use associated with reduced requirement to drive to empty vehicles
Miles driver per annum	46,751	30,471	**-16,280**	A 34% reduction in the total number of miles driven by recycling vehicles per year, with associated carbon savings.
Overall collection cost	**£2,065,729**	**£2,042,833**	**-£22,897**	**An overall £23k/annum financial saving resulting from lightened burdens on recycling collections.**

**Setout rate is defined as the percentage of households putting their bin out for collection on any collection day.*

Table A. 5: Impacts on the management of materials – Trafford

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
COSTS OF SORTING				
Total MRF input, tonnes	21,884	16,964	**-4,920**	The DRS leads to a 22% reduction in weight of total dry recycling collected.
MRF processing cost, £/t	£35	£44	**£10**	Material from other sources is assumed not available to make up shortfall in sorting plant capacity. MRF processing costs are thus assumed to remain fixed other than minor savings from reduced plant energy consumption and reduced consumables (i.e. baling wire). The overall costs of sorting materials therefore reduce only fractionally in this case (1.3%).
Total MRF processing cost, £	£761,220	£751,380	**-£9,840**	
INCOME FROM MATERIALS				
The 'basket price' revenue for mixed recycling, £/t	-£52	-£62	**-£10**	With reduction in containers in collected recycling, the remaining recyclate is higher value per tonne.
Total revenue, £	-£1,136,432	-£1,056,049	**£80,383**	Although the basket price per tonne of recycling increases, the absolute reduction in tonnage leads to a net loss in material revenues.
RECYCLING CREDIT				
Total recycling covered by credit, tonnes	21,884	16,964	**-4,920**	As above, the DRS leads to a 25% reduction in weight of recycling collected.
Recycling credit, £/t	£25	£25	**£0**	The payment per tonne from the WDA to the WCA is considered unchanged [this recycling credit rate is estimated].
Total recycling credits paid by WDA, £	£547,100	£424,103	**-£122,997**	The lower quantity of recycling collected leads to a reduction in the recycling credit transfer from the WCA to WDA. However, since this is a transfer, it has no net effect.
Total recycling credits received by WCA, £	-£547,100	-£424,103	**£122,997**	
RESIDUAL WASTE				
Residual waste collected, tonnes	25,933	25,335	**-598**	Only a small change in collected residual waste is observed, resulting from the high recycling rate in Trafford currently.
Treatment/disposal cost, £/t	£200	£200	**£0**	Estimated cost for residual waste for GMWDA, with no change in the rate per tonne under the DRS situation.
Total treatment/disposal cost, £	£5,186,600	£5,067,023	**-£119,577**	A £120k/annum reduction in residual waste costs. Greater benefits may be seen for lower performing authorities.
TOTAL				
Total materials management cost, £	**£4,811,388**	**£4,762,354**	**-£49,034**	**Overall £49k/annum decrease in costs for management of materials. Avoided disposal and MRF processing cost savings are sufficient to offset the loss in material revenues.**

Table A. 6: Net results – Trafford

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
Total materials management cost, £	**£4,811,388**	**£4,762,354**	**-£49,034**	Avoided disposal and sorting cost savings are sufficient to offset the loss in material revenues.
Collection cost total,	£2,065,729	£2,042,833	**-£22,897**	Financial saving on collections associated with the freeing up (avoidance) of 3 days of recycling collection per 20 day collection cycle and avoided fuel for reduced unloading.
OVERALL TOTAL	£6,877,117	£6,805,187	**-£71,931**	**Overall, cost savings of £72k/annum expected.**

A.1.1.3 The iof a DRS in North Devon

Modelling results for Devon are broken down across the following three tables, again with annotated explanations of individual relevant effects within the right hand columns.

Table A. 7: Impacts on collection – North Devon

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
Volume of container recycling collected per year	60,740	43,552	**-17,188**	The DRS leads to a 28% reduction in volume of recycling in kerbside boxes
Recycling setout rate* as modelled	65.0%	65.0%	-	The reduction in volume is not modelled to result in any decrease in households putting their recycling boxes out for collection
Recycling sort time per property modelled	27.7	25.2	**-2.5**	The reduction in quantity of materials placed out for collection is conservatively modelled to result in a 2.5 second (9%) faster sort time per property. This is a conservatively estimated figure, and the result in practice may be greater.
Average number of properties per day container recycling vehicles can service	587	616	**30**	The reduced amount of collection work required by collection operatives mean more properties can be collected per day
Resultant number of days of collection work per collection cycle	75	70	**-3**	In each weekly collection cycle, 3 days of collection work are avoided, which reduces staff and vehicle operational costs.
Total fuel used per vehicle, gallons	11,065	10,694	**-371**	A reduction in fuel use associated with the reduced collection work
Miles driver per annum	125,235	121,367	**-3,868**	A 3% reduction in the total number of miles driven by recycling vehicles per year, with associated carbon savings
Overall collection cost	**£3,229,192**	**£3,161,629**	**-£67,563**	**An overall £68k/annum financial saving resulting from lightened recycling collection burdens.**

