Improving the Capture Rate of Single Use Beverage Containers in Ireland

Final Report

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Report for Department of Communications, Climate Action & Environment

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Executive Summary

E.1.1 Introduction

The Department of Communications, Climate Action and Environment (DCCAE) commissioned Eunomia Research & Consulting Ltd. (Eunomia) to analyse options for Ireland to increase its capture rate of single use Polyethylene Terephthalate (PET) and aluminium beverage containers. This study will help to inform Ireland's response to the Single Use Plastics Directive, which requires the separate collection of 90% of single use plastic beverage bottles by 2029 and a 30% recycled content for such bottles by 2030.

The study has considered:

- the potential of Ireland's current waste management system to achieve this 90% target;
- the feasibility and impacts of a Deposit Return System (DRS) to increase the capture rate of beverage containers specifically; and
- alternative models to achieve the 90% target.

E.1.2 The Existing Collection System

According to the latest Environmental Protection Agency (EPA) data, Ireland has a 34% recycling rate for plastic packaging and a 72% recycling rate for metal packaging. Following an analysis of the information provided by stakeholders and waste characterisation reports, this study has estimated that Ireland is currently capturing 55% of PET beverage bottles separately (as shown in Table 1). It has been estimated that Ireland has a separate collection rate of 55% for cans, but a higher recycling rate due to the cans sorted from residual waste. It should be noted that there was considerable variation in the estimates of the number/ weights of beverage containers placed on the market, so further work would be needed to assess this more definitively.

Table 1: Estimated Current Separate Collection and Recycling Rates in Ireland

	Separate Collection (%)	Recycling (%)
PET Beverage Bottles	54.9	43.9
Aluminium Beverage Cans	55.0	69.4

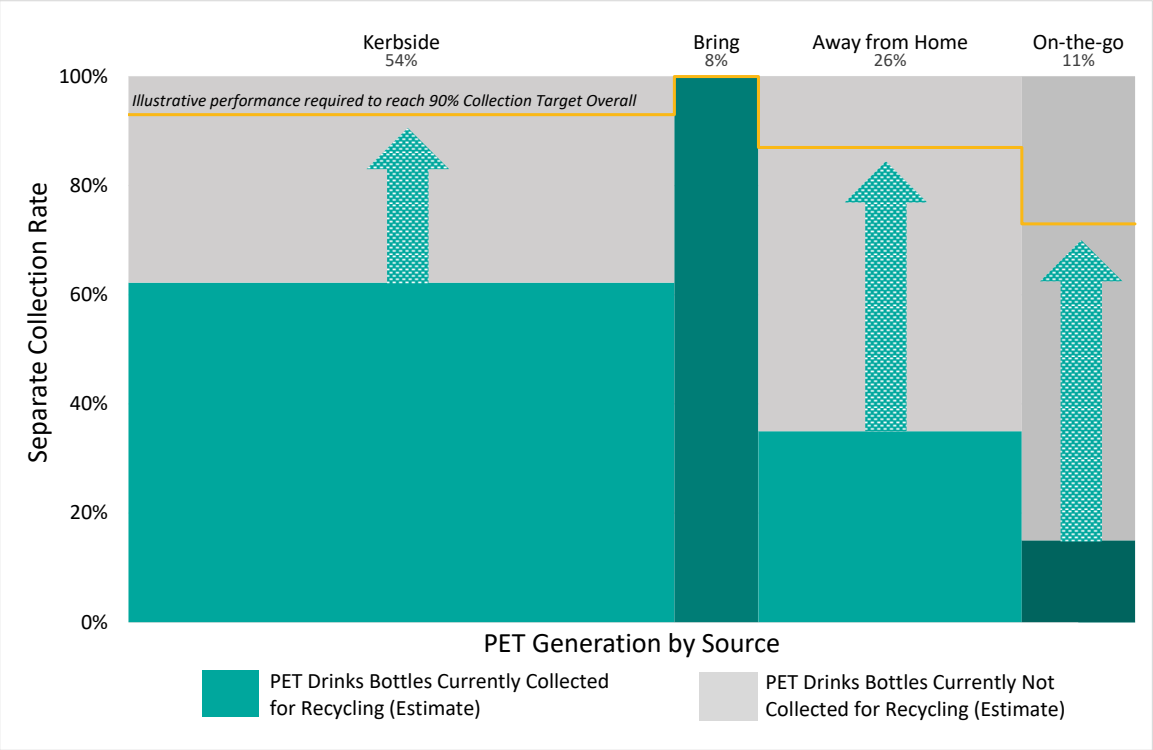
The analysis has therefore indicated that there is a 35 percentage-point gap between current performance of capture rates (55%) and the 90% target. Representatives of Ireland's recycling industry have also indicated that PET loss rates (i.e. the material that is collected and not recycled) are relatively high, due to contamination. Improvements to

collections are consequently needed if Ireland is to support the domestic supply of high-quality food-grade recycled PET (rPET) to meet the recycled content target.

As indicated in Figure 1, capture rates of PET beverage bottles consumed at home, away from home and on-the-go will have to increase. However, no evidence has been presented to suggest that the current system could be enhanced to reliably achieve a 90% separate collection rate. The pay-as-you-throw system already incentivises householders to separate their waste. Further investment in awareness campaigns is a possibility, however, there are doubts about the uplift in collection that might be achieved by any such investment. Furthermore, it would not have the same benefits in reducing contamination as a DRS collection. Commercial premises (businesses) raise further challenges, as this requires engagement with, and co-operation from, individual staff and customers of the businesses.

Some stakeholders consulted as part of this study suggested that rewards or financial incentives could be provided to encourage consumers to separate their waste at commercial premises but no proven examples were offered as evidence. It is not clear who would fund such rewards and, by only targeting certain premises where the beverages are consumed, this would limit the extent of increased collection that could be achieved.

Figure 1: Current Separate Collection Rates & Estimated Changes Required to Achieve 90%



In terms of beverage containers consumed on-the-go – which typically are placed in public bins or littered – investments could be made in recycling bin infrastructure in public places. The costs and benefits of this are, however, unquantified and it is well known that such on-the-go recycling bins are highly susceptible to contamination.

E.1.3 Alternative Approaches to a DRS

There is insufficient evidence to suggest that the current system could be 'enhanced' to reliably achieve a 90% separate collection rate and provide the necessary rPET. Stakeholders were asked for their views on alternative approaches – other than a DRS (discussed below) – that could be introduced. Most responses were based on enhancements to the existing system – discussed above – or DRS-like approaches. The Belgian waste collection system was also cited as a positive example by stakeholders, however there are some questions as to the reliability of Belgium's data. Belgium also operates a kerbside system like Ireland, but transparent bags are used so that waste collectors can inspect the waste for contamination and, in the Brussels region, householders risk fines if they do not separate their waste. This is considered a less viable approach in Ireland, where the competitive market-based system of collection could make it difficult for waste collectors to enforce the behaviour of their customers, as the householders could simply choose an alternative company. While Belgium is cited as a country that achieves high recycling rates without a DRS, the Brussels Capital Region has confirmed that it will now introduce a DRS – indicating that they do not consider the current, kerbside-based system to be sufficient.

An illuminating example of the relative merits of different approaches is provided by Norway, where a DRS has been 'voluntarily' established by producers. The Norwegian Government never required a DRS to be set up, but simply put in place a financial incentive to achieve a very high collection rate in the form of a Beverage Container Tax. The tax (payable on each container) is set at a relatively high level, but starts to decline once a 25% collection rate is achieved, dropping to zero once a 95% collection rate is achieved. In response to this incentive, the industry collectively decided that that most cost-effective option was to establish a DRS.

E.1.4 Deposit Return Systems

The basic premise of a DRS is that the consumer pays a deposit at the point of purchase, which can be redeemed when they return their used beverage container. It is this financial incentive (to get one's money back) that is central to the approach.

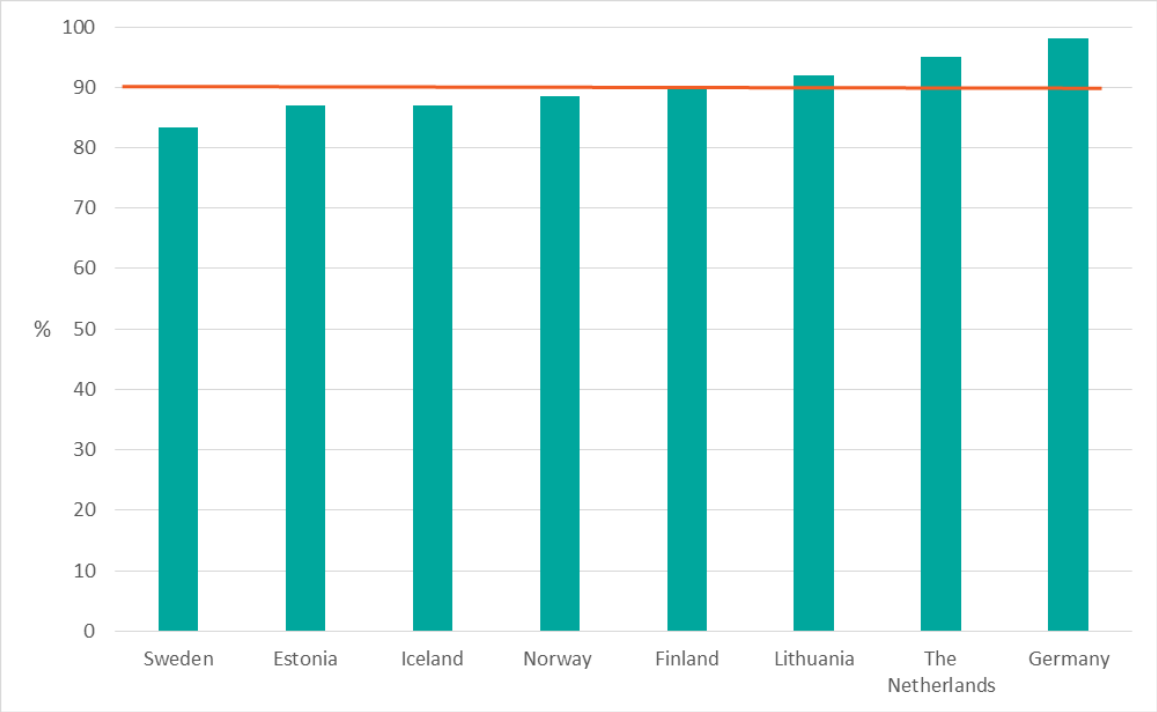
A fundamental difference between a DRS and 'reward schemes' such as those where people receive a voucher, or indeed a payment, for returning used beverage containers, relates to the nature of the incentive and the associated impact this has on scheme performance. Prospect Theory indicates that people are more motivated to avoid a loss (the deposit they paid) than to obtain a gain of equal value; as such, consumers are thought to be more motivated to return a plastic bottle to avoid losing their deposit than to earn a reward that they were not invested in in the first place.[1] This means that, all else being equal, a well-designed DRS, with the deposit set at an appropriate level, is

[1] Poortinga et al. (2019) *Rapid Review of Charging for Disposable Coffee Cups and other Waste Minimisation Measures.* Final Report for the Scottish Government. July 2019.

likely to lead to a larger increase in the recycling rate of beverage containers than a scheme based on 'rewards' only.

A number of stakeholders supported the introduction of a DRS, while others raised concerns about the costs and the impact of removing the majority of deposit-bearing containers from the kerbside collection system. Evidence from other countries indicates that, if the system is well designed – with a high enough deposit, convenient return options for consumers and robust governance – return rates consistently above 90% are possible. This study has identified, as Figure 2 shows, that half of the DRSs in Europe report a 90+% return rate for plastic beverage bottles. Norway expects to surpass 90% following the increase of the deposit values in 2018, [2] after the deposit values had not been changed for nearly thirty years.[3]

Figure 2: Plastic Beverage Bottle Return Rates in European DRSs



E.1.4.1 DRS Design for Ireland

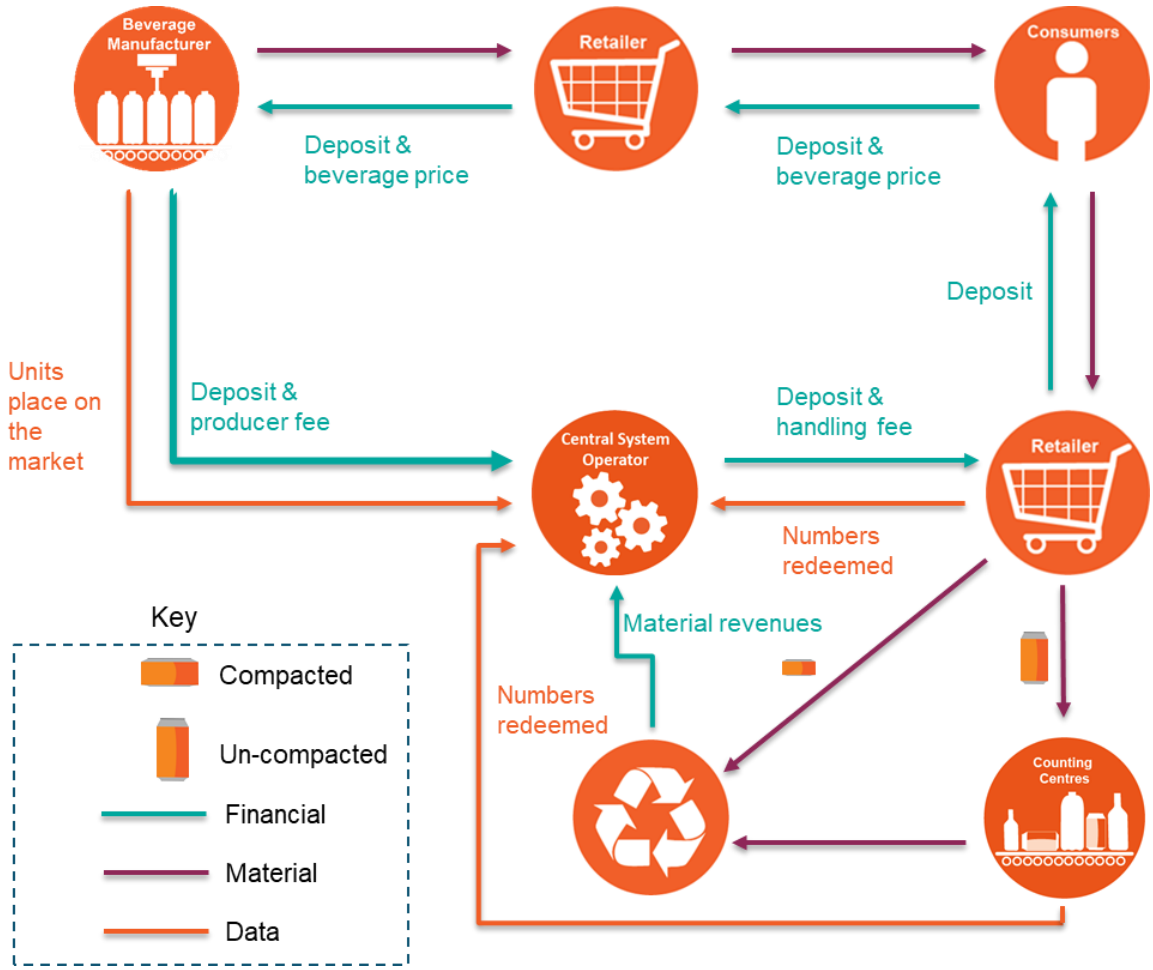
A review of existing DRS design features, and the various results they achieve, indicated that the design outlined in Table 2 would be most likely to support a 90% collection rate in Ireland, based on best practice elsewhere.

[2] Infinitum (2019) 2018 Annual Report
[3] Infinitum (2018) 2017 Annual Report

Table 2: Summary of Potential DRS Design for Ireland

Component	Option Chosen for Ireland
Governance	Centralised; privately owned and operated; targets set by government (and/ or Beverage Container Tax)
Scope – Containers	PET & aluminium (specified in study requirements)
Scope – Beverage	Water; soft drinks; juices; beer; cider; pre-mixed spirits
Deposit Level	€0.20
Labelling	Deposit logo and reduced producer fee for national barcode
Return Infrastructure	Return to retail – any container can be returned to any participating retailer Compacting RVMs for large retailers Manual service for small retailers
Handling fees	Variable handling fee based on retailers' costs and Central System Operator's (CSO) savings.
Funding	Material Revenues Unredeemed deposits Producer fee for every container placed on the market

Figure 3: Organisation of Possible DRS in Ireland



E.1.4.2 Costs

The costs of this system design, with a 90% separate return rate, were modelled and are shown in Table 3. As the majority of costs are covered by the material revenues (from selling the returned aluminium and PET) and unredeemed deposits (the 10% of deposits that are paid by consumers but not claimed for a refund), the net annual costs of the system – to be paid by beverage producers – are **€20 million**. This equates to a producer fee of **€0.011** per can/ bottle placed on the market (and for which producers would no longer be paying Repak).

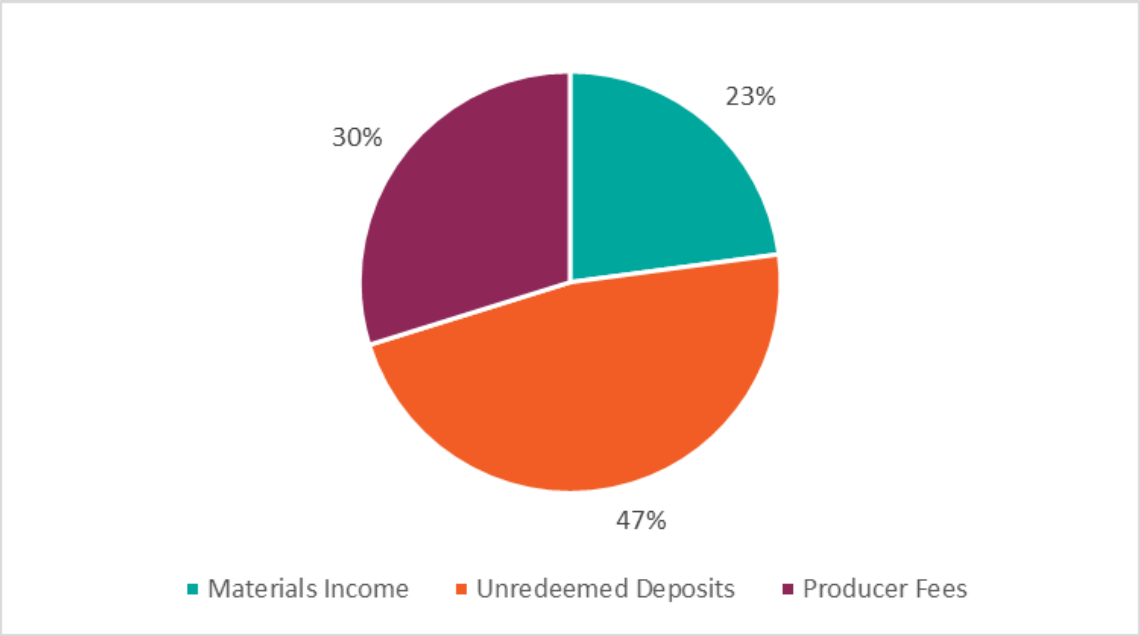
Table 3: Annual Modelled Costs and Revenues of a DRS for Ireland

Item	Total Cost, € million	Cost/Unit Placed on the Market, ¢
Central Admin System	2.95	0.17
Handling Fees	46.28	2.65

Item	Total Cost, € million	Cost/Unit Placed on the Market, ¢
Transport Costs	11.71	0.67
Counting Centre Costs	2.98	0.17
Materials Income	-15.35	-0.88
Unredeemed Deposits	-31.74	-1.82
Fraudulently Claimed Deposits	3.15	0.18
Net Cost	**19.99**	**1.14**
Funded by Producer Admin Fee	**-20.0**	**-1.14**

These annual costs include the annualised capital costs needed to set up the system (calculated at **€82.02 million),** which would be financed by a low-interest loan and re-paid (by material revenues, unredeemed deposits and producer fees) over several years.