**Setout rate is defined as the percentage of households putting their bin out for collection on any collection day.*

Table A. 8: Impacts on the management of materials – North Devon

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
COSTS OF SORTING				
Total container sorting input, tonnes	1,029	652	**-378**	The DRS leads to a 37% reduction in weight of total dry recycling collected.
Total processing cost, £	£46,327	£45,571	**-£756**	Most costs of sorting assumed fixed costs. Just some small energy savings and avoided bailing wire resulting in 2% reduction in sorting costs.
INCOME FROM MATERIALS				
Total recycling, tonnes	17,205	15,427	**-1,778**	The DRS leads to a 10% reduction in weight of total dry recycling collected.
The 'basket price' revenue for mixed recycling, £/t	-£57	-£63	**-£6**	With a reduction in beverage containers in collected recycling, the remaining recyclate is higher value per tonne.
Total revenue, £	-£415,443	-£348,755	**£66,688**	Although the basket price per tonne of recycling increases, the absolute reduction in tonnage leads to a net loss in material revenues.
RECYCLING CREDIT				
Total recycling covered by credit, tonnes	17,205	15,427	**-1,778**	As above, the DRS leads to a 10% reduction in weight of recycling collected.
Recycling credit, £/t	£56	£56	**£0**	The payment per tonne from the WDA to the WCA is considered unchanged.
Total recycling credits paid by WDA, £	£954,879	£856,177	**-£98,702**	The lower quantity of recycling collected leads to a reduction in the recycling credit transfer from the WCA to WDA. However, since this is a transfer, it has no net effect between the two parties.
Total recycling credits received by WCA, £	-£954,879	-£856,177	**£98,702**	
RESIDUAL WASTE				
Residual waste collected, tonnes	21,645	21,037	**-609**	Only a small (3%) change in collected residual waste is observed, resulting from the high recycling rate in North Devon currently.
Treatment/disposal cost, £/t	£100	£100	**£0**	Estimated residual waste cost per tonne.
Total treatment/disposal cost, £	£2,164,534	£2,103,669	**-£60,865**	A £61k/annum reduction in residual waste costs. Greater benefits may be seen for lower performing authorities.
TOTALS				
Total materials management cost, £	**£1,795,418**	**£1,800,485**	**£5,067**	**Overall £5k/annum increase in costs for management of materials. Avoided disposal and MRF processing cost savings not sufficient to offset the loss in material revenues.**

Table A. 9: Net results – North Devon

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
Total materials management cost, £	£1,795,418	£1,800,485	**£5,067**	Slight net cost increase in the management of materials. Avoided disposal and sorting cost savings not sufficient to offset the loss in material revenues.
Collection cost total,	£3,229,192	£3,161,629	**-£67,563**	Reasonable financial saving on collections from lightened recycling collection burdens
OVERALL TOTAL	**£5,024,610**	**£4,962,114**	**-£62,496**	**Net cost savings of £62k/annum expected.**

A.1.1.4 The impact of a DRS in North Somerset

Modelling results for North Somerset are also broken down across three successive tables below, with individual relevant effects noted within the right hand columns.

Table A. 10: Impacts on collection – North Somerset

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
Volume of recycling collected per year, m3	146,568	123,897	**-22,671**	The DRS leads to a 15% reduction in volume of recycling in kerbside boxes
Recycling setout rate as modelled	65.0%	65.0%	-	The reduction in volume is not modelled to result in any decrease in households putting boxes out for collection
Recycling sort time per property modelled, seconds	27.7	25.2	**-2.5**	The reduction in quantity of materials placed out for collection is conservatively modelled to result in a 2.5 second faster sort time per property. This is a conservatively estimated figure, and the result in practice may be greater.
Average number of properties per day container recycling vehicles can service	695	732	+37	The reduced amount of collection work required by collection operatives mean more properties can be collected per day
Resultant number of days of collection work per collection cycle	135	129	-6	In each weekly collection cycle, 6 days of collection work are avoided.
Resultant number of recycling vehicles required	27	26	-1	As a result of the above, collection rounds can be designed with one less vehicle.
Total fuel used per vehicle, gallons	35,949	34,391	-1,157	A reduction in fuel use associated with one less vehicle on the road
Miles driver per annum	298,957	286,478	-12,479	A 4% reduction in the total number of miles driven by recycling vehicles per year, with associated carbon savings
Overall collection cost	**£5,208,104**	**£5,055,824**	**-£152,280**	**An overall £152k/annum financial saving resulting from lightened recycling collection burdens and one less vehicle required.**

**Setout rate is defined as the percentage of households putting their bin out for collection on any collection day.*

Table A. 11: Impacts on the management of materials – North Somerset

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
COSTS OF SORTING				
Total container sorting input, tonnes	2,606	2,116	**-490**	The DRS leads to a 19% reduction in weight of total dry recycling collected.
Total processing cost, £	£117,278	£116,297	**-£981**	Most costs of sorting assumed fixed costs. Just some small energy savings and avoided bailing wire resulting in 1% reduction in sorting costs.
INCOME FROM MATERIALS				
Total recycling, tonnes	31,417	28,379	**-3,038**	The DRS leads to a 10% reduction in weight of total dry recycling collected.

The 'basket price' revenue for mixed recycling, £/t	-£69	-£76	**-£7**	With reduction in containers in collected recycling, the remaining recyclate is higher value per tonne.
Total revenue, £	-£935,451	-£821,568	**£113,883**	Although the basket price per tonne of recycling increases, the absolute reduction in tonnage leads to a net loss in material revenues.
RESIDUAL WASTE				
Residual waste collected, tonnes	21,919	21,388	**-532**	Only a small (2%) change in collected residual waste is observed, resulting from the high recycling rate in North Somerset currently.
Treatment/disposal cost, £/t	£107	£107	**£0**	Estimated residual waste cost per tonne.
Total treatment/disposal cost, £	£2,345,348	£2,288,465	**-£56,883**	A £51k/annum reduction in residual waste costs. Greater benefits may be seen for lower performing authorities.
TOTALS				
Total materials management cost, £	**£1,527,176**	**£1,583,195**	**£56,019**	**Overall £56k/annum increase in costs for management of materials. Avoided disposal and sorting cost savings not sufficient to offset the loss in material revenues.**

Table A. 12: Net results – North Somerset

All costs shown positive, and savings negative	Baseline	With DRS	Net impact	Notes relating to the impact
Total materials management cost, £	£1,527,176	£1,583,195	**£56,019**	Avoided disposal and sorting cost savings not sufficient to offset the significant loss in material revenues.
Collection cost total,	£5,208,104	£5,055,824	**-£152,280**	Sizeable financial saving on collections, one less collection vehicle required and a further collection day per week avoided
OVERALL TOTAL	**£6,735,280**	**£6,639,019**	**-£96,261**	**Net cost savings of £96/annum expected.**

A.1.1.5 Cost distribution impacts of a DRS

The distribution of costs and benefits resulting from a DRS, as relevant to South Oxfordshire, are presented in Table A. 13. Similar tables are provided for Trafford, North Devon and North Somerset in Table A. 14, Table A. 15, and Table A. 16 respectively.

Table A. 13: DRS net impacts – detailed distribution of costs under current and optimised conditions: South Oxfordshire

All costs shown positive, and savings negative	WCA S.Ox. DC	Collection contractor Biffa	Sorting contractor Biffa	WDA Oxfordshire CC	Residual contractor Viridor EfW	Net Costs
Staff and vehicle costs		£0				£0
Container costs						£0
Material revenues			£58,428			£58,428
Processing costs			-£178,636			-£178,636
MRF 'gate fee'*		-£120,207	£120,207			£0
Recycling credits	£175,975			-£175,975		£0
Treatment/disposal costs				-£31,010	£0	-£31,010
Total	**£175,975**	**-£120,207**	**£0**	**-£206,984**	**£0**	**-£151,217**
Optimised**	**-£75,609**	**-£60,104**	**£0**	**-£15,505**	**£0**	**-£151,217**

**Since the collection contractor is the same as the sorting contractor in this case, the net savings at MRF are shown as a pass-through cost item to the collection contractor line.*
***Please refer to Section 4.4.*

Table A. 14: DRS net impacts – detailed distribution of costs under current and optimised conditions: Trafford

All costs shown positive, and savings negative	WCA Trafford DC	Collection contractor AMEY	Sorting contractor Viridor	WDA GMWDA	Residual contractor Viridor EfW	Net Costs
Staff and vehicle costs	-£22,897					-£22,897
Container costs						£0
Material revenues			£80,383			£80,383
Processing costs			-£9,840			-£9,840
MRF 'gate fee'*		Not quantified	Not quantified			£0
Recycling credits*	Not quantified			Not quantified		£0
Treatment/disposal costs				-£119,577	£0	-£119,577
Total	**-£22,897**	**£0**	**£70,543**	**-£119,577**	**£0**	**-£71,931**
Optimised**	**-£47,414**	**£0**	**£35,272**	**-£59,789**	**£0**	**-£71,931**

**MRF gate fees and recycling credits do not exist in the traditional sense in Trafford due to the complex PFI arrangements in place. Rather than MRF gate fees, fixed infrastructure payments are incurred in relation to the plastics and cans sorting operations, and thus it is not certain that any effect will be felt in relation to the DRS. Rather than recycling credits, Trafford is also subject to an alternative levy payment system, and the impact of a DRS on these payments is uncertain and similarly not calculated. However, since these are financial transfers with a zero overall net value, this does not affect the overall analysis.*
***Please refer to Section 4.4.*