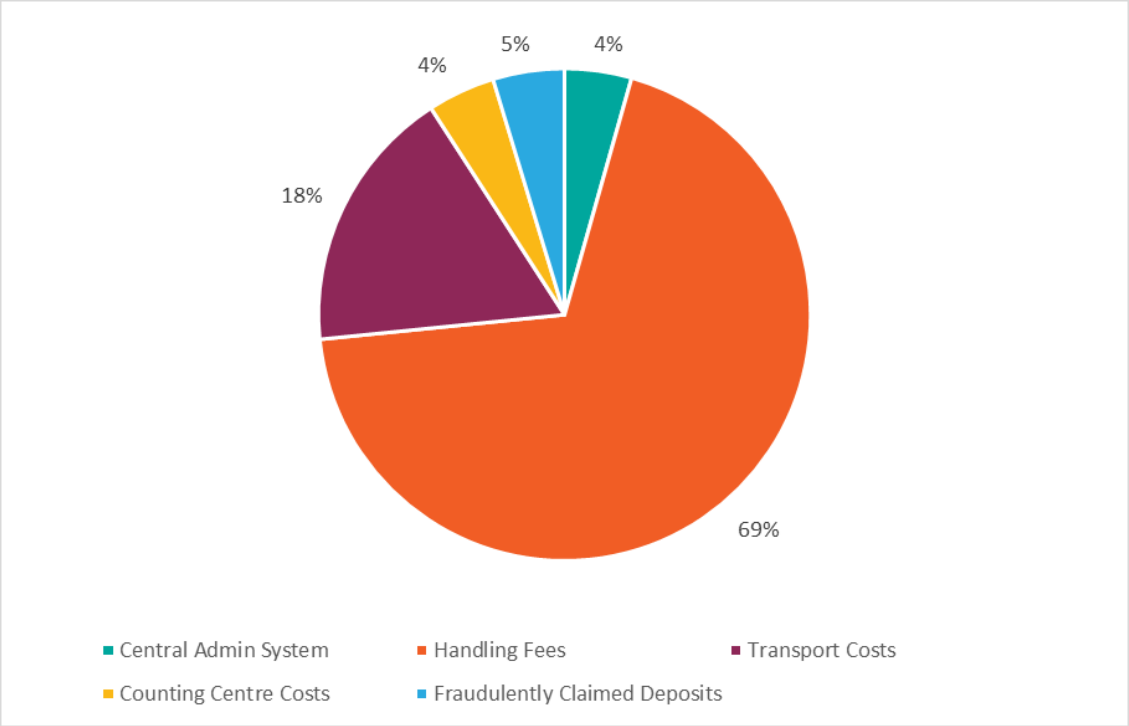
Figure 4: Sources of Funding for the Irish DRS



The majority of the annual costs are handling fees paid to retailers to compensate them for the costs of taking back used containers from their customers. This equates to **€0.032**

for each container returned to a reverse vending machine (RVM) and **€0.026** for each container returned manually (i.e. to smaller shops that do not have the space and/ or return volumes to justify an RVM).

Figure 5: Breakdown of Annual Costs

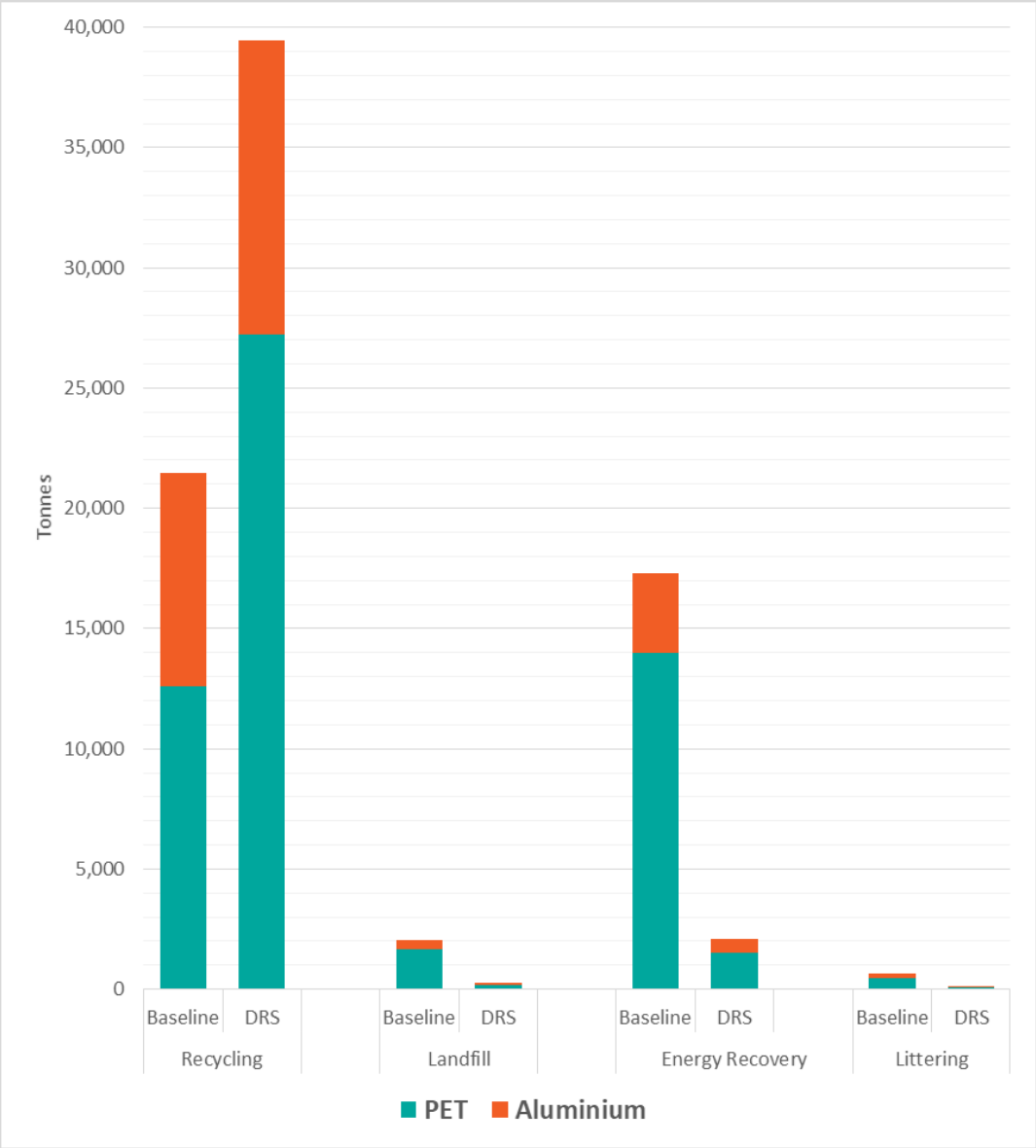


E.1.4.3 Environmental Impacts

With a 90% return rate, the DRS is expected to reduce the tonnage of deposit-bearing containers that are landfilled or incinerated by 88%. The consequent reduction in greenhouse gas emissions in a year is valued at **€1.83 million**, and the annual reduction in other air pollutants is valued at **€550,000**.

It is also estimated that littering of deposit-bearing containers will reduce by 85%. While the potential impact on litter clean-up costs is not estimated in this study, research indicates that communities attach a disamenity value to litter to reflect the impact on their well-being and perceptions of their community, and their willingness to pay for a less littered environment. The possible reduction in litter disamenity resulting from a DRS is estimated to be an **annual benefit of €95.8 million**.

Figure 6: Projected Change in Destinations of Deposit-Bearing Containers



E.1.4.4 Impact on Kerbside Collections

Concerns have been raised that a DRS could reduce the viability of Ireland's kerbside collections by removing a valuable source of revenue (as kerbside collectors will no longer receive the material revenues for the majority of deposit-bearing containers and they will lose the proportion of their Repak subsidy that comes from the beverage containers). It is suggested that this is a particular risk in Ireland as the market-based collections reduce the potential for the reduced volume of waste to deliver logistics savings. This is because it is more difficult to improve the efficiency of the rounds if the collection trucks are not collecting from every household.

PET packaging and aluminium cans (including, but not limited to, beverage containers) account for 5.0% and 1.3%, by weight, of mixed dry recyclables collected at the kerbside.

The vast majority of waste collected for recycling will not be affected by a DRS (although it should be recognised that aluminium cans and PET bottles can have high value compared to some other wastes).

This study consequently modelled:

- the lost material revenues for kerbside collections;
- the reduced Repak subsidy payments for kerbside collectors;
- savings in processing costs;
- savings in residual waste disposal costs; and
- the reduced material revenues and Repak subsidy payments for bring sites.

The overall impact is an increase in the costs of delivering household services of **€4.30 per household per year** (although this could be reduced if MRFs are able to adjust processes to maintain tonnage through-puts). With a current average cost to households of €275 per annum for kerbside collections, this would represent an increase of **1.6% in householders' fees** under the current funding arrangements. However, it should be noted that Repak subsidies are expected to increase in any event under the new rules for Extended Producer Responsibility (EPR), which require producers to cover more of the costs of waste management. If the Repak subsidy is discounted from the analysis, the costs of delivering household services increase by **€2.50 per household per year** as a result of a DRS.

As bespoke collections modelling was not possible within the scope of this study, this could be examined in more detail before any changes are made to Ireland's collection systems. A review of the kerbside system may in any case be needed, given the upcoming implementation of minimum requirements for EPR schemes and the transfer of more costs to producers.

E.1.5 Conclusions

This study has assessed a range of options to enable Ireland to meet the targets set out in the Single Use Plastics Directive, which requires the separate collection of 90% of single use plastic beverage bottles by 2029 and a 30% recycled content for such bottles by 2030.

Eunomia found no firm evidence that the current system could be 'enhanced' to reliably achieve a 90% separate collection rate. Proposals put forward by stakeholders relating to rewards or financial incentives to boost the current system were speculative in nature. In addition, to reach 90% overall, even with a very high performing kerbside household system, collection rates would need to reach over 80% for other streams such as commercial waste, street litter and events waste. Further, with current PET loss rates reported to be 10-20%, improvements would be needed if Ireland is to achieve its recycling targets under the new measurement method and to reduce reliance on imports for food-grade rPET.

On the basis of this study, a DRS is a feasible option for Ireland, and indeed the only way in which it can confidently be asserted that a 90% collection rate for plastic beverage bottles can be achieved. While some might argue that a DRS would only manage

approximately 4% by weight of Ireland's packaging waste, specific solutions are needed for plastic beverage bottles as a result of the Single Use Plastic Directive and beverage containers are more likely to be consumed on-the-go than some other forms of packaging. Evidence from other countries is that a well-designed DRS is an effective solution for beverage containers and, in these countries, kerbside collections are able to operate effectively alongside the DRS. There is also evidence that the awareness generated by a DRS could encourage householders to recycle more of their waste. In terms of littering behaviour, evidence suggests that a DRS can reduce littering of deposit-bearing containers by 95%. Furthermore, given that beverage containers are a high-volume component of litter, reducing their prevalence, in making an area look less littered, will reduce the rate at which other items are littered.

A DRS is a proven means by which a 90% separate collection rate can be achieved. Other approaches suggested by stakeholders in the course of this study have not been demonstrated in practice. While the Government may wish to undertake further detailed investigations into possible alternatives, a simple way of determining the most cost-effective means of achieving 90% plus return rates would be to introduce a Norway-style beverage container tax, and leave producers to use their expertise to determine how best to achieve it.

Contents

1.0 Introduction

The Department of Communications, Climate Action and Environment (DCCAE) commissioned Eunomia Research & Consulting Ltd. (Eunomia) to analyse options for Ireland to increase its capture rate of single use PET and aluminium beverage containers.

This study will help to inform the Irish Government's response to the EU Single Use Plastic (SUP) Directive, as well as to the revised EU Waste Framework and Packaging & Packaging Waste Directives. The SUP Directive requires:

- the separate collection for recycling of at least 77% of single use plastic beverage bottles (up to 3 litres and including caps and lids) by 2025, rising to 90% by 2029;
- minimum recycled content for Polyethylene Terephthalate (PET) beverage bottles of 25% on average by 2025 and 30% for plastic beverage bottles by 2030; and
- extended producer responsibility (EPR) schemes by 2023 where producers of single use plastic beverage containers cover the costs of awareness raising measures, the costs of waste collection for those products that are discarded in public collection, litter clean-up; and data gathering.

To achieve the separate collection target, the Directive suggests Member States could "inter alia":

1) establish a deposit return system (DRS) for beverage containers (which usually involves the application of a small, refundable deposit to incentivise consumers to return their beverage containers to be recycled); or
2) establish separate collection targets for relevant EPR schemes.

In addition to the requirements introduced by the SUP Directive, both the Packaging and Packaging Waste Directive (PPWD) and the Waste Framework Directive (WFD) were revised in 2018. The key changes of relevance to this study are summarised in Table 1-1.

Table 1-1: Summary of EU PPWD & WFD Requirements Relevant to Beverage Containers

Directive	Target	Deadline
Packaging & Packaging Waste Directive	Recycle 70% of all packaging waste	2030 (65% by 2025)
	Recycle 55% of plastic packaging	2030 (50% by 2025)

Directive	Target	Deadline
	Recycle 60% of aluminium packaging	2030 (50% by 2025)
Waste Framework Directive	Article 10: Ensure waste is collected separately	2021
	Article 8a: Producers to be financially responsible for the net costs of separate collections, transport and treatment of waste packaging	2023
	Article 11: Recycling calculation – the weight of the municipal waste recycled shall be calculated as the weight of waste which, having undergone all necessary checking, sorting and other preliminary operations to remove waste materials, actually enters recycling operations to be reprocessed.	2021

This study is primarily intended to support DCCAE in considering options to achieve the 90% separate capture rate. In addition, the consequences of potential policy options in respect of these other targets are also taken into account. As a result, this study has considered:

1) the potential for Ireland to achieve a 90% separate capture rate for beverage bottles within its existing waste management system;
2) alternative models to achieve the 90% target; and
3) an appropriate Deposit Return System (DRS) design for Ireland that could support a 90% separate collection target, the costs and impacts of such a system and the implications for Ireland's kerbside household collections.

While the SUP Directive refers to "plastic" bottles – which would, for instance, include HDPE – we have been asked to focus on PET in this project. It is also worth noting that Article 10(3) of the WFD includes the conditions under which Member States may allow derogations from the requirement for separate collections. However, the SUP Directive specifies separate collection of plastic beverage bottles, so this study does not assume that the Irish Government has allowed any derogations.

To support the study, DCCAE provided Eunomia with a list of stakeholders from across the waste management, recycling, beverage, retail and environmental sectors.

Information from the stakeholders has been used in the modelling and their views were sought on each of the three questions for this study.

This report is structured into the following sections:

- an overview of the existing waste management system in Ireland and its potential to achieve a 90% separate capture rate of single-use plastic beverage bottles (Section 2.0);
- an assessment of stakeholder views on alternative EPR models and approaches in other countries that are associated with a 90% capture rate (Section 3.0);
- an introduction to Deposit Return Systems and a possible DRS design for Ireland (Section 4.0);
- the methodology for assessing the costs and impacts of a DRS and the results of the costs and impacts modelling (Section 5.0);
- conclusions (Section 6.0); and
- a full technical appendix is also included at the end of this report to demonstrate the assumptions used in the modelling processes.

2.0 Existing Collection System for Beverage Containers

2.1 EU Waste Targets

On the basis of the latest data reported to Eurostat (Table 2-1), Ireland has already achieved the 2025 recycling target for all packaging and comfortably exceeds the 2025 and 2030 targets for metal packaging. There is, however, significant scope to improve the plastic recycling rate and a 47% increase on 2017 levels is required to achieve the 2025 target (i.e. a 16-percentage point increase). This does not take into account changes to the measurement method, under which recycling rates reported across the EU are expected to be revised downwards.

Table 2-1: Ireland's Packaging Recycling Rates and EU Targets

Packaging	2016 Eurostat	2017 EPA	2025 Target	2030 Target
All	67%	66%	65%	70%
Plastic	31.2%	34%	50%	55%
Metal	70.1%	72%	50%	60%

2.2 Waste Management in Ireland

2.2.1 Collections

Currently, the main route through which plastic bottles and metal drinks cans are captured is kerbside collection.

Most households in Ireland are served with fortnightly kerbside collections in either a two-bin or three-bin service – one bin for mixed dry recycling (MDR), one for mixed residual waste (MRW) and in many areas also a food/organics bin (the provision of food/organics bins to households in every town with 500 or more residents is now mandatory). Beverage bottles and cans are therefore collected in the MDR bin alongside other household packaging, paper and card. This co-mingled material is sorted at Materials Recovery Facilities (MRFs) into separate material streams for sale. There are 8 MRFs registered with Repak in the Republic of Ireland.

Collection services are marketed and provided direct to households by waste collectors, meaning individual householders agree contracts with, and are charged directly by, waste collectors. There are around 63 companies operating in the market, collecting from 1.2 million households.

Fee structures vary by area, with collectors setting their pricing options. Legislation introduced in 2016 made 'incentivised charging' compulsory and banned the setting of flat rate fees. By ensuring charges relate to the quantity of MRW, households have a financial incentive to minimise waste and to use the recycling services provided. The form this financial incentive takes is open to the waste collector and waste collectors are expected to offer a range of pricing options to customers: paying by lift, or a combination of standing charges and weight-based payments. This form of nationally-mandated 'pay-as-you-throw' (PAYT) mechanism for door-to-door residential collections is rare in Europe.

The Irish Waste Management Association estimates that up to 25% of the population do not take up kerbside dry recycling collection services even though they are, as a rule provided with recycling bins, although this data pre-dates the complete roll-out of incentivised charging structures. While it is estimated that 200,000 – 300,000 households do not use a collection service, new waste bye-laws require all households, apartments and commercial premises to participate in an authorised waste collection service, either by contracting a waste collector or by providing proof that they regularly use civic amenity sites.[4]

Complementing the kerbside collections, there is a network of approximately 1,700 - 1,900 locations (approximately 120 civic amenity sites and the remainder bring sites) where beverage containers (plastic, aluminium and glass) can be brought for recycling.[5]

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[4] (2019) *household waste bye laws*. https://www.mywaste.ie/my-household-waste-bye-laws/
[5] Private communications from Repak and the Waste Planning Offices

In addition to providing a convenient drop-off location for some households, these are likely to capture a small proportion of beverage containers consumed and disposed 'on-the-go'. Some of these bring sites are located on retailer premises or car parks, for instance, although these collect glass and aluminium, rather than plastic. The Convenience Store and Newsagents Association also reports that a low, and declining proportion of retailers provide recycling facilities due to concerns relating to broken glass and spillages, rodents, litigation and liability.

2.2.2 Funding

Repak, Ireland's Producer Responsibility Organisation for packaging and packaging waste, operates as a compliance scheme for packaging recovery, charging fees to members in accordance with the amount and type of packaging they place on the market and using these funds to subsidise the collection and sorting of packaging waste. Repak provides subsidies per tonne of different materials recovered for recycling or energy recovery, based upon materials sorted and segregated for onward sale.

In September 2018, Repak launched its Team Green campaign, involving the installation of recycling machines at some universities. They estimate that this will collect an additional 200 tonnes of PET. Repak is also trialling initiatives at sports clubs, gyms and with event management facilities to increase the collection of 'on-the-go' PET bottles. With a 40% take-up rate, they estimate that this could recycle an additional 3,000 tonnes as a minimum.[6]

All beverage producers in Ireland, of whom Repak are aware, are registered with them. However, it is likely that containers are placed on the market by other producers, comprising:

- self-compliers;
- producers below the de minimis threshold (with no reporting obligation under 10 tonnes); and
- non-compliers (free riders).

Repak funding totalled €21,912,770 in 2018, comprising €587,095 to local authorities and €21,325,675 to recovery operators. Repak reports that this funded the recovery of 286,000 tonnes of packaging waste and the recycling of 636,000 tonnes. Their 2019 budget has increased to €24,044,000, with 50% allocated to plastic, representing an increase of €3,063,000 for plastic packaging.

Repak charges producers €93.87 per tonne for aluminium and €99.41 per tonne for PET placed on the market. Using average weights of 16g for an aluminium can and 30g for a PET bottle, this equates to a fee of €0.0015 per can and €0.0030 per bottle.[7]

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[6] Private communication from Repak

[7] Using these weights, there are 62,500 cans and 33,333 bottles in tonne.

In terms of householder contributions, the average charge for kerbside collections is €275 per annum, meaning a cost to householders of €330 million for the whole of Ireland.[8]

2.2.3 Waste Flows

For this study, a range of stakeholders were asked for the current numbers or weights of PET and aluminium beverage containers placed on the market, and the associated recycling rates. Estimates varied significantly, indicating that further research will be needed to enable Ireland to accurately report on its capture rate of PET beverage bottles. It is not possible within the scope of this study to determine the exact size of the beverage market so, following further discussions with stakeholders and analysis of the Environmental Protection Agency's (EPA) official reports, the estimated waste flows in Table 2-2 were selected. Full details are provided in Appendix A.4.0.

Table 2-2: Current Final Destinations of Beverage Containers Placed on the Market Annually

	PET Beverage Bottles	Aluminium Beverage Cans
Units Placed on the Market	959,000,000	790,000,000
Placed on the Market (tonnes)	28,751	12,774
Recycling Rate (%) sent to re-processors	54.9%	55.0%
Recycling Rate (%) adjusted for losses at re-processors	43.9%	69.4%
Recycled (tonnes)	12,617	8,869
Energy Recovery (tonnes)	13,996	3,304
Landfilled (tonnes)	1,671	394
Littered (tonnes)	467	207

[8] Private communication from the Irish Waste Management Association

The recycling rates are based on information from Repak on the tonnages funded in 2018, with estimates of tonnages adjusted to reflect those actually entering the final recycling process, taking into account what is lost at the re-processor (in line with the new measurement provisions in the Waste Framework Directive). The recycling rate for aluminium also includes cans recovered from the residual waste stream. Of the PET collected, stakeholders in the recycling industry suggested that 10-20% is lost due to contamination, which they have described as a major problem. The PET that is not lost is flaked for use in sheeting and fibre, and possibly in food contact applications.[9] It is reported that none of the PET collected in Ireland is used for rPET to manufacture new beverage bottles and the recycled content of PET beverage bottles currently is thought to be under 5%, with beverage companies importing recycled material from other countries including Austria, France, the UK and the Netherlands. Interestingly, recyclers in Ireland also import PET to recycle from mainland Europe, Asia and South America. This indicates that there is capacity and demand to increase the domestic supply of quality rPET.

2.3 Potential to Collect 90% of Plastic Beverage Bottles under Existing System

2.3.1 Options to Enhance the Existing System

Achieving a 90% collection rate for PET beverage bottles would require significant improvements to the current system. Notably, to reach 90% overall even with a very high performing kerbside household system, collection rates would need to reach over 80% for other streams such as commercial waste, street litter and events waste.