Table A. 15: DRS net impacts – detailed distribution of costs under current and optimised conditions: North Devon

All costs shown positive, and savings negative	WCA North Devon	WDA Devon CC	Residual waste contractor Deepmoor	Net Costs
Staff and vehicle costs	-£67,563			-£67,563
Container costs				£0
Material revenues	£66,688			£66,688
Processing costs	-£756			-£756
MRF 'gate fee'		£0		£0
Recycling credits	£98,702	-£98,702		£0
Treatment/disposal costs		-£60,865	£0	-£60,865
Total	**£97,071**	**-£159,567**	**£0**	**-£62,496**
Optimised*	**-£32,064**	**-£30,432**	**£0**	**-£62,496**

**Please refer to Section 4.4.*

Table A. 16: DRS net impacts – detailed distribution of costs under current and optimised conditions: North Somerset

All costs shown positive, and savings negative	Unitary Authority North Somerset	Collection contractor Biffa	Residual contractor NES Avonmouth	Net Costs
Staff and vehicle costs		-£152,280		-£152,280
Container costs				£0
Material revenues	£56,941	£56,941		£113,883
Processing costs	-£490	-£490		-£981
MRF 'gate fee'				£0
Recycling credits	£0			£0
Treatment/disposal costs	-£56,883		£0	-£56,883
Total	**-£432**	**-£95,829**	**£0**	**-£96,261**
Optimised*	**-£76,572**	**-£19,689**	**£0**	**-£96,261**
**Please refer to Section 4.4.*				

A.2.0 Beverage container litter

There are a number of ways of thinking about, and presenting, the overall amount of beverage container litter, and the proportion of *all* litter that is comprised of beverage containers. These are as follows:

- By weight;
- By item count; and
- By volume.

A.2.1 Proportion by weight

A Zero Waste Scotland (ZWS) report from 2013 presents the composition (by weight) of litter in Scotland.[42] This identifies the following proportions:

- Plastic bottles – 8.6%
- Packaging glass – 9.1%
- Metal cans – 4.0%

In total, this indicates that 21.7%, by weight, of litter is from beverage containers. It's worth noting that the ZWS report does not identify beverage cartons as a separate category. It seems likely that these are included under the 9% by weight of litter that the report notes as being cardboard.[43]

However, it is possible to estimate a proportion by weight of litter that is beverage cartons from the relative amounts of the different packaging types placed on the market. Eunomia's 2015 DRS Feasibility Study for ZWS identified the number of units, and the associated weight, for different beverage containers placed on the market in Scotland each year, as shown in Table A. 17.[44]

[42] Zero Waste Scotland (2013) Scotland's Litter Problem: Quantifying the Scale and Cost of Litter and Flytipping, July 2013, available at http://www.zerowastescotland.org.uk/sites/default/files/Scotland's%20Litter%20Problem%20-%20Full%20Final%20Report.pdf

[43] Zero Waste Scotland (2013) Scotland's Litter Problem: Quantifying the Scale and Cost of Litter and Flytipping, July 2013, available at http://www.zerowastescotland.org.uk/sites/default/files/Scotland's%20Litter%20Problem%20-%20Full%20Final%20Report.pdf

[44] Eunomia Research & Consulting (2015) A Scottish Deposit Refund Scheme, Final Report to Zero Waste Scotland, available at http://www.eunomia.co.uk/reports-tools/a-scottish-deposit-refund-system/

Table A. 17: Units, average weight per container and total weight of containers placed on the market annually in Scotland

Container	Million Units	Average Container Weight (grams)	Total Weight (thousand tonnes)
PET Bottles	744	33	24.5
Ferrous Cans	148	35	5.2
Aluminium Cans	526	17	8.9
Beverage Cartons	237	21	5

In the can market, aluminium cans have a 78% market share, with steel cans having a 22% share. This means that the weighted average weight of a can placed on the market in Scotland is 21 grams, the same as the average weight for a beverage carton. Given that smaller cartons, in particular, where a straw is used to pierce the container, have one specific characteristic similar to cans – they cannot be resealed – it might be expected that they exhibit a similar 'rate' of littering to that of cans. Accordingly, on that basis, given that the number of beverage containers placed on the market annually in Scotland is 35% that of cans, one might expect the proportion by weight of litter that is beverage cartons to be similarly in proportion. Metal cans account for 4% of litter by weight, and thus one might expect beverage cartons to account for 1.4%.

Including beverage cartons thus calculated, the composition by weight of litter that is beverage containers totals 23.1%, allocated as follows:

- Plastic bottles – 8.6%
- Packaging glass – 9.1%
- Metal cans – 4.0%
- Beverage cartons – 1.4%

The ZWS report also puts a figure on the annual tonnage of litter dropped on the ground and subsequently cleared by local authorities in Scotland each year – at least 15,000 tonnes. This is a conservative figure as it does not include:[45]

- litter dropped and then cleared, on other public land (e.g. hospitals, schools and the transport network) or private land (e.g. stadiums and shopping centres);
- litter that is not picked up and that either (a) accumulates over a long period of time – although, in due course, much of this might eventually be cleared – or (b) ends up being washed into water courses and, ultimately, to the sea; and
- litter that is correctly discarded in litter bins.

However, if we take 15,000 tonnes as an estimate of litter dropped and cleared by local authorities each year in Scotland, the following tonnages can be calculated for specific littered items:

- Plastic bottles – 1,290 tonnes
- Packaging glass – 1,365 tonnes
- Metal cans – 600 tonnes
- Beverage cartons – 210 tonnes

In the absence of similar data in other countries of the UK, we pro-rate these tonnages on a per capita population basis to derive estimates for other countries. The populations of the UK countries used as the basis for pro-rating these tonnages are shown in Table A. 18:[46]

Table A. 18: Population of countries in the UK

	Population	Proportion of UK Total
Scotland	5,373,000	8.25%
England	54,786,300	84.14%
Wales	3,099,100	4.76%
Northern Ireland	1,851,600	2.84%
UK Total	**65,110,000**	**100.00%**

Source: ONS 2016

This leads to the annual tonnages of beverage containers picked up from the ground shown in Table A. 19.

[45] However, for the purposes of the current study, this figure is relevant in that it represents the beverage container litter managed by local authorities.

[46] Office for National Statistics (2016) Statistical Bulletin: Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2015, 23 June 2016, available at https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/latest

Table A. 19: Tonnage of beverage containers picked up from the ground each year in UK countries

	Plastic bottles	Packaging glass	Metal cans	Beverage Cartons	Total
Scotland	1,290	1,365	600	210	3,465
England	13,154	13,918	6,118	2,141	35,331
Wales	744	787	346	121	1,999
Northern Ireland	445	470	207	72	1,194
UK	**15,632**	**16,541**	**7,271**	**2,545**	**41,989**

It is estimated by ZWS that on average, 44% of litter is collected from the ground, and 56% is collected from bins.[47] While there will be variations across authorities, we assume this split overall. Accordingly, this suggests that the tonnages collected from litter bins are as shown in Table A. 20.

Table A. 20: Tonnage of beverage containers collected from street litter bins each year in UK countries

	Plastic bottles	Packaging glass	Metal cans	Beverage Cartons	Total
Scotland	1,642	1,737	764	267	4,410
England	16,741	17,714	7,786	2,725	44,967
Wales	947	1,002	440	154	2,544
Northern Ireland	566	599	263	92	1,520
UK	**19,896**	**21,052**	**9,254**	**3,239**	**53,440**

[47] Zero Waste Scotland (2013) Scotland's Litter Problem: Quantifying the Scale and Cost of Litter and Flytipping, July 2013, available at http://www.zerowastescotland.org.uk/sites/default/files/Scotland's%20Litter%20Problem%20-%20Full%20Final%20Report.pdf

A.2.1.1 Cost implications for English local authorities

At a residual waste gate fee of £100/tonne, and based on the calculated weights shown in Table A. 19 and Table A. 20, the current disposal/residual treatment cost to English local authorities from beverage containers in litter (both placed in litter bins and dropped on the ground) is circa £8 million per annum.

A.2.2 Proportion by item count

One way to estimate the *number* of littered beverage containers is to apply average item weights to the different types of beverage containers, and calculate how many beverage containers would be required to make up the tonnage figures presented in Section A.2.1.

The average weights for different beverage container types noted in the 2015 DRS Feasibility study are shown in Table A. 21.

Table A. 21: Average Weights for Beverage Containers

Container	Weight (grams)
Soft/Beer & Cider Bottles	300
PET Bottles	33
Cans (weighted average)	21
Beverage cartons[48]	21

Applying the average weights in Table A. 21 to the total weights in Table A. 19 leads to the estimate for the number of beverage containers picked up from the ground each year as shown in Table A. 22.

[48] The average weight given for cartons of 50cl or over is 28 grams, with the average for those below this weight being 12 grams. We use an average of 21 grams. This may underestimate the item count, as it would seem likely that the smaller beverage cartons, such as the 228ml cartons often consumed by children (with a straw in a plastic sleeve glued to the outside) would be more likely to be consumed on-the-go than larger cartons, which may be more likely to be consumed at home.