The tonnages of PET bottles in household kerbside waste and collected for recycling at the kerbside have recently been estimated in the EPA's waste characterisation study.[10] However, reliable data on PET bottle waste present in commercial/on-the-go/litter in Ireland is not available, so data from WRAP's 2018 consumer survey study "Drinks Recycling On-the-Go" is used in Figure 2-1 to estimate the potential scale of the 'away from home' (drinks disposed of while at events, while at work or study) and 'on-the-go' sectors in relation to tonnages disposed at home / arising in household collections.[11]

The graph highlights the significant tonnage likely to be present in away-from-home and on-the-go waste and the necessity of significantly improving capture rates in these areas (in addition to household kerbside collections) in order to reach the 90% target.

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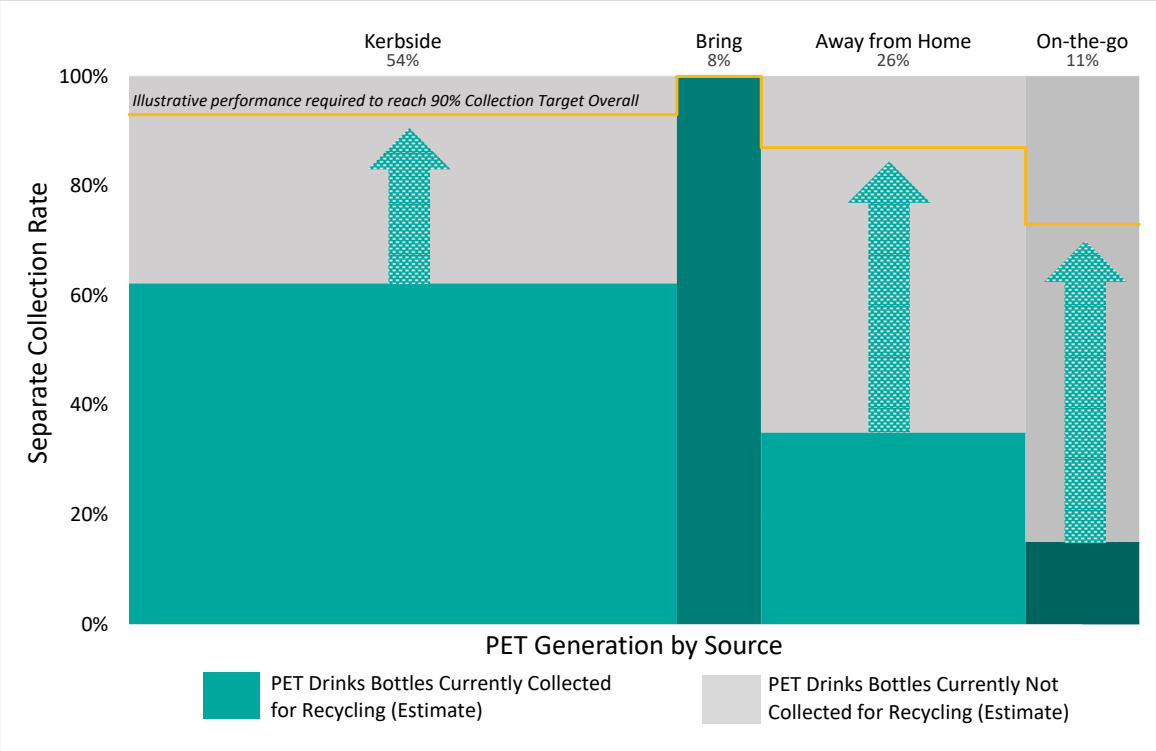
[9] Private communication from representative of the recycling industry in Ireland

[10] Environmental Protection Agency (2018) *Household Waste Characterisation Campaign Final Report*, November 2018, https://www.epa.ie/pubs/reports/waste/wastecharacterisation/Household_Surveys_Final_Report1.pdf

[11] WRAP (2019) *Drinks Recycling On-the-Go. Consumption, Recycling and Disposal of On-the-Go Drinks Containers.* Final Report. February 2019.

Figure 2-1: Current Separate Collection Rates & Estimated Changes Required to Achieve 90%



Household Kerbside Collections

The household kerbside system, based on the Environmental Protection Agency's Municipal Waste Characterisation Study 2018, currently achieves separate collection of PET packaging (not only beverage bottles) in the region of 62%. There is still a significant volume of PET in the mixed residual waste (MRW) stream, and in the ten years from 2008, the proportion of MRW that is plastics (not limited to PET) increased and overtook organic (non-garden) waste as the largest waste category. The proportion of MRW that is metal had also increased between 2008 and 2018, and packaging waste generally increased from 23.2% to 29.3%.[12]

Experience in other countries indicates that the highest performing kerbside systems are associated with some form of sufficient structural or financial incentive to reduce residual waste and increase recycling, along with effective and clear communication.

In Ireland, consumers already have a financial incentive to separate their waste, due to the 'pay-as-you-throw' (PAYT) system. The roll out of incentivised charging for

[12] Environmental Protection Agency (2018) *Household Waste Characterisation Campaign Final Report*, November 2018, https://www.epa.ie/pubs/reports/waste/wastecharacterisation/Household_Surveys_Final_Report1.pdf

household waste (after this was made compulsory and phased in from autumn 2017), if sufficiently well applied and enforced, should result in significant improvements in captures. Additionally, there is always room to improve captures further in specific areas through communications and engagement, for instance increasing awareness of the potential cost savings of reducing the amount of waste placed in residual waste in favour of the MDR bin. While a detailed analysis is beyond the scope of this study, an econometric analysis could also be undertaken of the impact of increased MRW charges. Previous studies investigating price elasticities and PAYT systems have concluded that behaviour is price responsive, so increasing charges could potentially encourage more householders to separate their waste fractions.[13]

Some regions in the UK have used a decrease in the frequency and reduction in containment size of residual waste collections to form a design-based (rather than financial) incentive for reducing residual waste. Another option, therefore, could be to increase the frequency of MDR collections and reduce the frequency of MRW collections, and in some areas, this may be applicable alongside the incentivised charging.

Another possibility for increasing capture rates is to increase the penalties for placing recycling in residual waste and/or the rewards for correct container utilisation.

If combinations of these systems are consistently well-applied, capture rates of PET beverage bottles in *door-to-door household kerbside* waste streams might approach 90% (Wales, without a PAYT scheme, reports a recycling rate of 75% for plastic bottles - not just beverage bottles).[14] However, it is harder for these interventions to increase recycling performance from flats to the same degree, since the communal nature of residual waste provision in flats makes it harder to apply individual incentives, limiting overall likely household separate collection rates. Therefore, coming up with a solution for individual apartment waste management would yield greater PET collection. For example, applying technologies at an apartment level by giving households a card to unlock a communal bin once a week or fortnight, which could replicate PAYT.

There is no good evidence based on household residual waste compositions that any other country manages overall to achieve a 90% separate collection rate for PET bottles from household kerbside collections (see section 3.1.1 for a discussion on Belgium's reported performance data). However, pockets of very high performance exist. No country is thought to have universally applied higher PAYT incentives and stricter enforcement of containment, perhaps because such measures can be unpopular.

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[13] Eunomia (2011) *A Comparative Study on Economic Instruments Promoting Waste Prevention*. Final Report to Bruxelles Environment. 16th December 2011.

[14] WRAP Cymru (2018) *Towards a Route Map for Plastic Recycling: Creating Circularity for Plastics in Wales*. June 2018. http://www.wrapcymru.org.uk/sites/files/wrap/Wales%20Plastics%20Route%20Map%20Final%20v5.pdf

However, as noted, the household kerbside stream is only part of the picture. The data on the total volumes of PET beverage bottles present in litter, in commercial waste and in events waste is not well captured. On-the-go material is not well measured and not covered in the 2018 waste characterisation study. However, there are significant volumes of PET bottle waste present across these streams, and the amount present in kerbside-collected household waste streams may only be between 50-70% of total PET bottle arisings. Therefore, no matter the efficacy of the household recycling system, significant change to the separate collection for recycling of PET beverage bottles arising in commercial/office wastes, street bins and litter, and events waste would be required.

Away-from-Home/Commercial Waste

Table 2-3 includes selected data from the 2018 Non-household Waste Characterisation Campaign, which concluded that, across commercial collections in Ireland, PET packaging (not necessarily beverage bottles only) accounts for 2.5% of MRW and aluminium cans (not necessarily beverage cans only) just 0.5%, which would indicate that (adjusting for contamination and moisture present) 10,463 tonnes of PET and 2,058 of aluminium cans are disposed of in non-household MRW. Separate collection rates (again adjusting for contamination) are at 37%. However, this data seems too large in the context of overall PET arisings of 28,000-30,000, perhaps due to the inclusion of non-beverage PET including food trays. This is clearly a substantial contributor to overall PET beverage bottle recycling performance.

Table 2-3: Proportion of Non-Household MRW Collections that could include PET & Aluminium Beverage Containers

Sector	PET Packaging	Aluminium Cans
Food Retail	2.7%	0.5%
Hotel	2.5%	“Small quantities”
Restaurant	1.8%	“Small quantities”
Office	3.0%	0.65%
Manufacturing	4.0%	-
Nationally	2.5%	0.5%

Source: EPA (2018) Non-Household Waste Characterisation Campaign.
https://www.epa.ie/pubs/reports/waste/wastecharacterisation/Final_Report_NHWC.pdf

Options to enhance the existing system for non-household waste streams include similar attention to charging mechanisms and incentives for small business and commercial

waste as is used for households. Often, commercial charging arrangements are not set up to sufficiently incentivise the use of recycling bins (charging per lift, for instance, can reduce the incentive to utilise multiple bins unless there is enough of a differential between recycling bin lift charges and residual lift charges). The various commercial sectors are challenging to engage without strong incentives – and again, achieving a 90% separate collection rate means near universal participation from businesses with very high levels of engagement from staff and visitors. There is little evidence to suggest separation rates for PET beverage bottles in commercial waste approaching 90% are likely to be achieved without more significant and direct financial incentives.

Much of the PET beverage bottle waste arising in some locations and companies – such as educational institutions, sports clubs, and events management companies – is due to consumers (not workers) disposing of purchased containers. This tonnage is again a significant proportion of PET placed the market. Incentives applied at a household or commercial level are less effective on consumer behaviour in these environments, so approaches include appropriate infrastructure (bins) and signage, but again here a step change in the incentive for consumers may be required. Repak's 'team green' initiative includes a strong communications campaign element aimed at changing behaviour, but also provides recycling machines with a localised reward that is intended to incentivise their use.

On-the-go Litter

For litter and street waste, provision of suitable infrastructure to enable separate collection for plastic beverage containers is often lacking. However, the expense of separate street bins for recycling may not be justified when the composition of collected material is frequently found to be no different to that in normal street litter bins, as such bins commonly suffer problems with contamination without many effective options for ensuring correct use. Community litter clear-ups tend to capture only partial segments of this waste for a limited period of time, so the options for making needed progress here are more limited. There is little evidence to indicate that there are potential alternatives to a DRS that will substantially divert PET beverage bottle waste that might otherwise be littered, or captured in litter bins, to instead be collected for recycling. By contrast, the financial incentive in a DRS is a proven mechanism for this.[15]

2.3.2 Stakeholder Responses

Eunomia asked the stakeholders about the potential for the existing system to reach the targets in the SUP Directive. A number of stakeholders have full confidence in the current system and point to reports from Repak that they already collect 90% of plastic beverage bottles. However, this figure refers to Repak's data on collections of PET

[15] Eunomia (2017) Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services. 11th October 2017

bottles in both the MDR and MRW streams. The challenge in this case is then to ensure that all bottles currently collected are *collected separately for recycling*.

Respondents suggested the increase to 90% separate collection could be achieved by:

- additional investment in education and awareness campaigns;
- additional investment in collection infrastructure including material-specific litter bins for recycling in public spaces;
- additional enforcement of existing policies;
- enforcement of the bye-laws requiring households and commercial premises to participate in the waste collection system;
- increasing financial incentives/penalties for householders;
- waste collectors checking residual waste for recyclables;
- more direct financial incentive to present PET bottles separately for recycling for households and businesses;
- extracting PET bottles from residual waste (by increasing Repak subsidies for waste transfer stations that extract PET and aluminium from residual waste)
- sponsoring litter-clean ups;
- introducing partial deposit systems;
- deposit systems at major events; or
- running a DRS through existing bring sites.

Of the proposals that stand greater chances of resulting in the step-change in PET bottle recycling required, the key ones include introducing partial DRS systems, introducing stronger direct financial incentives, and extracting additional PET from residual waste.

The last of these, extracting recyclables from residual waste will support the packaging recycling rates and reduce the amount of waste going to landfill, however, this is unlikely to constitute separate collection as required by the WFD and the SUP Directive. This will therefore not improve the quality of material collected. Recyclers in Ireland already emphasise that contaminated material is one of their biggest challenges and more food-grade rPET is needed to meet the recycled content target in the SUP Directive. Similarly, an Irish company, which operates energy from waste facilities in Ireland contacted Eunomia to suggest that all municipal solid waste should be required to go through a pre-treatment process, but this again does not entail separate collection.

It is clear that there are additional costs associated with any of the suggested steps. Whilst most respondents chose not to estimate the investment required to reinforce the current system, the Irish Waste Management Association proposed that awareness campaign budgets increase by 285% to €5 million per year. While this might be expected to have a positive impact on the separation rate, it is not possible within this study to determine the precise impact or, consequently, the extent of the benefits relative to the additional costs. Nor is it clear who would provide this additional funding and be responsible for managing the expenditure.

Recycling bins in public places might, as discussed above, make a difference, but additional steps would need to be taken to reduce contamination. Targeting specific public institutions (with schools and hospitals suggested by stakeholders, for instance)

would only target a selected proportion of the population, so the impact will be limited. By contrast, an approach that seeks to improve collection rates from the whole population is not only more likely to achieve targets, but to surpass them. Given the environmental benefits of maximising recycling rates, Ireland's ambition should not be limited by confining its efforts to limited sections of the population.

Requiring 100% participation in the waste collection system will not, by itself, automatically increase separate collection rates. This is because the option of using the residual waste services still remain. Therefore, awareness campaigns and, potentially, financial incentives would also be needed.

Litter clean-ups will not be as effective as litter prevention measures and the quality of the collected material might be poor due to high contamination and damage rates. Clean ups also rely on willing volunteers, so it is not clear if this would be a sustainable option, as people may not necessarily be willing to volunteer indefinitely over the long-term.

Running deposit systems at major events, such as sporting events and music concerts has proved effective in other countries where venues have replaced SUP cups with reusable cups on which a deposit is charged. It is certainly recommended that venues in Ireland consider this to support waste prevention and, the evidence suggests, reduce their costs.[16] However, it is not clear how a deposit system could work for beverage bottles and cans, given that there is likely to be no mechanism to guarantee that the cans/ bottles were bought at the venue (and consequently a deposit was paid at the point of purchase) and not brought into the venue, in which case the consumer would not have paid a deposit at the point of purchase but could still claim a deposit refund. Bags are often checked for security reasons at the entrances to major events and patrons are often prevented from bringing in their own alcoholic beverages, so a deposit system may require security guards to check for (empty or full) soft drinks containers. In all probability, some containers would still get through, but this would reduce potential losses. While there is a financial incentive for venues to replace disposable cups with reusable alternatives, the incentive to operate a deposit system for sealed beverage containers is less obvious, so the Government may need to require this and/ or Repak could provide some operational support/ financial incentives. While event licences could specify that separate collections must be provided, this does not guarantee that patrons use them.

Finally, in terms of running a DRS through the existing bring sites, this is an option to be considered but this seems to be beyond the scope of the scenario considered in this chapter, which is considering opportunities to enhance the existing system, without additional measures like a DRS. A DRS does not have to use the return to retail model, but could rely on redemption centres, which could be based at the civic amenity sites, so this is discussed in more detail in Section 4.4.4.

[16] https://www.isonomia.co.uk/cutting-cups-why-venues-and-events-should-use-deposit-schemes/

2.3.3 Conclusions

Achieving a separate collection rate of 90% for PET beverage bottles would require a significant step-change in the performance of the existing system. This is acknowledged by all stakeholders. Previous studies looking at options for managing single use plastics and reducing marine litter have noted that a 90% target (for collection, not necessarily separate collection): [17]

> *"can be met today through existing higher performing kerbside schemes and residual waste sorting at lower cost. Moreover, with the target for all packaging to be recyclable by 2030, this would decrease the necessity for implementing DRSs solely to help meet the target, though Member States could implement for other reasons, such as litter reduction or resource efficiency or increasing recycled content."*

Most of the stakeholders believed that the current system could be adapted to achieve the targets. In particular those involved in the funding or operation of the current system and those who are most likely to be involved in a potential DRS. It was, however, notable that those who receive the collected bottles for processing do not believe the SUP targets can be met under the current system and suggest that the separate collection rate currently is closer to 35-55%. Of those who believe the current system could reach 90%, the Irish Waste Management Association implied (as does the above quote) that increasing sorting of residual waste would be required (which is not separate collection). In addition, the Irish Brewers' response implied they believe the target was currently being met. Repak, who outlined the most detailed plan and suggested the following;

- significant changes to the existing system;
- implementing direct PET-specific financial incentives for households and businesses to sort PET bottles out for collection;
- financial incentives for the collection of PET beverage litter; and
- DRS systems for major sources of on-the-go PET waste.
- All major sources of PET would be covered by a direct financial incentive, arguably a marked change from the existing system and discussed again under 'alternative approaches to a DRS' below.

The majority of stakeholders imply therefore that significant changes are required, even if these are managed within the existing system. A couple reference a need to greatly step up expenditure on communications and engagement, but most imply a need for changes in the incentives for households and businesses, and ways to tackle PET bottle waste in litter. The ways that stakeholders suggest the current system might be

[17] ICS & Eunomia (2018) *Plastics: Reuse, recycling and marine litter – Impact assessment of measures to reduce litter from single use plastics*. Report for the European Commission, DG Environment. 30 May 2018

significantly adapted and improved to achieve 90% are discussed in the following section.

3.0 Alternative Approaches to a DRS

As the SUP Directive recognised, a DRS is not the only option for achieving the 90% target and it is appropriate that Ireland considers alternative EPR approaches.

3.1 Evidence from Other Countries

For this study, Eunomia gathered information relating to the various waste collection and recycling systems utilised in other European countries. These include high landfill taxes; mandatory waste separation with significant fines for non-compliance (alongside clear bags to easily check for contamination); maximum weights for residual waste per capita.

While official data on recycling rates for PET and aluminium beverage containers specifically is not widely available, the maximum recycling rate for plastic bottles, without using a DRS, is thought to be around 70%.[18] Similarly, a 2011 study for the European Commission indicated that Belgium is the only country without a DRS to collect more than 90% of metal beverage cans.[19]

In terms of official recycling rates, Figure 3-1, Figure 3-2 and Figure 3-3indicate the recovery and recycling rates achieved for all packaging, plastic packaging (not only PET) and metal packaging respectively. (Only recycling rates are shown for metal packaging as there is little variation between recovery and recycling rates).

It should firstly be noted that these reported recycling rates are expected to fall when the new measurement method is applied. However, on the basis of the current available data, Finland and Belgium have the highest packaging recovery rates (although the reliability of the Finnish data is drawn into question by the 109.8% rate). Belgium has the highest packaging recycling rate at 81.9%. Ireland is 10th (or 8th in the EU 28) for its recovery rate, and 10th (just below the EU average) for its recycling rate.

[18] ICF & Eunomia (2018) *Plastics: Reuse, recycling and marine litter – Impact assessment of measures to reduce litter from single use plastics*. Report for the European Commission, DG Environment. 30 May 2018

[19] Eunomia et al. (2011) *Options and Feasibility of a European Refund System for Metal Beverage Cans*. Final Report for the European Commission, DG Environment. 16th November 2011.