Table A. 22: Number of beverage containers picked up from the ground annually

	Plastic bottles	Packaging glass	Metal cans	Beverage Cartons	Total
Scotland	39,090,909	4,550,000	28,625,954	10,000,000	82,266,863
England	398,594,132	46,394,503	291,887,235	101,965,941	838,841,811
Wales	22,547,299	2,624,401	16,511,203	5,767,914	47,450,816
Northern Ireland	13,471,194	1,567,984	9,864,846	3,446,119	28,350,144
UK	**473,703,535**	**55,136,888**	**346,889,238**	**121,179,974**	**996,909,635**

It is reasonable to assume that ZWS calculated dry weights when seeking to understand the composition of litter (by weight) composed of different item types, as part of the aim of the research was to identify the amount of potentially recyclable material.[49] However, the *overall* tonnage of litter collected in Scotland by local authorities is likely to contain some moisture, either in the form of liquid left in beverage containers, or from rain-soaked newspapers etc. Therefore, the overall number of beverage containers picked up from the ground by local authorities may be lower than suggested by the calculations presented in Table A. 22.

A.2.2.1 Cost implications

Where individual littered beverage containers are picked up manually by street cleansing operatives, the number of items can clearly have an effect on the time it takes to remove litter from a specific area. It takes time to walk to the littered item, pick it up and place it in a barrow and then walk on to the next item.

However, some littered beverage containers will be picked by street sweeping vehicles, proceeding along roads, and these will not be slowed down by the presence of littered beverage containers.

[49] Zero Waste Scotland (2013) Scotland's Litter Problem: Quantifying the Scale and Cost of Litter and Flytipping, July 2013, available at http://www.zerowastescotland.org.uk/sites/default/files/Scotland's%20Litter%20Problem%20-%20Full%20Final%20Report.pdf

It's interesting to consider the value of the time that may be spent by street cleansing staff on physically picking up littered beverage containers. Data is sparse, and there is no clear indication of the proportion of littered containers that are manually picked up against the proportion removed by other means. Furthermore, the additional time incurred by a street cleansing operative from the presence of an additional littered beverage container will vary depending on the context.

In a town centre, where littered beverage containers (and other littered items) may be in relatively close proximity to each other, the additional time required to pick up the marginal littered beverage container may be a matter of a second or two. However, in a park, where littered items may be scattered more widely, or indeed in any location where litter is anything less than highly concentrated, the time taken to walk to and pick up the marginal littered item may be much higher – perhaps up to ten seconds per item. Sports pitches where litter removal is undertaken by local authorities are a particularly interesting case in this regard. Discussions with Blackpool's street scene manager indicate that litter on such pitches is almost entirely plastic bottles.[50]

In Table A. 22 we estimated that 839 million littered beverage containers are picked up each year by local authorities in England.[51] If each of these were picked up manually, and we assume it takes an average of 5 seconds per item, at a wage cost of £10 per hour (including on-costs), this would equate to nearly £12 million per year simply picking up these littered items. To account for the possibility that the estimate of 839 million may be slightly high, and that not all littered beverage containers will be picked up manually, we can apply a somewhat arbitrary reduction, and assume that only 420 million are picked up manually each year. Assuming five seconds to pick up each additional littered beverage container, and a wage cost of £10 per hour, this would be nearly £6 million per annum.

Such calculations are, of course, somewhat speculative in nature but worthwhile to at least get some idea of the scale. While the estimate is subject to some uncertainty, the cost of physically picking up littered beverage containers is not zero. Furthermore it is a real cost in that it is using up time that could be applied to clearing up other littered items.

A.2.3 Proportion by volume

Eunomia's 2015 DRS Feasibility Study for Zero Waste Scotland identified that the average proportion of beverage containers in litter from four studies in Estonia, Czech Republic, Slovakia and Luxembourg was 46%.[52] This is consistent with a recent study from New

[50] Personal communication with Jez Evans, Street Scene Manager, Blackpool Council
[51] Albeit noting that the way this is calculated means it could be an overestimate.
[52] Eunomia Research & Consulting (2015) A Scottish Deposit Refund Scheme, Final Report to Zero Waste Scotland, available at http://www.eunomia.co.uk/reports-tools/a-scottish-deposit-refund-system/

South Wales that noted that total beverage container litter accounted for 49% by volume.[53,54]

For the purposes of the current study we again use the (possibly conservative) assumption that beverage containers account for 40% of litter by volume.

A.2.3.1 Cost implications

The volume of litter, either correctly discarded in bins or dropped on the ground, clearly has potential capacity implications. All things being equal, the greater the volume of litter, the quicker litter bins will fill up (and potentially overspill) and require emptying, and the more sacks of litter will be filled by street cleansing operatives. High volumes of litter that lead to bins filling up quickly may also lead to demand from the public for additional bins.

[53] New South Wales Environment Protection Authority (2016) 2015–16 National Litter Index Results for New South Wales, available at http://www.epa.nsw.gov.au/resources/litter/nsw-national-litter-index-results-160513.pdf

[54] Beverage containers due to be included in the proposed DRS accounted for 43% of the total volume.