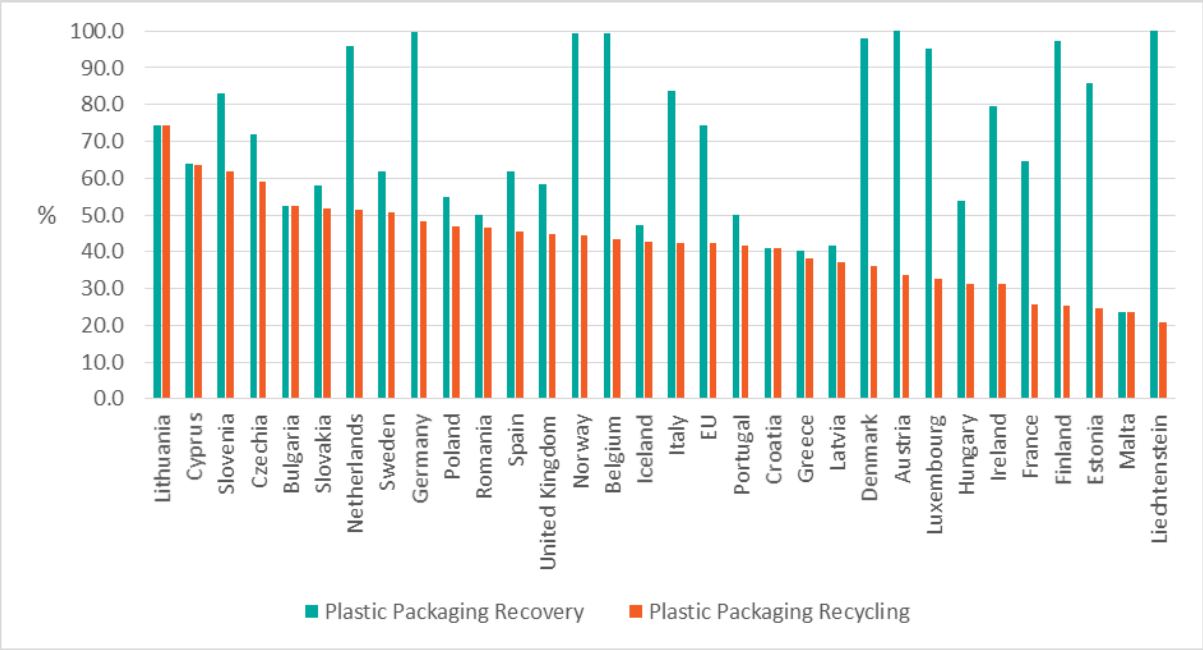
Figure 3-1: 2016 Packaging Recovery & Recycling Rates across Europe

Source: Eurostat

In terms of plastic packaging, Lithuania has the highest recycling rate (at 74.4%, but it should be noted that this is the same as its recovery rate). Lithuania does, however, achieve a 92% collection rate for PET bottles in its DRS.[20] No country currently recycles 90% of their plastic packaging, but Luxembourg, the Netherlands, Finland, Denmark, Norway, Belgium, Germany, Lithuania and Austria all report recovery rates over 90%. Six of these countries have a DRS for PET bottles (Belgium and Austria do not). Reinforcing the difference between recycling and recovery rates, the Netherlands is the only one of these countries to report a recycling rate over 50%. While recycling rates for metal packaging are generally higher than for plastic, only Germany, the Netherlands, Luxembourg, Belgium and Lichtenstein report a recycling rate over 90%.

[20] Reloop, and CM Consulting (2018) *Deposit Systems for One Way Beverage Containers: A Global Overview*, 2018, https://reloopplatform.eu/wp-content/uploads/2018/05/BOOK-Deposit-Global-27-APR2018.pdf

Figure 3-2: 2016 Plastic Packaging Recovery and Recycling



Source: Eurostat

Figure 3-3: 2016 Metal Packaging Recycling

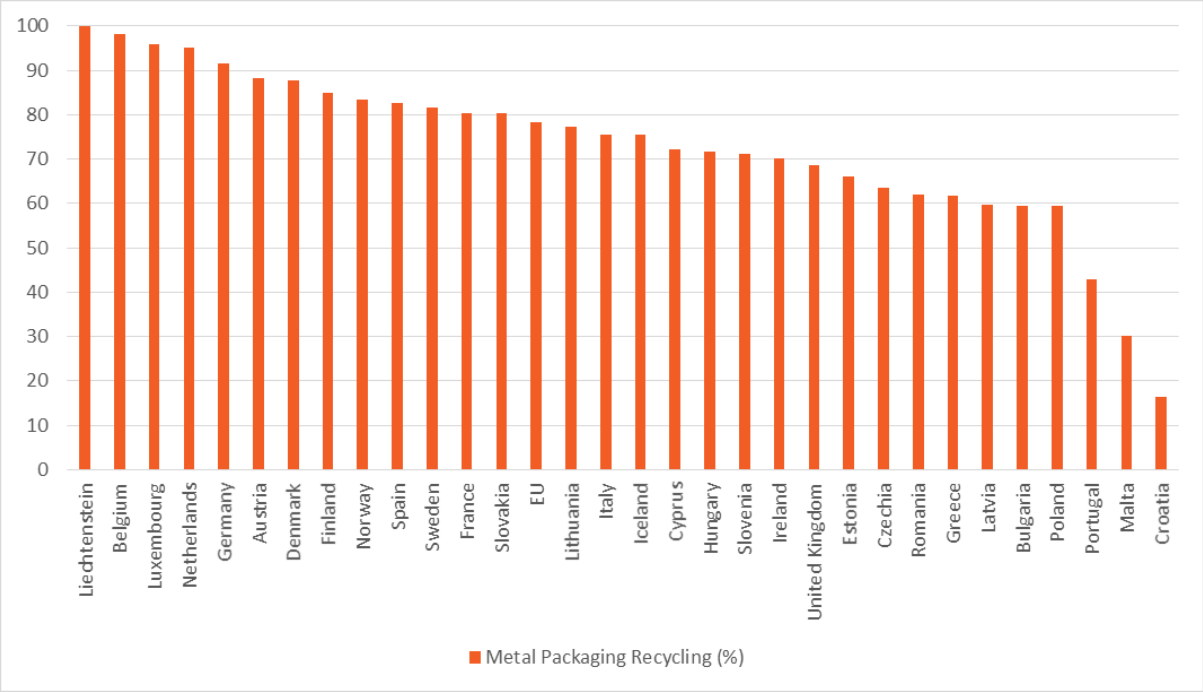
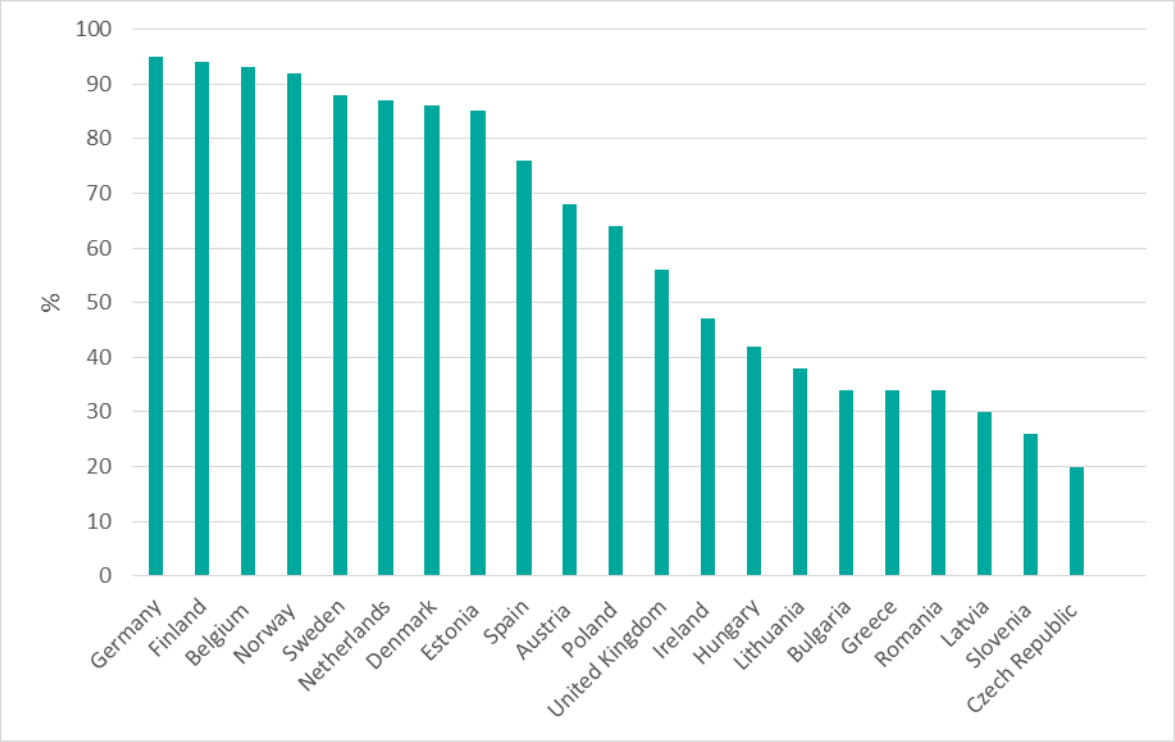


Figure 3-4 illustrates the beverage can recycling rates estimated for a study for the European Commission in 2011[21] (this only includes countries where estimates were possible; where a range was given, the higher value has been used). With the exception of Belgium and the Netherlands, all of the top eight countries have a DRS for cans (as the data was taken from 2009, this pre-dated the introduction of a DRS in Lithuania, which now has a return rate for cans in the DRS of 93%, up from the 38% shown in the chart).[22]

Figure 3-4: Best Estimates of Beverage Can Recycling Rates (2011)



Source: Eunomia et al. (2011) Options and Feasibility of a European Refund System for Metal Beverage Cans.

3.1.1 Belgium

The Belgium EPR scheme has been selected to examine in more detail because Belgium:

- was identified by Irish stakeholders as an example to be followed;
- reports the highest packaging recycling rate in the EU;
- reports one of the highest plastic packaging recovery rates; and
- reports the second highest metal packaging recycling rate.

[21] Eunomia et al. (2011) *Options and Feasibility of a European Refund System for Metal Beverage Cans*. Final Report for the European Commission, DG Environment. 16th November 2011.
[22] Reloop, and CM Consulting (2018) *Deposit Systems for One Way Beverage Containers: A Global Overview*, 2018, https://reloopplatform.eu/wp-content/uploads/2018/05/BOOK-Deposit-Global-27-APR2018.pdf

The Belgian packaging EPR system is run by Fost Plus, which promotes, co-ordinates and finances the separate collection, sorting and recycling of household packaging waste. (Valipak is the producer responsibility organisation for commercial and industrial packaging.)

Fost Plus lists its first core activity as raising awareness, and uses a range of communication tools to encourage households to separate their waste. They also report that they work with companies to improve the recyclability of their packaging.[23] Fost Plus has a co-ordinating role between municipalities, waste inter-municipal companies, collection companies and sorting centres. Fost Plus uses fees from packaging producers and income from the sale of the collected material to finance its operation.

Door-to-door collections use the blue bag system, which requires consumers to place their plastic packaging, metal packaging and beverage cartons in Fost Plus blue bags. As the bags are translucent, collectors check the contents and, if they see waste that should not be in the bag, they will not collect the bag and instead leave it at the door with a red sticker.[24]

It should be noted that Belgium's regulatory framework supports its high collection rate. For instance, Belgium has one of the highest landfill taxes in Europe and a landfill ban on some waste streams, which are likely to promote high recycling and incineration rates. In the Brussels Capital Region (Belgium has a federal structure, although Fost Plus covers the whole country), it is mandatory to separate waste. Householders risk substantial fines if they do not comply. The Flanders region imposes limits on the maximum weight of residual waste per capita.[25] Importantly, Belgium has set higher recovery and recycling targets for packaging waste than the EU, at 90% and 80% respectively.[26]

Data

There are some uncertainties about the reliability of Belgium's data. In the first instance, the federal structure – meaning the three regions report independently to Eurostat – could create complications, given that waste could be placed on the market in one region but collected in another. The fact that Fost Plus has reported a 102.6% recycling rate raises concerns. The reported Belgian performance has been analysed by the Recycling Netwerk (an independent environmental organisation).[27]

Recycling Netwerk estimates that 5-10% of packaging collected in the blue bags is bought outside Belgium (predominantly neighbouring France and the Netherlands); as this counts towards the tonnage collected but not the tonnage placed on the market, it

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[23] https://www.fostplus.be/en/about-fost-plus/organisation/activities
[24] https://www.fostplus.be/en/sorting-recycling/all-about-sorting/sorting-rules-pmd
[25] European Environment Agency (2013) Municipal Waste Management in Belgium. February 2013.
[26] IEEP (2017) *EPR in the EU Plastics Strategy and the Circular Economy: A Focus on Plastic Packaging*. 19th December 2017.
[27] https://recyclingnetwerk.org/2018/06/07/factcheck-werkelijke-recyclagecijfers-zijn-lager-dan-wat-fost-plus-beweert/

leads to an over-estimate of the collection rate. While it could equally be argued that packaging placed on the market in Belgium is collected in neighbouring countries – balancing out the imports – Recycling Netwerk suggests that the price differences between the countries mean far less packaging is exported than imported.

Secondly, the Belgian data relies on producers self-reporting the quantities placed on the market, so is susceptible to under-reporting and free-riding. Ovam, the Flemish environment agency, estimates free-riders at 8%.[28]

In terms of the metal recycling rate, only 51% of cans are collected separately in the blue bags, so the high recycling rate is due to the addition of metals collected in mixed residual waste and recovered from incinerator bottom ash. This could include non-packaging metal (such as coat hangers). Recycling Netwerk suggests that the reported 82.9% recycling rate for plastic bottles and flasks is an over-estimate of 20-25% once free-riding, imports and dirt (that adds to the weight of the collected bottles) are accounted for. Corroborating this, evidence from OVAM indicates that 19,104 tonnes of plastic bottles and flasks are disposed of in residual waste in Flanders – equivalent to 38.1%, while 19-33% of the weight of litter in public bins is accounted for by plastic bottles and cans.

This suggests, therefore, that Belgium's recycling rates are not necessarily as high as they appear to be and not all the recycled packaging waste is separately collected – as will be required under the Waste Framework Directive.

Costs

A report for the Irish Waste Management Association (IWMA) estimated that municipal waste collections (for residual and recycling) in Belgium (Flanders) cost €62.85 per capita excluding VAT, with residual waste collections costing €140 per tonne, or €22.40 per capita.[29] Packaging recycling collections cost €14.76 per capita.[30] The total cost per capita for all waste collections is lower than in Ireland (€81.50), however the costs are not necessarily directly comparable, given that Flanders has a high population density and low rural population, whereas the opposite is true of Ireland.[31]

Table 3-1 lists the fees charged by Fost Plus and Repak and the equivalent fee for PET bottles and aluminium cans (based on respective weights of 30g and 16g). Aluminium costs in Belgium are approximately a third of the costs in Ireland, whereas the fee for plastic in Belgium is three times higher than in Ireland.

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[28] https://www.ovam.be/sites/default/files/atoms/files/DEF-Eindrapport%20impactanalyse%20SGS%20eenmalige%20drankverpakkingen-06.05.2015.pdf
[29] SLR (2018*) Household Waste Collection Benchmarking Report.* Report for IWMA. June 2018.
[30] https://www.fostplus.be/en/about-fost-plus/numbers-and-charts
[31] SLR (2018*) Household Waste Collection Benchmarking Report.* Report for IWMA. June 2018.

Table 3-1: Comparison of EPR Fees in Belgium and Ireland

	Aluminium	Plastic
Belgium		
Fee per tonne	€33.90	€346.30
Equivalent per container	€0.0005	€0.104
Ireland		
Fee per tonne	€93.87	€99.41
Equivalent per container	€0.0015	€0.0030

Source: https://www.fostplus.be/en/enterprises/your-declaration/rates

It has also been reported that a weakness of the Fost Plus system is the need for "continuous awareness campaigns" "to remind citizens of the correct sorting rules", which will contribute to the costs of the system.[32] The need to educate consumers about a DRS and the costs associated with this can also be cited as a weakness of DRSs by some stakeholders, so it is worth noting that other systems also require investment in consumer campaigns. These other systems do not necessarily have the advantage of a financial incentive (the deposit) to drive consumer behaviour, potentially reducing the need for ongoing education.

Consideration of a DRS

Interestingly, Ovam in 2015 investigated the possibility of a DRS.[33] Whilst they did not ultimately pursue a DRS, the Minister signed an agreement with the packaging industry, in which the industry committed €9.6 million of funding to combat litter. The Flemish Government has since made it clear that a DRS could be introduced if collection and recycling targets are not met.[34]

More recently, the Brussels Capital Region Government confirmed in July 2019 that it will introduce a DRS for cans and plastic bottles. It remains to be seen whether Wallonia

[32] IEEP (2017) EPR in the EU Plastics Strategy and the Circular Economy: A Focus on Plastic Packaging. 19th December 2017.
[33] https://www.ovam.be/sites/default/files/atoms/files/DEF-Eindrapport%20impactanalyse%20SGS%20eenmalige%20drankverpakkingen-06.05.2015.pdf
[34] https://bioplasticsnews.com/2018/07/21/flanders-plastic-packaging-single-use-bags-deposit-system/

and Flanders will co-operate with Brussels on a joint system, but the decision in Brussels indicates that they do not consider the blue bag system sufficient.[35]

Considerations for Ireland

Both Belgium and Ireland have door-to-door collections and a single producer responsibility organisation for household packaging. Aside from the use of bags rather than opaque bins, the major difference is Ireland's competitive, market-based collections. This is unlikely to be able to achieve the same efficiencies and economies of scale as a system with municipality-wide collections from a single waste operator. Producers in Belgium are also responsible for the full net costs of the waste collections.

The analysis has indicated that Belgium's collection rates are not necessarily as high as they first appear and the reliance on incinerator bottom ash means that a significant proportion of metal packaging is not collected separately. The large gap between the plastic packaging recovery (99.5%) and recycling (43.4%) rate also indicates significant scope for improvement, either in the method of collection and/ or in the promotion of recycling over incineration.

Nevertheless, bins in Ireland could be replaced by transparent bags so that, as some stakeholders suggested, waste collectors can more easily inspect the MDR for waste that should not be in the bag. This, however, is only intended to avoid contamination of waste that has already been separated; to increase the separate collection of beverage containers, MRW would also need to be placed in transparent bags and inspected. Such inspections would, in all probability, need to be mandated by the Government. Such inspections are likely to be difficult and time consuming in any system, but it is worth noting that Ireland's competitive market-based system can complicate the situation, given that there could be more pressure on waste companies to complete their collections as quickly as possible to minimise costs. There could also potentially be a concern that, if they repeatedly reject bags, the householder could choose to switch to a competitor.

The Irish Government could follow Brussels' example and introduce higher targets, potentially with a financial incentive for producers (for instance by charging an additional tax if targets are missed). A mandatory requirement to separate waste could also be introduced, along with fines. Such fines would rely on private, competing companies policing their customers. It may also be the case, as some stakeholders have suggested, that more awareness campaigns are needed.

While Belgium has been regularly cited as best practice, it is notable that Brussels has opted to introduce a DRS to complement the existing blue bag kerbside collection system.

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[35] https://recyclingnetwerk.org/2019/07/18/deposit-return-system-is-a-milestone-for-a-cleaner-brussels/

3.1.2 Norway

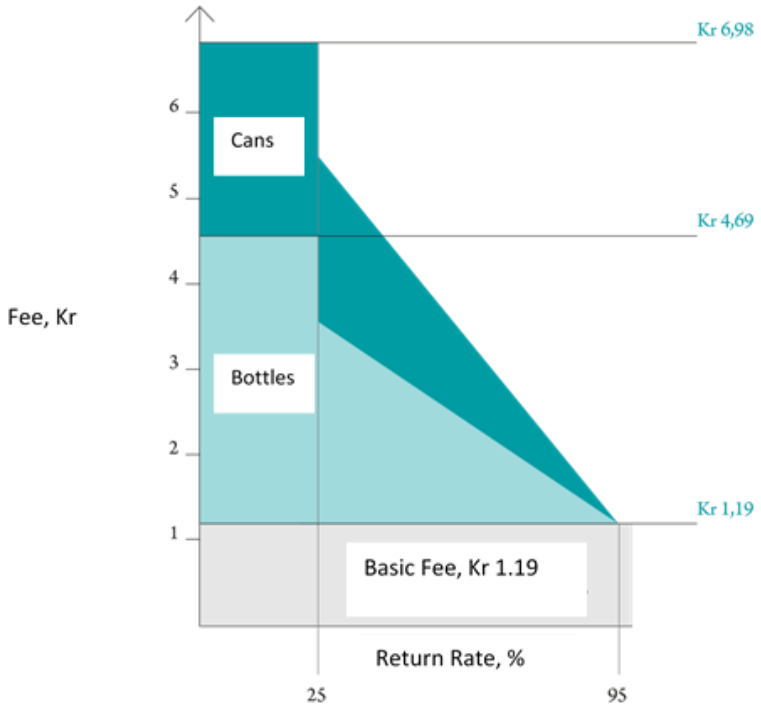
While Norway is not in the EU, it is a member of the EEA and subject to EU law. It is worth reflecting on its approach in light of the SUP Directive's suggestion that the 90% separate collection target could be achieved by establishing "separate collection targets for relevant EPR schemes".

The Norwegian Government imposes an excise duty per unit of single-use beverage packaging placed on the market. There are two elements to the tax: a base tax and an environmental tax. For containers with a collection rate less than 25%, producers pay the full amount of both taxes. Above 25%, the environmental tax is inversely proportional to the collection rate and containers with a recycling rate of at least 95% are exempt, as illustrated in Figure 3-5.

The current rates are:

- Basic Fee = NOK 1.19 (€0.12)
- Environmental Fee – cans = NOK 5.79 (€0.60)
- Environmental Fee – bottles = NOK 3.50 (€0.36)[36]

Figure 3-5: Norwegian Beverage Container Tax



Source: Infinitum

[36] https://infinitum.no/om-pantesystemet/milj%C3%B8avgiftssystemet.

The beverage container tax provides an obvious financial incentive for producers to reach a high collection rate. In response to this, the beverage industry chose to establish a DRS in order to minimise their tax liability, to the extent that is optimal from a financial perspective. In effect, therefore, the Norwegian DRS was voluntarily introduced by industry in response to the financial incentive provided by the tax. Infinitum, the not-for-profit organisation that runs the DRS on behalf of the beverage industry, provides a calculator on its website for producers to calculate the cost savings of the DRS fees relative to the environmental tax.[37]

87.3% of cans and 88.6% of bottles are returned to reverse vending machines (RVM) for a deposit refund (Infinitum does not list the numbers returned manually to small retailers without an RVM). Infinitum also reports a recycling rate of 98.9% for cans and 95.1% for bottles because they include containers returned via centralised sorting, slag sorting (for cans) sorting at source and energy recovery. This means that Norway's approach does not currently guarantee a 90% separate collection rate, but Infinitum expects to exceed 90% in 2019 following an increase to the deposit value in the 2018.[38]

There is, therefore, scope to improve the DRS so that an even higher percentage of containers are returned directly to the DRS, but Norway nevertheless achieves impressive recovery and recycling rates that exceed most other countries.

3.1.3 Finland

Finland also has a voluntary DRS and a simpler supporting economic instrument to Norway. Finland imposes an Excise Duty on Certain Beverage Containers (including cans and bottles for specified alcoholic and soft drinks) of €0.51 per litre, but producers are exempt if they join an approved DRS.[39] While a simple exemption does not necessarily promote improvements to the collection rate, the Government Decree on a Drink Packaging Return System specifies that any DRS should be set-up to achieve a recycling rate of 90%.[40]

In 2018, the Finnish DRS reported return rates of 95% for cans and 90% for plastic bottles.[41]

Considerations for Ireland

Norway offers a flexible approach that enables producers to decide upon the optimal solution that achieves a return rate that minimises their overall financial costs. If managed well, such an incentive mechanism will provide an ongoing incentive to improve return rates. Finland's approach is slightly less flexible – because the Government specifies a DRS as the means of qualifying for the tax exemption – but it

[37] https://infinitum.no/kostnadskalkulator
[38] Infinitum (2019) 2018 Annual Report
[39] https://www.palpa.fi/juomapakkausten-kierratys/pantillinen-jarjestelma/#mce_temp_url#
[40] https://www.finlex.fi/fi/laki/alkup/2013/20130526
[41] https://www.palpa.fi/juomapakkausten-kierratys/pantillinen-jarjestelma/#mce_temp_url#

nevertheless provides a degree of choice and suggests that a financial incentive combined with statutory targets can be effective in producing a 90+% return rate.

While the Irish Government could simply legislate to require the producer responsibility organisation (Repak) to achieve a 90% separate collection rate, including a financial incentive along the lines of the Norwegian beverage container tax (or potentially penalties if the target is missed) means the target is more likely to be achieved. By including a tax where the liability only drops to zero at 95%, or perhaps even 100%, this would provide an appropriate incentive.

While Norwegian beverage producers ultimately chose to introduce a DRS, Repak could use its expertise and work with its members to go through the same process to determine the optimal solution for Ireland. Producers who currently self-comply could either join the Repak initiative, develop their own approach, or pay the tax.

3.2 Stakeholder Responses

When asked to propose alternative solutions, many of the stakeholders suggested options which reflect those already discussed in 2.3.2 above (which discussed possible options to enhance the existing collection system). The proposals fall into broad categories of:

- increasing infrastructure provision (increasing provision of on-street and bring site segregated containers);
- adapting collection methods (e.g. Belgian blue-bag system, operating a separate PET bottle collection);
- reinforcing use of PAYT system with some combination of increased enforcement and prize/reward systems;
- implementing partial DRS (at sport clubs, events, public spaces); and
- providing direct financial incentive for households, businesses, sports clubs, Tidy Towns, to separately collect PET including from litter.

Infrastructure provision alongside increased communication and awareness will help collection rates but most stakeholders agree stronger incentives are required.

3.2.1 PET in Household Waste

For PET in household waste, a change in the *method* of dry recyclable collection (i.e. switch to a bag collection) is likely to have limited impact without a change in the incentives in the system. Using technology such as cameras to penalise or reward householders, or introducing financial incentives to separate waste could well prove an effective deterrent/ incentive for some households. However, this is not guaranteed to generate the necessary volumes, not least because it does not address beverage containers that are consumed on-the-go. Given that householders in Ireland already have an incentive to separate their waste because of the PAYT, it is not clear what additional impact any rewards/ penalties could have unless they were of a significant value (and so, of significant cost to producers). Installing and monitoring the cameras, as well as acting on the evidence, will of course also add to Repak/ waste collectors' costs,

and could raise civil liberties concerns. Nor is it clear how feasible it would be to monitor residual waste bins. A DRS approach is proven to serve the purpose of providing a financial incentive to separate plastic bottles specifically for PET collection. Its clear organisation and funding structure, is advantageous compared to an incentive-based system that is unlikely to be as effective – not least because it is based solely on obtaining a reward rather than avoiding a loss (as discussed below).

Similarly, the participation rate in any competition will not necessarily be high enough to sufficiently increase the return rate (especially because this does not target on-the-go). In addition, running such a competition, including taking the time to inspect bins, would come at a cost to waste producers. Producer responsibility organisations have trialled competitions in other countries. For instance, inviting consumers to return beverage containers with their name and contact details to be entered into a prize draw. However, there is little information on the results achieved and they are unlikely to be as effective as a universally rolled-out DRS which has the full backing of the beverage industry and that is based on deposit refunds, rather than rewards. Prospect theory indicates that consumers are more motivated to avoid a loss than to obtain a reward; this means that a deposit-based system is generally more effective than a reward-based system because, having paid a deposit in the first place, this represents a loss unless it is refunded.[42]

Given the additional work involved, it is not clear what incentive all the waste operators in Ireland would have in order to inspect all the bins they collect and running any competitions on a company-basis, rather than a national basis, would arguably be rather inefficient.

3.2.2 PET in Commercial Waste

There is little evidence to suggest that reaching 90% separate collection rates for PET bottles in commercial waste is likely to be achieved without more significant and direct financial incentives. The only specific suggestion from stakeholders in this area is to explore a similar direct financial incentive for businesses to segregate PET for collection. A DRS for Ireland would provide a comprehensive incentive compared to one aimed solely at businesses. This is because a DRS applies to anyone (staff, consumers, waste collectors) who comes into contact with the bottle prior to the deposit having been redeemed, rather than just the business itself. Again, Repak anticipate a take-up rate of 40% if locations such as colleges and gyms are targeted, which is unlikely to be sufficient to raise separate collection rates to 90% across all waste streams.

3.2.3 On-the-go PET

On-the-go consumption will need to be targeted if Ireland's capture rate is to improve substantially. Stakeholders suggest a payment could be made to clubs, charities and

[42] Expert Panel on Environmental Charges and Other Measures (2019) *Rapid Review of Charging for Disposable Coffee Cups and other Waste Minimisation Measures.* Full Report for Scottish Government. July 2019.

events for PET bottles collected, and Repak reports that it is trialling payments to Tidy Towns.

This implies a simple reward approach, whereby there is no deposit but clubs, charities etc. are paid a reward by Repak/ waste collectors for every container they collect. The volumes returned, and the associated costs, however, would be unpredictable and the reward would need to be high enough to provide sufficient incentive. Deposits are usually set at around €0.15 – €0.20 to provide a financial incentive, however a reward at this level – funded directly by producers/ Repak/ waste collectors – is markedly above the market value of the material and would soon become unaffordable. By contrast, a DRS often relies on producers paying a fee per container, but this is usually under €0.01 or €0.02. As noted above, prospect theory also indicates that a reward-based system is less effective than a system based on avoiding a loss.

Under a DRS, clubs and charities could still run collection drives and consumers could donate unwanted containers for the charity to claim the refund. Equally, consumers can be given the option of donating their deposit refund to charity when they return their used container.

Targeting clubs, charities and events would only achieve partial coverage (Repak estimate, for instance, take-up rates from events and clubs in the region of 40% and Tidy Towns of 80%). In contrast, the DRS has the advantage of targeting all containers consumed on-the-go, not just specific premises. A DRS would be expected to capture significantly more than 40% of such containers, and could be designed to maximise capture rates, not just to collect enough containers to meet a minimum target. The tonnage of PET bottles consumed on-the-go is not well measured but is likely to be a relatively large portion of overall PET waste, meaning comprehensive coverage may be needed to achieve a 90% separate collection rate overall (as indicated in Figure 2-1).

3.2.4 Conclusion

The approaches suggested by stakeholders that would be most likely to make significant progress towards the targets replicate aspects of a DRS by providing direct financial incentives, but in a disparate way to fit in with different collection channels.

Providing a sufficient financial incentive to return containers without charging a deposit in the first place is likely to increase costs substantially. In addition, providing a DRS-like system in some areas but not others, introduces problems of fraud and technical challenges, as well as the risk of consumer confusion. There is evidently a desire by stakeholders to explore approaches that would integrate a DRS-like incentive with existing collection channels (collections from households, at bring sites, at events and sports clubs etc.). However, because these would be less comprehensive than a universal requirement, the incentive to participate is likely to be lower.

A reward-based system not only entails a lower financial incentive than a DRS, but is also psychologically less motivating because a deposit that has been paid, unlike a reward, represents a potential loss. As such, reward systems are likely to result in lower return

rates for the same level of financial incentive than a well-designed DRS, and so are less likely to enable Ireland to meet the target.

It is theoretically possible that if the incentives are sufficiently targeted at the major sources of PET waste, they are well thought-through, and the response from the public is engaged and positive, a 90% target could be achieved. However, the risks are higher for such an unproven response. The net costs to producers involved would need to be more fully understood to compare against a DRS, where the unredeemed deposits and material values reduce overall system costs. Voluntary, ad-hoc programmes, such as offering rewards at commercial premises, do not necessarily include the same accountability mechanisms as formal systems – for instance, it is difficult to set targets if an unknown proportion of beverage containers is being targeted by the programme.

In terms of existing models, three stakeholders referred to Belgium's EPR system, so this is discussed in more detail below.

4.0 Deposit Return Systems

4.1 What is a Deposit Return System?

The basic premise of a DRS is that the consumer pays a deposit at the point of purchase, which can be redeemed when they return their used beverage container. It is this financial incentive (to get one's money back) that is central to the approach.

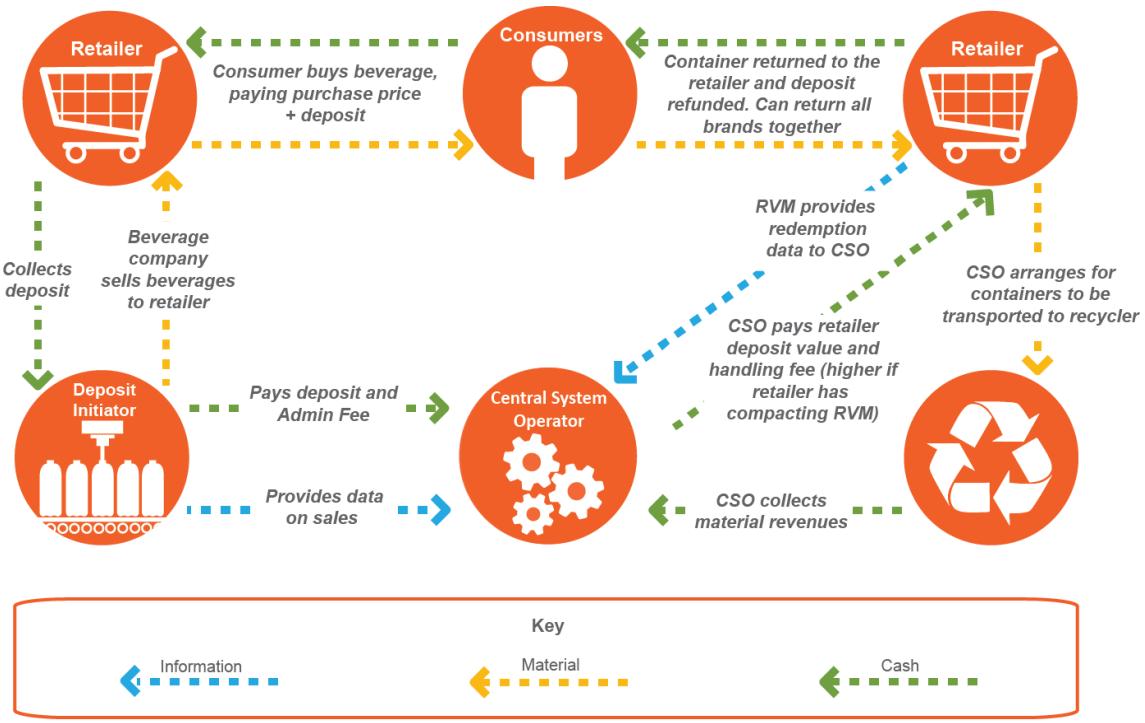
A fundamental difference between a DRS and 'reward schemes' such as those where people receive a voucher, or indeed a payment, for returning used beverage containers, relates to the nature of the incentive and the associated impact this has on scheme performance. Prospect Theory indicates that people are more motivated to avoid a loss (the deposit they paid) than to obtain a gain of equal value; as such, consumers are thought to be more motivated to return a plastic bottle to avoid losing their deposit than to earn a reward that they were not invested in in the first place.[43] This means that, all else being equal, a well-designed DRS, with the deposit set at an appropriate level, is likely to lead to a larger increase in the recycling rate of beverage containers than a scheme based on 'rewards' only.

A DRS can apply to one-way (single-use) containers and/ or to refillable bottles (in which case the refillable bottles are returned to be reused rather than recycled).

Figure 4-1illustrates the organisational structure of a DRS.

[43] Poortinga et al. (2019) *Rapid Review of Charging for Disposable Coffee Cups and other Waste Minimisation Measures.* Final Report for the Scottish Government. July 2019.

Figure 4-1: Key Relationships and Transactions in a DRS



Source: Eunomia

Generally, the system works as follows:

1) Beverage producers initiate the deposit by paying it into a deposit account;
2) Retailers pay the deposit to producers/ distributors at the wholesale stage;
3) Consumers pay the deposit to retailers, along with the price of the beverage;
4) Consumers claim a full refund when they return their used beverage container to a designated return location;
5) The return location is reimbursed for the refunded deposit from the deposit account; and
6) The returned used beverage containers are transported to be processed and recycled. The material can be used to manufacture new containers.

4.1.1 Objectives of a DRS

A DRS for single-use containers is primarily used to support a high recycling rate and reduce littering of beverage containers, but a DRS delivers additional benefits, connected to these direct impacts.

- **To increase recycling** – a number of European DRSs achieve return rates above 90%, diverting significant numbers of beverage containers from landfill and

incineration. This consequently reduces greenhouse gas emissions and other air pollutants.[44]

- **To reduce littering** – research indicates that a well-designed DRS could reduce the littering of deposit-bearing beverage containers by 95%, meaning the volume of all litter could reduce by approximately a third.[45]
- **To secure a reliable supply of high quality recyclate** – the well-defined collection stream reduces the risk of contamination compared to other collection methods and means the recycled material is generally of food-grade quality and can be used to manufacture new beverage containers.[46]

A DRS has also been shown to boost employment, with the potential to create jobs (full or part-time) in administration, transportation, processing and recycling.[47] As a form of EPR, a DRS can also be used to give producers more control over the system they are required to fund.

Several existing DRSs achieve a return rate of 90%, but the performance of a DRS depends on the design of the system. The likelihood of a well-designed DRS to support a 90% separate collection rate is arguably demonstrated by the inclusion of a DRS as a possible method in the SUP Directive. As discussed above, however, the Directive is also clear that other, unspecified options may be pursued as long as achievement of the separate collection target can be demonstrated.

This section firstly reflects on discussions to date in Ireland relating to a DRS, before considering the recent stakeholder responses – many of which reflected the earlier research – and design options for Ireland.

4.2 Previous Research

There have been a number of previous studies and reports addressing the question of a DRS for Ireland. While a comprehensive literature review and a critical analysis of these studies are outside the scope of the current project, some of the key conclusions and issues raised are summarised below.

A study by Eunomia in 2009 for the then Department of the Environment, Heritage and Local Government involving an international review of a range of waste policies, touched on the possibility of a DRS. The study did not, however, involve detailed analysis of the design and impacts of a DRS for Ireland, and accordingly, the report could not recommend a DRS for Ireland "principally because the information regarding the implementation costs is not such that the costs can be said to unequivocally justify the

[44] For instance, Denmark, Finland, Germany and Lithuania have reported return rates over 90% and Norway reports recycling rates over 90%.
[45] Eunomia (2017) Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services. 11th October 2017
[46] Private communications with industry representatives.
[47] Eunomia (2019) Employment and Economic Impact of Container Deposits. January 2019.

benefits". The study also concluded however that "the arguments against the measure are not sufficiently well made for this proposal to be considered to have been rejected outright. We suggest that the matter is looked into more closely".[48]

In June 2017, a Private Members' Bill – the Waste Reduction Bill – was introduced to the Dáil Éireann to:

1) Ban single use, non-recyclable and non-compostable plastic tableware; and
2) Introduce a DRS for beverage containers.[49]

The Bill was referred to the Houses of the Oireachtas Joint Committee on Communications, Climate Action and Environment, which produced a report on the Bill following detailed scrutiny.[50] The Committee supported the Bill, "subject to any necessary technical amendments to make the Bill effective". The Committee noted that the Government supported the objectives of the Bill but was concerned by the potential cost of a DRS to the Exchequer. It was also suggested that the impact of a DRS "may be minimal compared to existing" DRSs in other Member States because these were established when waste management was under-developed and a DRS may not be compatible with existing initiatives in Ireland, including the Repak producer responsibility scheme. Other stakeholders suggested that DRSs for one-way containers have generally only been introduced where there is an existing deposit system for refillable bottles, meaning there is an established culture and/ or infrastructure.

The Committee heard from a number of stakeholders, whose views they broadly divided into two categories:

- "A DRS is vital to tackle plastics pollution in the oceans and combat littering in Irish communities"
- "A DRS is unnecessary, as Irish plastic beverage container recycling rates are already very high, and the significant financial resources which are required to set up a scheme (and administer it annually) could be better spent elsewhere. Introducing a DRS would, in effect, amount to an effective dismantling of the existing waste recycling system with little economic and environmental justification."

The Committee's report also noted that an opinion poll had indicated that 89% support a DRS (although the methodology for this opinion poll has not been examined as part of this study and it is understood that this was national survey, so it is not possible to comment on the reliability of the findings).

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[48] Eunomia et al. (2009) *International Review of Waste Management Policy*: Summary Report for the Department of Environment, Heritage and Local Government. 29th September 2009.
[49] https://www.oireachtas.ie/en/bills/bill/2017/80/
[50] Joint Committee on Communications, Climate Action and Environment (2018) Report of the Joint Committee on the Detailed Scrutiny of the Waste Reduction Bill 2017 [PMP].

PMCA Economic Consulting prepared a report for Repak in 2017 on a proposed DRS.[51] The study claimed that:

> *"A deposit would not significantly increase recycling rates for packaging. Recycling rates in European countries with a deposit system in place are not statistically significantly higher than countries, such as Ireland, that do not have a deposit".*

PMCA also suggested that littering of beverage containers is not a significant problem in Ireland because chewing gum and cigarette butts account for a higher proportion of litter. While this is often the case if litter is measured by unit count, beverage containers generally represent a much higher proportion of litter if it is calculated by volume or weight – both of which can be more representative of the visibility of the littered item and affect the number of items that can be collected during street-cleansing. The PMCA seems to rely on a 2014 report by the OECD, which apparently indicated that littering is the key reason to consider a DRS, however, this seems to ignore the other reasons for considering a DRS, namely: increased recycling rates and higher quality of recycled material.

The PMCA also cited the potential impact on retailers, however there was no mention of a handling fee that retailers could receive by way of compensation. The potential implications and complications arising from cross-border trade were also mentioned, and this is discussed in more detail below. They also highlighted the high-costs of the German DRS, however Germany has a decentralised system which may not achieve the same efficiencies and economies of scale as other, centralised, European systems can achieve.

The PMCA report asserts that a deposit "is basically the same as a consumption tax (even if it is not imposed by the State)." This, however, seems to be misleading, given that taxes are generally not refundable, while a consumer – in a well-designed DRS – should be able to obtain a full refund on their deposit if they so wish.

PMCA concluded that:

> *"A deposit is neither suitable for Ireland nor necessary to achieve the objectives sought by those who are seeking to introduce it".*

Finally, a Review of the Producer Responsibility Initiative Model in Ireland for the Department of the Environment, Community and Local Government provided a wide-ranging review of the producer responsibility programmes for a range of items, including packaging.[52] This review concluded:

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[51] PMCA Economic Consulting (2017) Report on the Proposed Deposit and Return System for Beverage Containers in Ireland. Prepared for Repak Limited. 4th December 2017.

[52] RPS et al. (2014) Review of the Producer Responsibility Initiative Model in Ireland. Main Reported (Redacted). July 2014.

> *"To add a wide-ranging packaging deposit and return scheme to the current system is inappropriate in view of the operation of the existing EPR packaging scheme and proposed policies concerning household waste collection, combined with the high administrative costs of a deposit and return system and the limited experience with deposit and return schemes beyond drinks containers. There may be specific types of packaging waste or specific externalities, such as some forms of littering, where introduction of a deposit and return scheme might be appropriate. However, this would require careful examination through a cost-benefit analysis."*

This review was conducted before the development of the Single Use Plastics Directive, which has specific targets for plastic beverage containers that arguably strengthens the case for measures targeting beverage containers specifically. It is agreed that a cost-benefit analysis is always recommended before any policy change.

4.3 Stakeholder Responses

The stakeholders discussed in Section 2.3.2 were also asked whether they would support the introduction of a DRS as a means of collecting 90% of PET and aluminium beverage containers.