A.3.0 Likely reductions in littering from a DRS

Perhaps surprisingly, to the best of our knowledge, no specific research has been undertaken in the European context to identify the effect of a DRS on littering of beverage containers. It is therefore necessary to look to studies undertaken in the US. A 2005 peer review for Defra, by Perchards, of a study on DRS systems for packaging highlights a number of examples.[55] The peer review notes that:

> *Mandatory deposits came into force in nine US states between 1972 and 1983 (the only deposit law adopted since then was in Hawaii in 2002, though a related measure was California's Advance Disposal Fee, adopted in 1986). The leading US authority on litter measurement, Dan Syrek of the Institute of Applied Research, conducted a series of litter studies in a number of US states during this period, including a series of "before and after" studies in the states where mandatory deposits were imposed on non-refillables, and "side- by - side" studies comparing results in adjacent deposit and non-deposit states.*
>
> *These studies were carried out with a very robust methodology and they present an unsurpassed view of the effect of this policy measure on littering. We are unaware of any European studies of comparable comprehensiveness.*

The Perchards peer review highlights that one of Syrek's studies, prepared for a Special Joint Committee of the Michigan Legislature to study the impact of the Beverage Container Deposit Law, collected samples in September 1978 and September 1979. The deposit law came into force on 3 December 1978. It appears that this may well be the *only* dedicated piece of research implemented on behalf of a state government specifically to determine the effects on littering of a DRS on beverage containers. Perchards notes, in respect of the Michigan study that:[56]

> *It was found that while beverage container litter had declined by 85%-88%, the changes in total litter rates were not statistically significant*

Perchards then offers the data shown in Table A. 23.

[55] Perchards (2005) Deposit Return Systems for Packaging Applying International Experience to the UK, Peer Review of a Study by Oakdene Hollins Ltd., Report to Defra 14 March 2005, available at http://www.oakdenehollins.com/pdf/Deposit_Returns_2005_Peer_Review.pdf

[56] Perchards (2005) Deposit Return Systems for Packaging Applying International Experience to the UK, Peer Review of a Study by Oakdene Hollins Ltd., Report to Defra 14 March 2005, available at http://www.oakdenehollins.com/pdf/Deposit_Returns_2005_Peer_Review.pdf

Table A. 23: Results presented in Perchards (2005) for Before-and-After Studies

IAR FINDINGS ON DEPOSIT LEGISLATION EFFECTIVENESS				
	Measurement Parameter	**Beverage container Litter rate**	**Other Litter rate**	**Total Litter rate**
BEFORE-AND-AFTER STUDIES				
Michigan 1978	Visible items per mile	226.0	1447	1673
Michigan 1979	Visible items per mile	6.3	808	815
	% change	*-91.5%*	*+2.1%*	*-10.5%*
California 1986	Visible items per mile	70.0	1836	1953
California 1993	Visible items per mile	42.2	1970	2013
	% change	*-63.9%*	*+7.3%*	*+3.1%*

Source: Perchards 2005, reporting Syrek

The first thing to note about this table is that the 85%-88% reduction in beverage container litter reported in the text for Michigan is not matched by that shown in the table, which is a reduction of 91.5%. However, if the reported number of visible items per mile are accurately presented, then the 91.5% shown in the table is also inaccurate. A reduction in the beverage container litter rate from 226 to 6.3 visible items per mile is actually a 97.2% reduction in beverage container litter.

An error has also been made in presenting the 'other litter rate' and the 'total litter rate'. For 'other', i.e. non-beverage container litter, the reduction from 1447 to 808 items is a decline of 44.2% rather than an increase of 2.1% as indicated. For total litter, the drop from 1673 to 814.3 visible items per mile is a reduction of 51.3%, rather than a reduction of 10.5% as in the table.

The key figure in respect of considering impacts of a DRS is the 97.2% reduction in beverage container litter. This is consistent with the findings from a study by PwC on the German Einwegpfand (one-way deposit) that stated:[57]

> *With a deposit system, there is practically no longer any littering of single-use beverage containers bearing deposits*

Interestingly, the percentage changes calculated in the Perchards report based on the findings from the California studies are also incorrect. The number of visible items per mile that are beverage containers drops from 70 in 1986, to 42.2 in 1993, which is a reduction of only 39.7%, rather than the 63.9% indicated. The total number of visible items per mile in 1986 is also incorrect - it's overstated - and should be 1906 rather than 1953. This means that the total increase in visible items per mile between 1986 and 1993 is 5.6%.

Notwithstanding these errors, it's remarkable that the California scheme is presented as one of the two examples of 'before and after' studies that apparently, according to Perchards:[58]

> *Present an unsurpassed view of the effect of this policy measure on littering*

Firstly, it's important to note that the level of the deposit in California, at only 2.5 cents (on beverage containers smaller than 24oz, 5 cents on those above this size), meant the financial incentive to return the beverage container was far smaller than in other schemes. For example, the deposit level in Michigan, upon scheme implementation in 1979, was 10 cents on non-refillables (i.e. one-way beverage containers). Even without accounting for the effect of inflation between 1979 and 1987, it is clear that a 2.5 cents payment on return is unlikely to lead to the same reduction in littering as a 10 cents deposit/refund.