Respondents were split over the potential for the current system to achieve the 90% separate collection target for plastic beverage bottles and in their perceptions of a DRS. Responses tended to follow a very similar pattern to debates over a potential DRS in other countries, with stakeholders who could be required to support a DRS and/ or could lose revenue as a result of it tending to support the existing system or being more cautious about the potential of a DRS, and those would could benefit from the material returned to a DRS tending to be more supportive of a DRS. It seems notable that those with direct experience of the existing material collected suggested that a DRS could address problems with cross-contamination, which is difficult to sort and can impair the quality of the end product.

The NGO sector was more in favour of a DRS and refuted the suggestion that the SUP targets can be achieved under the current system, with beverage containers used 'on-the-go' representing a particular challenge. While other stakeholders suggested working with Tidy Town groups to increase the capture rate under the existing waste management system, Environmental Pillar reported that 60 of these groups have signed up to support a DRS.

Reservations about or opposition to a DRS tended to relate to the following key issues:

- That a DRS only addresses one element of waste;
- the impact on the kerbside collection system;
- uncertainties about the costs and benefits;
- cost to retailers and lack of space for RVMs; and
- a risk of litter around shops.

4.3.1 Narrow Scope

It is of course true that the DRS only deals directly with beverage containers (and only, in the case of this study, PET and aluminium ones). This is because:

- beverages are consumed relatively quickly and in high volumes, so are a significant source of packaging waste;
- beverages are often consumed 'on-the-go', increasing the risk that they are littered or disposed of in residual waste;
- beverage containers are easily cleaned, with beverages leaving little residue in the containers; and
- Ii the system is producer-led, extending the organisational structure beyond the beverage industry becomes more complex. The DRS cash-flow and audits would also be more complicated if packaging (for products consumed over a longer period of time) were returned years after being purchased.

Environmental Pillar also cited the 2016 Coastwatch survey, which indicated that the top 5 marine litter include plastic drinks bottles (on 83.6% of shores), drinks cans (on 72.8% of shores) and bottle lids (on 50.9%). The methodology and robustness of this survey is not clear, however the Coastwatch findings reflect global concerns about marine litter, with beach surveys generally indicating a high proportion of beverage containers, along with items like cigarette butts and snack packets. Research for the European Commission indicated that plastic drinks bottles were the third most prevalent item Celtic Sea beach litter samples, plastics caps and lids were fourth and metal drink cans were 7th (small pieces of polystyrene were the most prevalent item followed by nets and ropes).[53] While the packaging found on Ireland's beaches were not necessarily consumed on those beaches or even in Ireland, the more countries that increase their collection rate of beverage containers, the fewer containers will wash-up on shores around the world.

Just because a DRS does not directly address other waste does not mean it is not an effective solution for beverage containers specifically, or that other solutions should not be considered for other types of waste. One respondent suggested that a mix of public and private funds should not be used for only one element of waste products, (i.e. only beverage containers). However, a well-designed DRS should not involve any public funds, but is instead solely funded by producers and consumers of beverage containers. This includes the set-up costs, for which the organisation operating the DRS on behalf producers takes out a loan. The repayments are incorporated into the annual operating costs so are paid by producer fees, unredeemed deposits and material revenues.

It is also worth noting Lithuania's experience since introducing a DRS in 2016. 93% of consumers in Lithuania reported that the introduction of a DRS had meant they were

[53] JRC Technical Reports (2016) Marine Beach Litter in Europe – Top Items. https://mcc.jrc.ec.europa.eu/documents/Marine_Litter/MarineLitterTOPitems_final_24.1.2017.pdf

more likely to consider sorting all their waste more responsibly.[54] This indicates that, while the DRS may only relate directly to beverage containers, it has the potential to raise recycling in the public consciousness and to promote positive behaviour change.

It was also suggested by stakeholders that producers could switch to cartons to avoid inclusion in the DRS. This is more of a potential risk for some beverages than others (for instance, fruit juices are sold in PET and cartons, while carbonated soft drinks tend to be sold in PET or aluminium). This could, however, be avoided by either including cartons within the scope of the DRS or by ensuring that the EPR fee for cartons reflects the true costs of collecting these and their limited material value. A supporting economic instrument – like a beverage container tax – could also be applied to containers sold without a deposit to avoid any potential reduction in costs for containers outside the scope of the DRS.

4.3.2 Impact on Kerbside Collections

In an effective DRS, the vast majority of deposit-bearing containers will be removed from the existing waste stream and, with this, one source of revenue. It is important to understand the consequences of this, so the impact on the kerbside collections is modelled in the current study (see Section 5.3.2). Consequently, this section does not analyse this aspect in detail but instead briefly considers the specific points raised by stakeholders. It is, however, worth noting, that – as Ireland is currently recycling 34% of all plastic packaging – there is scope to increase the recycling rates of other types of plastic or metal packaging (such as HDPE bottles for household cleaning products or shampoo, PET pots, tubs and trays or food cans) which would help to replace the lost revenue associated with the DRS. As indicated above, the DRS could well encourage consumers to think more about their waste and how it is treated, and could encourage more people to ensure their packaging waste is recycled.

Additionally, producers under the revised Waste Framework Directive are required to pay the full net costs of collecting, transporting and treating packaging waste – which may mean producer responsibility fees have to increase - and should ensure that waste collections receive the funding they need. Similarly, under the SUP Directive, plastic producers will be obliged to cover the costs of litter clean-up and infrastructure associated with the plastic.

Both DCCAE and stakeholders in Ireland are concerned about the potential impact of a DRS on the existing household collection system. A previous report by PMCA Economic Consulting reported that a DRS would “reduce economies of scale” for kerbside collections.[55] The nature of Ireland’s kerbside collections, however, means the system is

[54] USAD (2018) Lithuania’s Deposit System. Presentation to the 1st European Conference on Deposit Systems for Beverage Containers. 20th November 2018.
[55] PMCA Economic Consulting (2017) Report on the Proposed Deposit and Return System for Beverage Containers in Ireland. Prepared for Repak Limited. 4th December 2017.

not in any case designed to maximise economies of scale, given that mixed dry recyclables are already divided between many different companies.

Lithuania – which introduced its DRS relatively recently in 2016 – has door-to-door collections for plastic, metal and glass, which stood to lose material to the DRS (which covers cans and plastic and glass bottles). While the door-to-door service is not universal, the Lithuanian Environmental Protection Agency has reported, since the DRS was introduced, that they intend to expand the door-to-door collections so that they are more widely available in the country. This indicates that they did not consider the two services to be mutually exclusive or that the DRS undermined the viability of door-to-door collections (with additional services needed beyond the DRS because the DRS only collects beverage containers).[56] Similar effects have been reported in Estonia, which also operates a DRS alongside kerbside collections, with 100% of households in the capital city of Tallinn having door-to-door collections for packaging materials.[57]

Although both Lithuania and Estonia report slightly lower packaging recycling rates than Ireland (see Figure 3-1), there is nevertheless scope in Ireland to increase the amount of packaging waste that is separately collected at the kerbside. Germany also relies on door-to-door collections for packaging waste, and has a higher packaging recovery rate than Ireland according to the latest Eurostat data, so it seems that the two systems – kerbside and DRS – complement each other in Germany too.

Norway, Sweden, Finland and Denmark all have a DRS with return rates above 80%. While the Nordic countries have traditionally relied on bring sites for household waste collections, it is notable that there has been a significant increase in door-to-door collections over the past decade. In Denmark, 48% of municipalities have door-to-door collections for metal packaging and 42% for plastic packaging. In Finland, there is door-to-door collection for plastic and just over a quarter of the population has a door-to-door collection for metal. This may be due to the low population densities in Finland. In Norway, 87% of municipalities have separate collections for plastic packaging and this is mostly via door-to-door services. Interestingly, despite the DRS for cans, door-to-door collections are being rolled out for metal packaging across Norway due to the higher collection rates this is likely to achieve. While these countries do not have the same competitive system as Ireland, these examples nevertheless indicate that a DRS is not incompatible with a kerbside collection system and does not remove too much valuable material from the kerbside. Indeed, recent analysis for the Nordic Waste Working Group for the Circular Economy concluded that the DRSs in Denmark, Norway, Sweden, Finland

[56] Eunomia et al. (2018) Study to Identify Member States at Risk of Non-Compliance with the 2020 Target of the Waste Framework Directive and to Follow-up Phase 1 and 2 of the Compliance Promotion Exercise. Early Warning report: Lithuania. January 2018.

[57] BiPro (2015) Assessment of Separate Collection Schemes in the 28 Capitals of the EU. Capital Factsheet – Tallinn/ Estonia. Report for the European Commission.

and Iceland – alongside EPR systems and landfill bans on combustible and biodegradable waste – had all had a significant positive impact on recycling rates.[58]

It was suggested that householders may leave their beverage containers outside their MDR bins so that someone else can claim the deposit, and that this will attract vermin. However, this has not been identified as a notable problem in other DRSs, but scavenging was noted as a concern with Belgium's kerbside system and there are plenty of examples of kerbside collections that do not use wheelie bins or bags, but instead open boxes that could equally attract vermin if this were a real risk. Some DRSs give consumers the option of donating their deposit to charity, or, in Sweden for instance, special collection "tubes" have been installed in public places (especially next to litter bins) so that consumers can donate their containers for someone else to redeem. Charities themselves may even provide collection facilities (such as the Red Cross in Norway). There are therefore, a number of options for consumers to donate unwanted deposits/ containers.

4.3.3 Costs and Benefits

A DRS does require investment and on-going financial support from producers, so it is important to conduct a full analysis to understand the associated costs. Accordingly, the likely costs and impacts of the proposed system for Ireland have been modelled as part of this study and are outlined in Section 5.0. Should DCCAE proceed with the idea of a DRS, they may choose to conduct a full cost benefit analysis and regulatory impact analysis. Producers would then conduct their own, more detailed planning. For instance, the collection logistics can be modelled more accurately once it is known exactly where counting centres and processing plants will be located. In addition, the exact number of units placed on the market would be submitted confidentially to the system operator.

It was questioned whether consumers would be motivated to bring their used beverage container to a shop if they are not motivated to recycle it at the kerbside. This, however, seems to overlook the financial incentive provided by the deposit. Additionally, retailer collections are likely to be more convenient for on-the-go consumption. Evidence from recyclers also suggests that beverage containers collected via a DRS will be less contaminated than those collected through the kerbside.[59] Indeed, a representative of the Irish recycling industry commented that their "biggest problem is cross contamination which is very difficult to sort out".[60]

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[58] Eunomia (2018) *Analysis of Nordic regulatory framework and its effect on waste prevention and recycling in the region*. Report for the Nordic Council of Ministers Waste Group. 4th December 2018. http://norden.diva-portal.org/smash/get/diva2:1304371/FULLTEXT01.pdf

[59] This is a common experience across DRSs because the beverage containers are collected separately to all other waste. It was also a view expressed by Irish recycling industry representatives contributing to this study.

[60] Private communication from recycling industry representative.

Another issue highlighted was that beverages could be imported from Northern Ireland because they would be perceived as cheaper if there is no deposit in Northern Ireland. Firstly, a DRS is being considered for Northern Ireland and the rest of the UK, so this may not be a problem in the future. Secondly, however, it highlights the importance of awareness campaigns to avoid the deposit being perceived as a price increase and to ensure consumers know it is fully refundable. The border with Northern Ireland does pose a potential fraud risk, and this is discussed in more detail in Section 4.4.7.

Litter reduction is another potential benefit of a DRS.[61], Indicating that there are potential litter clean-up savings to be made. Local authorities in 2018 spent €91.3 million on street/ road cleaning, €9.5 million on litter warden services and €4.9 million on public awareness initiatives.[62] While a DRS would not negate this need for local authority spending – not least because beverage cans and bottles are not the only items that are littered – it would help to reduce the volume of litter. This is because consumers have a financial incentive to return their can/ bottle and even if it is littered by the original consumers, passers-by have an incentive to pick-up the can/ bottle in order to claim the deposit. This would support public awareness initiatives, thereby reducing costs further because people are more likely to litter in an environment that is more heavily littered, and less likely to litter in a less heavily littered environment[63]. It is also worth noting that, under the SUP Directive, some of these litter costs could be borne by producers.

In a consumer survey in Lithuania two years following the introduction of the DRS in 2016, 95% reported that the amount of litter in parks, lakes and other natural spaces had reduced and 97% believed the DRS was necessary.[64]

4.3.4 Impact on Retailers

In a return to retail model, retailers do incur costs (mainly in terms of staff time and foregone retail space and, if using RVMs), so this does need to be considered. However, in well-designed systems, retailers are compensated for these costs with a handling fee (see Section 4.4.5). It could also be argued that as retailers have a role in placing packaging waste on the market, like beverage producers, they have a role to play in ensuring the packaging waste is treated appropriately.

It is recognised that not all retailers have space for an RVM, or will receive the necessary volume of containers to justify the cost of a machine. While it was suggested that this creates a two-tier system, most DRSs in Europe give retailers the choice of providing a

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[61] Eunomia (2017) Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services. 11th October 2017

[62] https://www.dccae.gov.ie/documents/20190501-Local%20Authority%20Street%20Cleaning%20and%20Litter%20Expenditure%202018.pdf

[63] https://www.isonomia.co.uk/broken-windows-and-litter-tidying-up-incpens-arguments/

[64] USAD (2018) Lithuania's Deposit System. Presentation to the 1st European Conference on Deposit Systems for Beverage Containers. 20th November 2018.

manual or automated service. It is not generally perceived as a problem that there are two types of service – handling fees compensate for both and consumers recognise that a manual service is more appropriate for some, particularly smaller, retailers.

It was reported that convenience stores account for more than 70% of retailers in Ireland; other countries too have more small shops than large supermarkets. For instance, in Norway, there are approximately 12,000 return locations but only 3,700 RVMs, so the vast majority of retailers provide a manual service, but over 90% of containers are returned via an RVM. This means that a significant number (albeit a small percentage of all containers) are returned to smaller retailers. However, it is likely that consumers return containers to smaller retailers in lower volumes that then would to a supermarket. This is because smaller local shops are more likely to capture containers consumed on-the-go. Whereas people returning their containers to a supermarket might be more likely to wait until they are going to the supermarket anyway to do their weekly shop). This is likely to reduce disruption for smaller retailers but could also generate benefits in terms of footfall. Indeed, small retailers in Norway are reported to be supportive of the DRS because it increases footfall. One retailer commented "It increases the number of people in our shops. It's good for business."[65]

In terms of the concern that a DRS could draw litter to shops, it is not clear what the rationale is for this. It seems unlikely that people would make the effort to take their used beverage container back to the area of a shop, but not actually redeem their deposit. Even if the containers were littered, the deposit means someone else has an incentive to pick up the container to redeem their deposit. While it is noted that the CSNA reports fewer retailers are providing recycling facilities because of incidents (such as breakages and spillages), a DRS is entirely different because of the cash incentive. Return locations are also likely to be in the shop itself, so a DRS return location is not comparable to a general waste facility. Indeed, the deposit could mean that some people do not even perceive the beverage container as waste, but as a resource with value.

4.4 Existing DRSs

Part of this study was to consider an appropriate DRS design for Ireland. This should be based on existing best practice elsewhere. Therefore, if producers in Ireland do invest in a DRS, it is based on tried and tested models, with appropriate adaptation for Ireland's specific circumstances. Table 4-1 lists the jurisdictions with a DRS at present, and the countries where a DRS is either actively being introduced or is being considered as an option.

[65] Harrabin, R. (2018) UK 'could adopt' Norway recycling system, *BBC News*

Table 4-1: Existing DRSs and Countries Considering a DRS

Countries with a DRS	Countries that are planning/ considering a DRS
Norway	Kosovo
Estonia	Malta
Finland	The Czech Republic
Sweden	Scotland
Denmark	England, Wales & Northern Ireland
Germany	Romania
Lithuania	Latvia
Croatia	Belarus
Iceland	Turkey
Israel	Portugal
The Netherlands	Slovakia
Canada (12 provinces)	France
The USA (10 states)	Austria
Australia (4 territories)	Brussels, Belgium

A number of these systems have very different designs and achieve equally varied results, with return rates ranging from 48% in Northern Territory, Australia, to 98.4% in Germany.[66] The design of a scheme significantly affects the results it achieves. Systems with inherent inefficiencies and low return rates are often cited as evidence against a DRS, whereas they only really provide evidence against a poorly-designed DRS, as the weaknesses could be avoided with an alternative approach. A well-designed DRS (with an appropriate deposit value, convenient return infrastructure, targets and accountability mechanisms) will lead to return rates in excess of 90%. Accordingly, it is important to understand the different design options and their implications and draw upon these in selecting a suitable design for Ireland.

[66] Reloop & CM Consulting (2018) Deposit Systems for One-Way Beverage Containers: Global Overview.

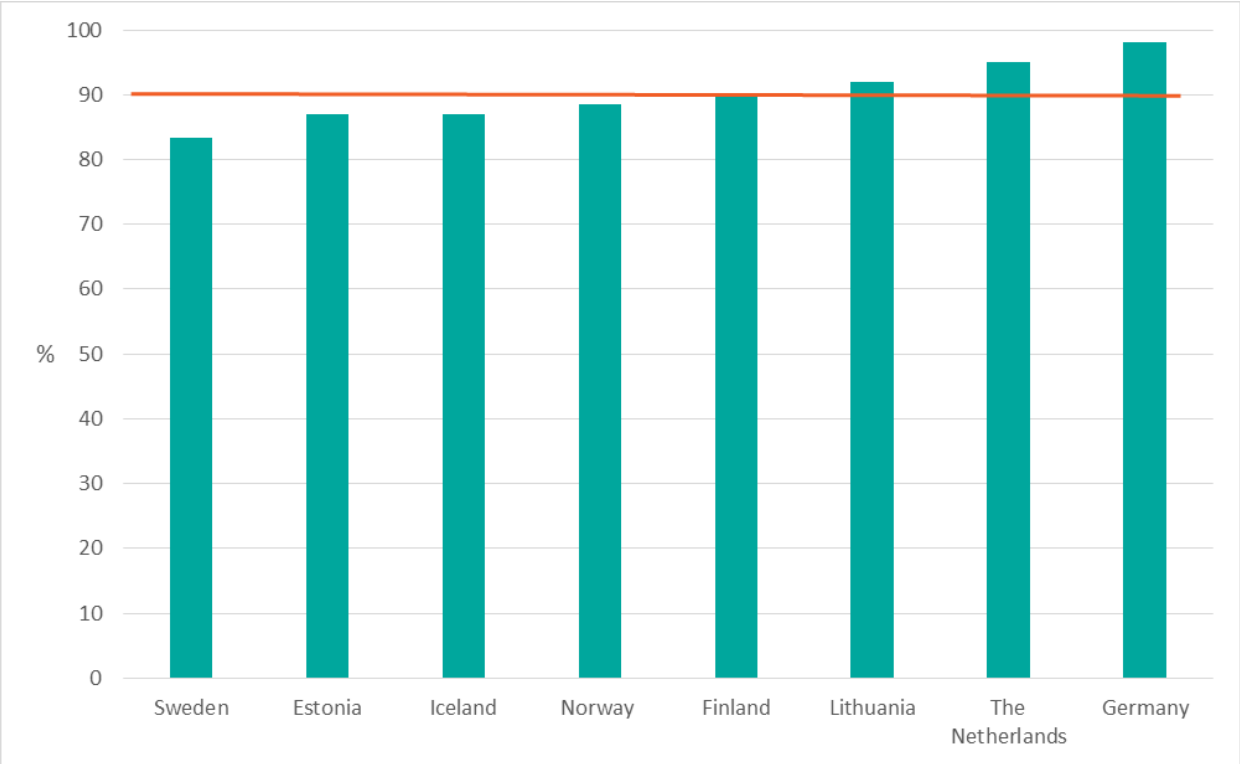
Table 6-4 provides a snapshot of DRSs, which have been selected to illustrate a range of:

- return rates;
- years in operation;
- centralised and decentralised structures; and
- levels of Government involvement.

Section 4.4 then assesses the various approaches for each element of a DRS to make a recommendation for Ireland. DRSs outside the EU and the European Economic Area are considered because the DRS design does not necessarily depend on the wider regulatory context and systems in the USA offer lessons for other countries.

As noted above, there is significant variation in the results achieved by DRSs around the world, however most systems in Europe reliably achieve over 80% and, as indicated in Figure 4-2, half report a 90+% return rate for plastic beverage bottles. (Norway expects to surpass 90% following the increase of the deposit value in 2018.)[67] These figures do not include plastic beverage bottles captured and recycled by alternative collections to the DRS.

Figure 4-2: Plastic Beverage Bottle Return Rates for European DRSs



[67] Infinitum (2019) 2018 Annual Report

Source: Chart – Eunomia. Data – Returpack; Reloop; Infinitum, Palpa

While each component is considered separately in this section, it is also important to take into account the interaction between the different elements. For instance, the success of the return infrastructure can depend to some extent on the nature of the handling fees. This section focuses on the design principles for Ireland; the modelled costs of the proposed system are provided in Section 5.3.1, the impact on the existing kerbside collection system is given in Section 5.3.2 and the environmental impacts are included in Section 5.3.3. (The methodology used to reach these results is outlined in Section 5.1).

4.4.1 Governance and Organisation

Centralised schemes are generally more transparent and accountable than decentralised ones, as there is a dedicated organisation – the Central System Operator (CSO) – responsible for the scheme's data management and overall success. Organisations such as Infinitum in Norway publish annual reports and accounts so that their board members, funders, consumers and regulators can monitor their activities and the results they achieve. Public reporting on the number of producers, beverage sales and returns also helps to detect free-riding. This is because beverage producers can use their knowledge of the beverage market and their competitors to judge whether all companies that are required to do so are paying into the scheme.