Secondly, there are seven years between the 'before' and 'after' study. In this time, overall consumption of beverage containers will most likely have increased, and the value of the 2.5 cent or 5 cent payment for return of the beverage container will have been further eroded by inflation.

That the California example is presented here, strongly suggests that the Michigan study, which, based on the count figures presented in Table A. 23 showed a 97.2% reduction in beverage container litter was the only credible 'before and after' study undertaken by Dan Syrek and the Institute for Applied Research.[59]

The Perchards peer review also presents the findings from adjacent state studies by Syrek. These findings are reproduced in Table A. 24.

[57] PWC (2011) Reuse and Recycling Systems for Selected Beverage Packaging from a Sustainability Perspective: An analysis of the Ecological, Economic and Social Impacts of Reuse and Recycling Systems and Approaches to Solutions for Further Development, available at http://www.duh.de/fileadmin/user_upload/download/Projektinformation/Kreislaufwirtschaft/PwC-Study_reading_version.pdf

[58] Perchards (2005) Deposit Return Systems for Packaging Applying International Experience to the UK, Peer Review of a Study by Oakdene Hollins Ltd., Report to Defra 14 March 2005, available at http://www.oakdenehollins.com/pdf/Deposit_Returns_2005_Peer_Review.pdf

[59] Perchards, in their 2005 peer review, do not provide a reference for Syrek's work, although they do indicate that one of his studies was published in 2003. In fact in another paper by Perchards ('Peer Review of the Boomerang Alliance Report: National Packaging Covenant – Say No to the Waste Club', 3 March 2005, available at http://www.pca.org.au/application/files/5614/3769/2418/Oz_Boomerang_Report.pdf) in which the same miscalculations are presented, the list of references include Syrek (1980) Michigan: After – a study of the impact of beverage container deposit legislation on street, roadside and recreation area litter in Michigan. The Institute for Applied Research; and Syrek (2003) What we now know about controlling litter – Findings pertinent to Michigan derived from thirty years of litter research. The Institute for Applied Research. It has not been possible to find either of these papers online

Table A. 24: Results presented in Perchards (2005) for Adjacent State Studies

IAR FINDINGS ON DEPOSIT LEGISLATION EFFECTIVENESS				
	Measurement Parameter	Beverage container Litter rate	Other Litter rate	Total Litter rate
ADJACENT STATE STUDIES				
California 1974	Visible items per mile	228.2	1998	2226
Oregon 1977	Visible items per mile	27.6	1930	1958
	% difference	*-87.9%*	*-3.4%*	*-12.0%*
Pennsylvania 1984	Visible items per mile	167.5	3117	3285
New York 1984	Visible items per mile	52.7	3485	3538
	% difference	*-68.5%*	*+11.8%*	*+7.7%*

Source: Perchards 2005, reporting Syrek

Assuming the number of visible items per mile are correctly reported, the percentage changes shown are accurate. Unfortunately it has not been possible to find the original analysis from which these figures are derived. Again, it does seem strange that studies that apparently present 'an unsurpassed view of the effects of a DRS on littering' includes a survey of two adjacent states, but taken three years apart (California 1974, and Oregon 1977).

It's interesting to note that while the Perchards peer review reports on Pennsylvania and New York as adjacent states, it neglects to mention a 1986 study published in a peer reviewed journal, that compares the 'before' and 'after' situation in New York (either side of the September 12, 1983 implementation of the New York State Bottle Bill), with measurements, at the same time, in the adjacent state of New Jersey.[60] The study considered both highway exits and railroad tracks, where groups 'tend to party' according to the authors. For deposit-bearing beverage containers, the authors reported immediate reductions of between 95% and 99% depending on the location. Clearly not all beverage containers were deposit-bearing, and the authors report that the overall reduction in beverage container litter was more moderate – an initial 44% reduction at highway exits in New York, for example.

What's therefore important to note is that Syrek's figures reporting the number of visible beverage containers per mile, as presented in Perchards' peer review, may not distinguish between those that are deposit-bearing and those that are not deposit-bearing. The figures thus presented may therefore *understate* the reduction in littering of deposit-bearing beverage containers.

[60] Levitt, L. & Leventhal, G. (1986) Litter Reduction: How Effective is the New York State Bottle Bill? Environment and Behavior, Vol. 18 No. 4, July 1986, 467-479.

A.3.1 Implications for a DRS in England

These findings above suggest that reductions in littering of deposit-bearing beverage containers in excess of 95% could reasonably be expected in England. The 90% reduction assumed in the 2015 feasibility study by Eunomia for Zero Waste Scotland could thus be something of an underestimate.

However, taking, again, a conservative approach, we have assumed that a DRS will lead to an 80% reduction in littering of beverage containers subject to a DRS. Assuming that such containers account for 40% of litter by volume, an 80% reduction will lead to a 32% reduction in litter overall.

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