In a centralised system, everything is funded from a central budget. The CSOs set producer fees for every container placed on the market meaning producers know in advance what their financial responsibilities towards the DRS will be. It is more equitable, and more in line with the producer responsibility principle, to charge producers for the number of units placed on the market. By contrast, decentralised systems are financed by individual producers, who pay for their own containers to be collected and any handling fees to retailers/ redemption centres. Consequently, the funding required of producers in decentralised systems is dependent on the return rate, meaning producers cannot plan their expenditure and producers with a higher return rate pay more than those with a lower return rate.

A CSO can also market the system, promoting education and awareness that supports a high return rate, whereas there is no organisation with responsibility for this in a decentralised DRS. The CSO would, for instance, be responsible for ensuring consumers understand the system and that the deposit is fully refundable, to avoid the deposit being perceived as a price increase – a concern that was raised by some stakeholders.

While decentralised systems could be said to give beverage producers more freedom, decentralised systems like Connecticut's also result in more responsibilities for producers, as there is not a single organisation to which they can delegate. Centralised systems are often more efficient, in part because the CSO can achieve economies of scale (as they are managing all returned containers). In addition, decentralised systems can create duplication, as multiple beverage producers are collecting their own containers, or have the administrative burden of contracting a business to do so on their behalf. As such, decentralised systems can mean that returned containers have to be

sorted and stored separately by brand – something that is not necessary in centralised systems – and potentially inconveniencing retailers and consumers who have to check which stores will accept their brand of containers.

In terms of governance, producers should have the freedom to develop the most effective system and adapt it as necessary. As such, it is preferable to avoid specifying too many details in legislation, particularly as it can then be a lengthy process to amend the legislation. The legislation could specify the range of containers on which a deposit must be charged if it is to be legally placed on the market (without excluding the possibility of including more). It can also specify either a minimum deposit value or a role for the Government in approving or reviewing the deposit value, as happened in Norway in 2018. The Government does have an important oversight role and should set firm targets, against which the CSO can be held accountable.

Systems where the CSO has a statutory obligation or financial incentive to increase the return rate mean that the CSO will seek to drive continuous improvements and consider novel ways to capture more containers. In Sweden, for instance, its CSO, Returpack, has installed "tubes" or "pipes" by public bins, from which other people take donated containers to redeem the deposit. [68]

As demonstrated by Norway and Finland, the Government does not necessarily need to legislate for a DRS but could simply use a supporting economic instrument and statutory targets. This gives producers the maximum degree of flexibility, and indeed accountability. A tax also helps to level the playing field so that producers of containers not included in the DRS (such as cartons, pouches and glass bottles) are not deriving a financial and competitive advantage.

A voluntary system such as the one in the Netherlands – without the regulatory framework found in Finland or Norway – does not necessarily share the same objectives as the Government and has fewer in-built accountability mechanisms. It also means there is more potential for disparate and competing systems – all retailers in the Netherlands are involved in the system apart from Lidl and Aldi, which have established their own system. This potentially creates inefficiencies and confusion and inconvenience for consumers if they have to separate their containers by retailer. It could also mean monitoring and audits are more difficult if a number of systems are reporting on sales and return volumes.

[68] http://www.mynewsdesk.com/se/ab_svenska_returpack/pressreleases/haelften-av-landets-kommuner-har-pantroer-nu-erbjuder-pantamera-alla-kommuner-att-testa-2577747

Recommendation for Ireland

- Centralised, producer owned and led
- Retailers represented on the Board
- Government targets and annual oversight of return rates
- Consider a Beverage Container Tax or similar supporting instrument to reward higher return rates and level the playing field.

4.4.2 Scope

Generally, a broader scope should increase the impact of the DRS in terms of recycling rates and reduced littering of beverage containers. An inclusive DRS also provides a level playing field, avoiding market distortions that could mean producers favour one type of material over another or change their packaging to avoid DRS fees.

This study is restricted to PET bottles and aluminium cans, which is similar to the approach in both Norway and Sweden. As explained in Section 4.4.1, consideration should be given to producers' obligations for beverages in glass bottles, foil pouches and cartons. The Netherlands' scope – in only including larger PET bottles – does not maximise the potential benefit of the DRS or support economies of scale.

In terms of container sizes, while some Canadian systems specify up to 5 litres, a more common range is 0.1 to 3 litres. These sizes can be easily processed by reverse vending machines (RVMs) and mean that retailers are not required to store excessively large containers.

In terms of the beverage types included, an inclusive scope is simpler for consumers and retailers as they do not have to check which beverages do and do not have a deposit. If only a limited range of beverages are included, consumers may feel it is less worthwhile to return their containers if they have only paid a deposit on a small proportion of them. This could also restrict the CSO's ability to deliver economies of scale.

Milk has traditionally been excluded because of hygiene concerns about residue left in the bottle. This is now less of an issue, as the vast majority of containers are returned to RVMs that compact and store the containers. As milk is more likely to be consumed at home, the bottles can also be easily rinsed. However, as milk is more commonly sold in cartons, HDPE bottles or glass bottles, the vast majority will in any case be outside the scope of the system, so it is more straightforward to simply exclude milk.

Wines and spirits are often excluded because they are imported so the labelling requirements and fraud prevention measures can be more challenging. If glass bottles were included in the DRS, there is an argument for the inclusion of wines and spirits but, as such as small percentage are sold in cans or PET bottles, it is not recommended that they are included at this stage.

Recommendation for Ireland

- PET bottles and metal cans
- 0.1-3 litres
- All beverages apart from milk, wines and spirits.

4.4.3 Deposit Value

The deposit is the key mechanism for incentivising returns, so needs to be set at a high enough level to support a high return rate, balanced against the increasing risk of fraud with higher deposit values and the impact on consumer, retailer and producer cash flow. In Table 6-4, Connecticut has the lowest deposit at $0.05 (€0.06) and, as this has not changed in over thirty years, has lost value in real terms. This low deposit value is one factor contributing to the decline in the Connecticut's return rate in recent years. This is in contrast to Oregon, which increased its deposit value from $0.05 (€0.06) to $0.10 (€0.11) in April 2017; during January – March 2017, Oregon's return rate was 59% but this increased to 82% between April and December 2017 after the deposit was raised.[69] In 2018, the first full year with the higher deposit, Oregon reported an 85% return rate.[70]

At the other end of the spectrum, Germany has a relatively high deposit and is reported to achieve a high return rate, but the fraud prevention measures are also more expensive than in the majority of systems and this is partly attributed to the high deposit value. It is also worth noting that the German system was explicitly intended to promote refillable bottles.

The deposit should also be proportionate to the price of beverage and be appropriate for the national economy. Table 4-2 shows the deposit values in various European countries (or the range where there are different deposit values depending on the size or type of container) and adjusted for purchasing power parity (PPP) to the value of the Euro in Ireland to take account the relative strength of the economies and differences in wealth.

[69] https://www.obrc.com/Content/Reports/OBRC%20Annual%20Report%202017.PDF
[70] https://www.obrc.com/Content/Reports/OBRC%20Annual%20Report%202018.PDF

Table 4-2: Selected Deposits and Latest Return Rates

	Deposit	Deposit (PPP-€)	Return Rate
Denmark	1 Kr	0.114	90%
	3 Kr	0.343	
Estonia	€0.10	0.144	83%
Finland	€0.10	0.090	88-95%
	€0.40	0.359	
Germany	€0.25	0.260	98%
Lithuania	€0.10	0.173	92%
Norway	2 Kr	0.150	87%-89%
	3 Kr	0.224	
Sweden	1 KR	0.088	85%
	2 Kr	0.176	

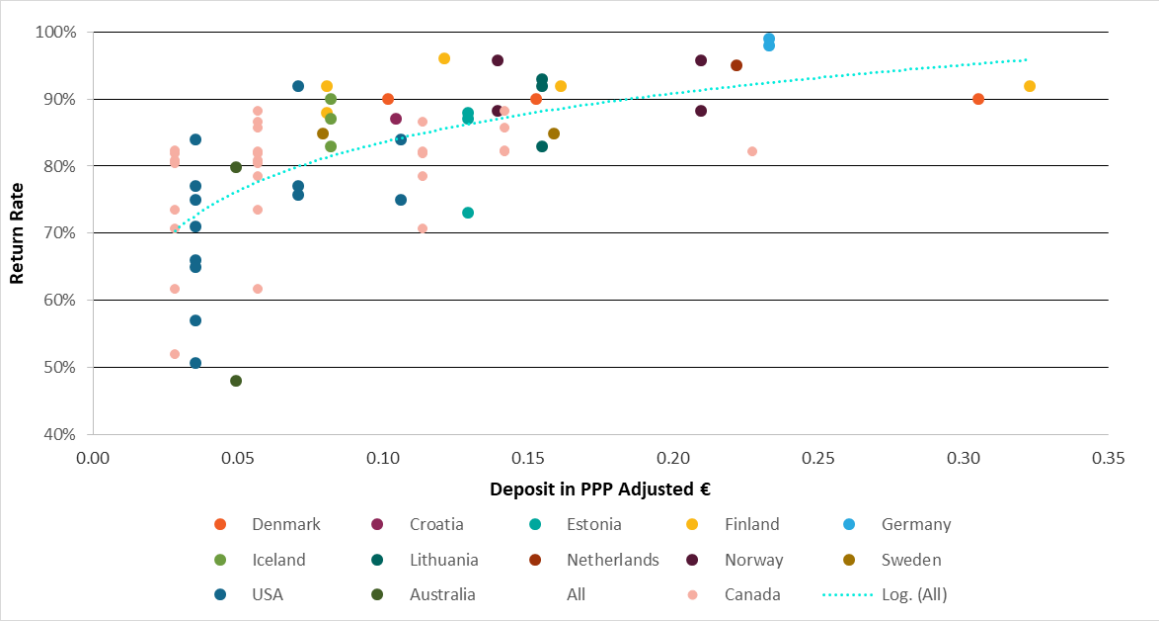
A single value, and to a certain extent the two-tier approach in Norway and Sweden, provides clarity and simplicity, whereas Finland has four deposit values, which could mean a lack of clarity, particularly for new systems and for tourists. Finland's deposit levels mean there is a higher incentive to return cans than small PET bottles, which could potentially affect the plastic littering and recycling rates. The deposit values could also affect producers' packaging choices if one option adds less to the up-front purchase price (even though the deposit is refundable).

A flat-rate deposit is recommended, at least at the outset, but a higher deposit could be considered in the future for larger containers. Using the PPP-adjusted values in Table 4-2, €0.20 would be an appropriate value for Ireland and, depending on the rest of the system design, is likely to support a return rate around 90%. As illustrated in Figure 4-2 the correlation between deposit values and return rates in existing systems indicates

that a deposit of €0.19 is associated with a 90% return rate (although there are other factors affecting the return rate, such as the level of convenience for consumers).

It is important that the system operator has the flexibility to increase the deposit value if return rates are falling. Whilst legislation could specify a minimum deposit value, the actual value should not be fixed in legislation because it can be a difficult and time-consuming process to amend the deposit when needed. Involving the Government can mean it becomes more of a political decision than a practical consideration of what is needed to increase the return rate and meet targets.

Figure 4-3: DRS Return Rate as a Function of the Deposit Value



€0.25 has been suggested as a possible deposit value, however, currently only Germany has such a high flat-rate deposit. While the deposit is fully refunded, the impact on consumers' and retailers' cash-flow should be considered, along with the fraud risk

If a DRS is introduced in Northern Ireland and this is aligned with the proposed system in Scotland (where 20p is currently the suggested deposit value), a €0.25 deposit in Ireland would be higher. Retailers in Ireland could consequently be concerned that this potentially increases the likelihood of drinks being imported from Northern Ireland because they are perceived as "cheaper". This could also result in a higher incentive to try to import used beverage containers from Northern Ireland in order to claim the higher deposit refund in Ireland. Of course, if a DRS is not introduced in Northern Ireland but is in Ireland, the differential would be greater if the deposit were €0.25.

Another consideration is that it is easier to increase the deposit than to reduce it, so this is an argument to start at a lower value and, if the return rate is not high enough after a couple of years, the deposit can then be increased.

4.4.4 Return Infrastructure

Convenience is one of the factors that influences the return rate and it is notable that European countries, and Michigan in the USA, that use return to retail generally have higher return rates. The return to retail approach allows consumers to claim their refund while they are doing their shopping or passing a shop, so is generally convenient.

Redemption centres are locations specifically established for the DRS solely for the purpose of receiving used beverage containers and make it easier for consumers to return their containers in bulk. Mass redemption by professional redeemers is common in the USA, and these require special infrastructure so can increase the time and cost of setting up the DRS. Redemption centres can also mean that consumers have to make special journeys to return their containers. In places like Connecticut and California, redemption centres are closing because they are not financially viable, illustrating the drawback of relying on redemption centres that need to be able to make a profit. These closures have meant consumers have fewer opportunities to redeem their containers and are either foregoing their deposit or travelling further and waiting in longer queues.

Some stakeholders suggested that a DRS could use existing civic amenity sites, which is certainly one option. This would avoid having to establish special redemption centres and would facilitate consumers to bring their beverage containers along with their other wastes to recycle when they visit a civic amenity site. This is still, however, likely to be less convenient than the return to retail model, given that most consumers would be going to a grocery shop more regularly than a civic amenity site. Return to retail is also more likely to address more on-the-go consumption, given that civic amenity sites are not necessarily in town centres or in every community. Not all householders in Ireland use the existing recycling centres and some are out of town so are not necessarily that accessible for everyone – particularly those without a car.

To avoid consumers having to sort their containers or visit multiple shops, all retailers should be required to refund any deposit-bearing container, regardless of whether they sell that type. Small retailers could be exempt from a take-back obligation. However, smaller retailers are not likely to receive high volumes for which they will have limited space and retailers have reported that a DRS can be good for business by giving customers a reason to visit their shop. In some European countries where small retailers are not formally part of the DRS, they will voluntarily take-back containers so as to provide a service to their customers, and the retailer then visits a larger shop to obtain a refund.

As retailers are integral to the success of the system, they should be represented on the CSO board so that the industry can influence how it is run, and they should be compensated for their costs of providing a service (as discussed in Section 4.4.5).

In addition to choosing where consumers can return their containers, there is a choice of how they do this – using reverse vending machines (RVMs) or manual returns. Return to retail models use both, with smaller retailers generally choosing the manual option as they do not have the space for an RVM or the return volumes to justify the cost. RVMs are automated machines into which consumers can put their used containers in order to

obtain their refund – either by crediting their account, giving the option to donate to charity or providing a receipt to claim the cash at the check-out. RVMs come in a range of sizes and capabilities. Generally, they can identify the container and beverage type by scanning barcodes, confirm the refund owed and, in some cases, compact the containers. Compaction prevents fraudulent multiple redemptions and reduces the number of vehicles required to transport the containers due to the higher bulk density.

Retailers can either buy or lease the RVMs directly from the supplier, or they can be provided by the CSO, which agrees a through-put payment model with the RVM supplier. In this case, the RVM supplier is paid an agreed fee for every container returned to their RVMs. In Denmark and Lithuania, the CSO provides the RVMs to retailers. RVMs do not necessarily need to be inside a shop, but could for instance be in a car-park or at the entrance (although in stores/ entrance foyers is more common).

As discussed in Section 4.3.4, some stakeholders have concerns about the impact on retailers. This, however, is why it is important that retailers are represented on the board of the CSO, have a choice about the type of service they provide and are financially compensated through the handling fees, as discussed in the following section.

Recommendation for Ireland

- Return to retail
- RVMs where retailers choose to install them

4.4.5 Handling Fees

A handling fee is usually paid to retailers or redemption centres for taking back used containers.

Handling fees based on cost recovery (as in Norway and Estonia for instance) mean retailers are fairly compensated. Knowing the handling fee to be received, retailers can predict their handling fee income based on anticipated return volumes and can make an informed decision about whether or not to invest in an RVM. Handling fees can also be used to provide an incentive for the use of compacting RVMs to reduce the overall costs of the system.

Conversely, the fixed fee approach used in Connecticut means that many retailers' costs will not be covered, so they will be incurring losses as a result of the DRS, particularly retailers with an RVM. In Connecticut, as the fees have not changed to reflect wages and rental costs, they have lost value in real terms. Prescribing handling fees in legislation can also politicise the issue, subjecting the legislature to lobbying from retailers for a fee increase and from producers who will oppose a change that would increase their costs. By contrast, in Norway and Estonia, fees can be negotiated between the CSO and retailers and, as retailers and producers are represented on the board, all interests are taken into consideration.

The Netherlands does not pay a handling fee as in other European systems. Choosing not to pay a handling fee is likely to limit both the quality and convenience of the service

offered to consumers, so will not support a high return rate. While the Government could legislate to impose a legal obligation on retailers to take-back used containers, retailers are less likely to support the system if they are not compensated for their costs. While retailers in Germany can profit from the material revenues, it also means they are vulnerable to falls in the secondary materials market and cannot be confident that their costs will be covered.

Recommendation for Ireland

- CSO calculates per-container fee based on retailers' staff, storage and RVM costs.
- Higher fee for RVMs, recognising the efficiency savings they generate for the system as a whole.
- Higher fee for PET due to the additional storage space bottles require, compared to cans.
- Reviewed annually.
- Paid from central CSO account.

4.4.6 Funding

The material returned to a DRS can have a higher value than the same material type obtained via other collection methods due to the high quality and limited contamination associated with the single stream collection and well-defined scope. The containers are consequently an important source of revenue and producers may be particularly interested in the PET, as the DRS can provide food-grade rPET that can be used to manufacture new bottles.

Where retailers or individual producers own the returned material, they do not necessarily obtain the highest prices because of the lower volumes and there is additional administration for them. As such, the material is most effectively managed by a CSO in a centralised system, with the revenues used to part-fund the system.

Similarly, unredeemed deposits are a valuable source of income for a centralised system (providing there are targets to support a high return rate). By contrast, if producers retain the unredeemed deposits, as in some decentralised systems in the USA, this can create perverse incentives as producers can profit from a lower return rate. Similarly, governments that incorporate unredeemed deposits into their general budgets (as Connecticut does) can come to rely on these as a source of income so could again be less motivated to increase the return rate.

Using unredeemed deposits to fund the DRS means the money is retained within the system and consumers choosing not to recycle their used containers through the system make a financial contribution to its success. While in theory allowing the CSO to retain the deposits also means they will be less inclined to support a high return rate, this is not a concern in reality – in most cases, the CSO is created specifically to deliver a high return rate and, in the most effective systems, the CSO has return targets (set by Government) to meet and a strong incentive to do so.

The net costs in a centralised DRS are funded by producers, in line with their producer responsibility obligations. Basing producers' contribution on the number of units they place on the market (as in Estonia), rather than the number returned (in Connecticut) is more equitable and more in line with the producer responsibility principle. The up-front fees also enable producers to predict and budget for their costs. Norway's fee structure reflects the actual costs associated with each type of container and means producers can take into consideration the cost implications when designing their containers. As such, the Norwegian approach can enhance the environmental impact of the DRS by incentivising producers to design their beverage containers to be more efficiently recycled. Moreover, the Norwegian/ Estonian/ Lithuanian approach avoids cross-subsidies as, if the fees were the same for aluminium and plastic, aluminium producers would effectively be subsidising plastic bottles with aluminium's higher value and lower processing costs. Due to the efficiency of the Norwegian system and the high value of aluminium, Infinitum effectively has a "negative fee" for aluminium cans, as producers do not have to pay a producer fee, nor do they have to initiate the full deposit. In Estonia and Sweden, there is no fee for aluminium cans.

Recommendation for Ireland

- Unredeemed deposits re-invested in the system.
- Material revenues re-invested in the system.
- Net costs covered by producer fees, set to reflect the different processing costs and values of each material and used to promote eco-design.

4.4.7 Fraud Prevention and Labelling

Any deposit system is susceptible to fraud in a number of possible ways, including:

- Producers under-reporting sales, meaning they avoid producer fees and initiating all the deposits.
- People claiming a refund on a deposit that was not paid because
  - The container was imported from another country/ state.
  - The container is outside the scope of the system.
  - The container has already been redeemed, so a deposit that was paid once is refunded multiple times.
- Retailers/ redemption centres over-reporting return volumes to claim more handling fees and deposit refunds.

Fraudulent or mistaken returns could be a particular risk in Ireland, given the open border with Northern Ireland, especially as there is not currently a DRS in Northern Ireland. The UK Government has, however, consulted on a DRS for England, Wales and Northern Ireland and has indicated that it is moving forward with this. While this would reduce the risk of fraud (especially of the deposits in Northern Ireland and Ireland were set at comparable levels), the border raises further questions in terms of labelling. Even if there is a DRS in both countries, the free movement of people and goods across the

Irish border means a beverage could easily be bought in one country and returned in another.[71]

Producer fraud is primarily addressed through legislation requiring producers to ensure a deposit is paid on all containers, with accompanying penalties for failing to do so, and/ or contractual agreements and financial penalties with the CSO in centralised systems. This also relies on market surveillance from both the CSO and competing producers.

Barcodes are usually registered with the system operator so that the CSO can monitor return patterns and compare these to sales volumes – the barcodes are scanned by RVMs, which can transmit data to the CSO or at counting centres for manual returns. The RVMs reject the container if the barcode is not recognised or is not the registered barcode for that shape/ size of container. This reduces the risk of fraud and enables the CSO to quickly identify unusual patterns – such as a high volume of one specific container type being returned at once or an exceptionally high return rate.

The barcodes are even more effective if they are national barcodes, unique to the country in question, rather than a universal barcode which can be used in several countries. The German DRS requires national barcodes – the high deposit value means this is more important, while the size of the German market means it is more feasible for producers – whereas Estonia and Norway offer producers the choice. A national barcode potentially increases producers' costs, because they have to maintain separate stock-keeping units (SKUs) for one country and cannot so easily shift distributions across different countries if required. The DRS producer fee in Norway and Estonia is therefore lower for national barcodes, with the higher fee intended to compensate – to some extent – for lost revenue for unredeemed deposits.

In the USA, where barcodes are not used and the same containers are sold in states with a deposit and without a deposit, containers could easily be returned for a refund on a deposit that was not originally paid, because the beverage was bought in a neighbouring state. In most states with a DRS, this is simply accepted because the deposit is so low ($0.05), whereas the potential losses would be more significant with a €0.20 deposit. Michigan, however, is an interesting example because the deposit is $0.10 and Pepsi chose to include a Michigan-specific "deposit code" on their cans. This requires separate distribution lines but the expansion of Direct Store Delivery has made this easier. This is arguably more practical for a business of Pepsi's size, but also shows that there are alternative/ additional options to a barcode if the container is also stamped with a code. These would not, however, necessarily be readable by RVMs.

It is understood that the majority of beverage companies in Ireland have distribution lines that cover the whole island of Ireland, so they do not have SKUs for Northern Ireland, with the exception of "price-marked packs" that include Euro or Sterling on the

[71] At the time of writing, it is not clear if the UK will leave the EU on 31st October with or without a deal, so it is not clear whether there will be either a need for, or an agreement on, a backstop to maintain the open border, or whether border checks will in future be required.

packaging itself. Beverage industry representatives have, therefore, indicated that separate packs for Ireland and Northern Ireland would cause "huge logistical and supply chain issues".

It is clear that separate SKUs would require a degree of adaptation from producers, and that this could be even more challenging for smaller producers. It is, however, worth noting that Estonia has a population of 1.32 million – significantly less than Ireland's 4.85 million and less than Northern Ireland's 1.87 million.[72] It is, therefore, reasonable to assume that beverage consumption in Estonia is lower. This indicates that, if national barcodes are a viable option in Estonia – where producers will also be operating in neighbouring countries, as in Ireland – they may be an option in Ireland – especially as price-marked packs are used already in some cases.

Nevertheless, it should be recognised that the border with Northern Ireland – with or without a separate DRS in Northern Ireland – creates potential inconvenience to producers, the risk of confusion for consumers and lost unredeemed deposits for the CSO. If Ireland does proceed with a DRS, it will be important to liaise with producers and retailers operating on both sides of the border and with the Northern Ireland Department of Agriculture, Environment and Rural Affairs. Once established, the Irish CSO and the Northern Irish/ UK CSO could also liaise with each other to monitor any issues and try to ensure the two separate systems can operate alongside each other.

It is, for instance, possible for RVMs to register containers bought outside the DRS (Norway reports on the number of "foreign" containers they have collected and recycled, but on which they have not paid out a deposit refund). In this case, the Northern Irish/ UK and Irish CSOs could potentially reach an agreement on the processing of containers from the other side of the border, or exchange data on the number of containers returned from the other's jurisdiction.

Given that the continuing uncertainty over the UK's exit from the EU and the potential implications for the Irish/ Northern Irish border is a major concern for businesses on both sides of the border, it would be preferable to wait until there is some clarity on the future border arrangements. A DRS should not in any case be introduced immediately because, if the Government does decide to proceed with a DRS, there will firstly be more detailed consultations and impact assessments before a CSO is eventually set-up and the CSO will in turn need planning time.

[72] https://data.worldbank.org/indicator/SP.POP.TOTL?view=chart

Recommendation for Ireland

- Deposit logo specified by CSO to indicate to consumers that the container is part of the DRS and the value of the deposit.
- All barcodes to be registered with the CSO and scanned on return.
- Producer fee is lower for national barcodes.
- Ongoing dialogue relating to cross-border sales and returns.

4.4.8 Logistics and Processing

The CSO will be responsible for collecting the used containers from retailers. They can either manage the logistics in-house, contract a haulage business, pay distributors to collect used containers when they deliver new stock (the distributors transport the containers to their central distribution hubs, from which the CSO organises onwards transport), or use a combination of options.

Containers returned to an RVM have already been registered with the system, counted and compacted, so they can be transported straight to processing, where they are sorted and bulked to be recycled. Containers returned manually must firstly go to a counting centre to be counted and verified so that the CSO knows how much each retailer is owed in terms of refunded deposits and handling fees and to provide data on return volumes.

As recycling companies in Ireland currently import PET from mainland Europe, Asia and South America, it seems there is significant potential to process the plastic bottles returned to the DRS within Ireland – supporting Ireland's recycling industry and potentially reducing the distance PET has to be transported before being recycled.

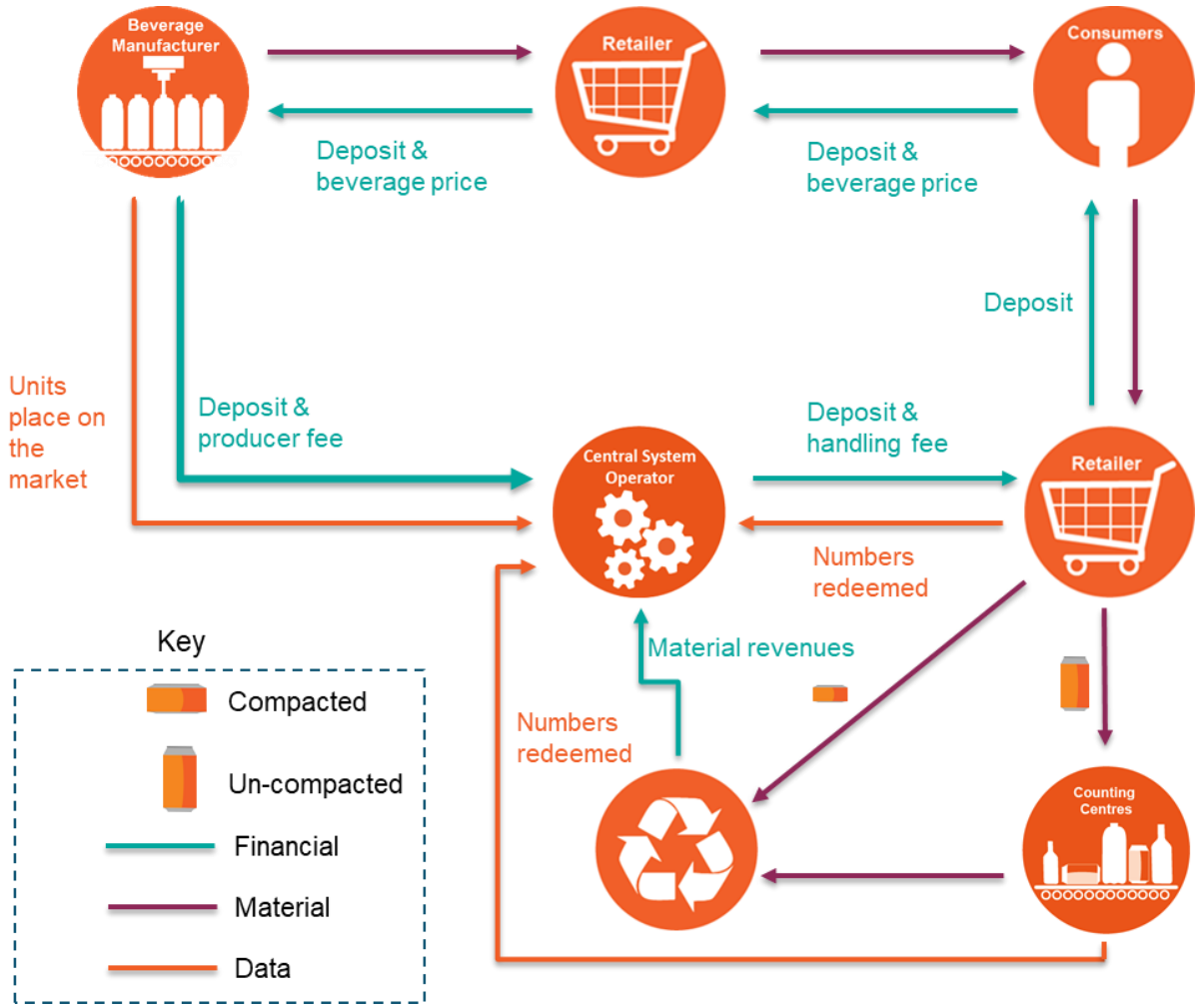
4.5 Summary of DRS Design for Ireland

If a DRS is introduced, the exact specification will be determined in consultation between the beverage and retail industry, within parameters set out by the Government. The system outlined here is, however, based on existing best practice, with the various components associated with a high return rate and a high degree of transparency, accountability and efficiency (see Table 4-3).

Table 4-3: Summary of Design to be Modelled

Component	Option Chosen for Ireland
Governance	Centralised; privately owned and operated; targets set by government (and/ or Beverage Container Tax)
Scope – Containers	PET & aluminium (specified in study requirements)
Scope – Beverage	Water; soft drinks; juices; beer; cider, pre-mixed spirits
Deposit Level	€0.20
Labelling	Deposit logo and reduced producer fee for national barcode
Return Infrastructure	Return to retail – any container can be returned to any participating retailer Compacting RVMs for large retailers Manual service for small retailers
Handling fees	Variable handling fee based on retailers' costs and CSO's savings.
Funding	Material Revenues Unredeemed deposits Producer fee for every container placed on the market

Figure 4-4: Organisation of Possible DRS in Ireland



5.0 Modelling the Costs & Benefits of a DRS in Ireland

5.1 Methodology

Eunomia's DRS model calculates the overall system resources and costs associated with implementing a DRS. The model has been specifically adapted for Ireland and the system detailed above, using data inputs from stakeholders wherever possible. This study also required an analysis of the impact of removing the vast majority of deposit-bearing containers from the kerbside collection system. The modelling methodologies are outlined below, with full details provided in the technical appendix.

The results of the modelling – the costs and impacts of the proposed DRS design in Ireland – are then detailed in Section 5.3.

5.1.1 Mass Flows

The first step in an analysis of the costs and benefits of the DRS is to consider the material flows in Ireland, i.e. how many beverages are sold and how the empty containers are currently managed through the waste stream once the beverage has been consumed. Market data reports were compared with EPA waste statistics and estimates from a range of stakeholders to estimate the number and tonnage of PET and aluminium beverage containers placed on the market annually in Ireland. While the numbers used in this report are considered to be appropriate estimates, it should be noted that there is currently no definitive source.

The next step was to determine what percentage is currently recycled, landfilled, incinerated or littered. As the EPA reports on packaging generally, rather than beverage containers specifically, the recycling and incineration rates used in this study were based on information provided by Repak and the recycling industry's estimated loss rates.

A littering rate of 1.62% was applied, based on the EPA's data for "unmanaged" waste. While Ireland publishes a detailed National Litter Survey, the data is on the proportion of littered items by product category, so there is insufficient information to indicate the weight of beverage containers in litter.

Based on these inputs and assumptions, the final material flows used in the analysis are shown in Table 5-1, with the final destinations allowing for loss rates in each scenario. As the purpose of the study is to look at options to achieve a 90% collection rate, it is assumed for the purposes of the modelling that the DRS achieves this target in order to indicate the costs of meeting this target (and the DRS design has been specifically chosen to support this). The recycling rate under a DRS is higher than the 90% return rate, as it is reasonable to assume that a small proportion of deposit-bearing containers would still be collected via the kerbside MDR system, as some consumers will opt to forego their deposit but will still want to recycle their used container.

Table 5-1: Baseline and DRS Waste Flows in Year Modelled

	Baseline (Tonnes)			DRS (Tonnes)		
	PET	Al	Total	PET	Al	Total
Put on the market (incl. free riders)	28,751	12,774	41,525	28,751	12,774	41,525
Collection						
DRS returns (including cross border)	-	-	-	26,106	11,380	37,486

	Baseline (Tonnes)			DRS (Tonnes)		
Other separate collection	15,771	7,026	22,797	1,581	826	2,407
Final Destination						
Recycled	12,617	8,869	21,486	27,241	12,212	39,453
Landfill	1,671	394	2,065	181	69	250
Energy Recovery	13,996	3,304	17,300	1,520	576	2,096
Litter that remains in the natural environment	467	207	674	70	31	101
Recycling Rate, %	43.9%	69.4%	51.7%	94.7%	95.6%	95.0%
Litter Rate, %	1.62%	1.62%	1.62%	0.2%	0.2%	0.2%

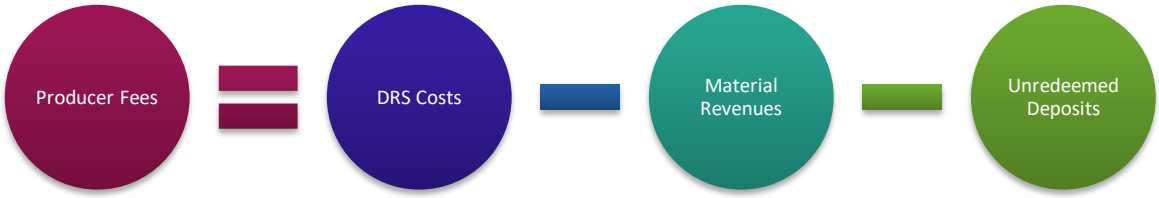
5.1.2 DRS Model

The DRS model is used to calculate the initial set-up costs of the DRS (these are listed in Section 5.3.1.1), which are then annualised over a period of 5 to 9 years, depending on the particular asset. These set-up costs include establishing counting centres, purchasing vehicles for transporting the returned containers and the purchase costs of the RVMs. In terms of the ongoing operational costs, the model calculates the costs of collecting, transporting and counting the returned beverage containers and the central system operator's administrative costs to provide an annual operating cost for the DRS. The material revenues and unredeemed deposits are then factored in to calculate the net costs to be paid by producers. These net costs are divided between the number of containers placed on the market to provide the producer fee, as summarised in Figure 5.

Counting centres are centres that are used to count any containers that are redeemed via manual redemption. When a container is redeemed using an RVM the machine will automatically scan the barcode on the container, but this is not possible via manual redemption. Therefore, manually redeemed containers are first transported to a counting centre, which will contain one or more counting machines, depending on

system set up, in order to scan the barcodes and then compact the containers ready for onward transportation to material reprocessors.

Figure 5: Calculation of the Net Costs to Producers



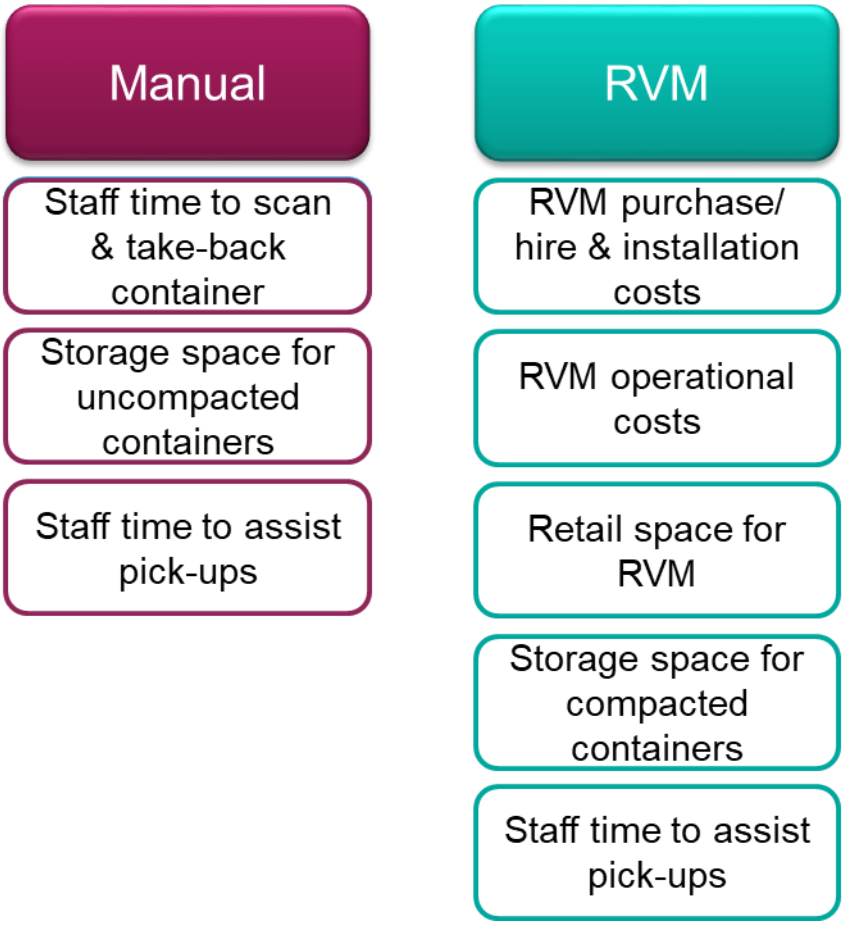
5.1.3 System Costs

This section gives a brief overview of the methodology used to calculate the system costs associated with the set-up and ongoing operation of the DRS. A more in-depth methodology, including detailed assumptions, can be found in Appendix A.4.0.

Retailers' handling fees – included in the annual costs of the DRS – are calculated 'bottom-up' based on the costs incurred to retailers in relation to:

- **space** – based on the average per m^2 rental cost, with assumptions made on the floor space taken up by RVMs and/ or required container storage space;
- **labour** – based on average hourly wages, with assumptions made on the additional labour time required for taking back containers, processing receipts, cleaning machines and emptying bins;
- **RVM/ maintenance costs** – based on annualised costs associated with purchase, installation and ongoing servicing of RVMs; and
- **containment costs** – based on annualised costs associated with the purchase of bins/ bags etc. for storing and transporting the beverage containers, plus the ongoing washing costs.

Figure 5-6: Costs Used to Calculate Retailers' Handling Fees



As indicated in Figure 5-6, the handling fees for retailers with and without an RVM take into account different costs. This system has been designed with two different types of return points - redemption through RVMs, and redemption through manual takeback. The number of each type of return point is calculated by firstly determining the number of participating retailers, then applying assumptions based on previous work and understanding of how other systems operate to obtain a realistic number of retailers that would install RVMs and those that would not. It is assumed that retailers would use only one method and so would not provide both a manual service and RVMs at one location. Assumptions are then made on the number of RVMs installed at participating retailers, based on store size, which determines the overall number of RVMs required and the subsequent cost to the system.

Any containers redeemed via manual redemption will not have been accounted for within the system, i.e. the redemption barcode will not have been scanned, and therefore must first be transported to a counting centre for this function, before being delivered to a re-processor.

The DRS model includes a simple collection model that estimates the costs of transporting containers to the first onward destination. This is done by calculating the total number of vehicle days required per annum to collect containers, using a number of assumptions which are set out in detail in Appendix A.6.4.

5.1.4 System Revenue

After the total costs of the DRS system are calculated, the total system revenue is calculated to arrive at the net system cost. The system receives revenue from the sale of materials and unredeemed deposits. Revenue from materials is calculated based on the total recycled tonnage taken from the waste flows and average cost per tonne figures for each material stream (based on a range provided by the stakeholders). The total revenue from unredeemed deposits is calculated on the basis of an overall 90% return rate for the system and adjustment to account for an assumed 1% loss to the system from deposits paid out in error (fraud).

5.1.5 Impact on Existing Waste Management

This section outlines the factors to be taken into consideration when estimating the impact of the DRS on the existing waste management system, and the principles behind the costed results in Section 5.3.2.

The introduction of a DRS would represent a significant change in how two key material streams are collected in Ireland: PET bottles and aluminium cans. These materials are currently targeted both by civic amenity site collection schemes arranged by municipalities and by kerbside collections systems provided by the commercial sector. Funding is provided to both municipalities and the private sector in the form of subsidies generated through payments made to Repak by its members.

In the existing waste management system, capture rates of the DRS-targeted materials are estimated to be currently 55-65%, while it is possible to capture 90-95% under a DRS, if the right design is chosen and the scheme is well managed. Waste characterisation reports indicate that aluminium cans (not necessarily exclusively beverage cans) account for 1.29% of MDR bins and PET packaging (not only beverage bottles) represents 5% of the MDR bins.[73]

The introduction of a DRS would mean a decrease in beverage containers captured at bring sites and within the existing kerbside recycling collections, as well as a decrease in these materials remaining in residual waste. The reduction in tonnages will affect material revenues and disposal costs and could also lead to reductions in collection vehicle resource requirements (as vehicles will fill less quickly). The MRF processing costs per tonne could also be affected, as discussed in Section 5.1.5.2.

The system will also lead to a significant reduction in beverage container litter. Whether or not litter related financial cost savings are realised depends, in practice, on whether the lower litter volumes can provide a basis for a reduction in litter-picking/street sweeping rounds. As a result, any potential litter clean-up savings are not included in this study, as it is difficult to reliably determine how street-cleaning services will be affected.

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[73] EPA (2018) *Household Waste Characterisation Campaign*. Final Report. November 2018. https://www.epa.ie/pubs/reports/waste/wastecharacterisation/Household_Surveys_Final_Report1.pdf

It is, however, worth noting that local authorities in Ireland spent over €105 million on litter-related services in 2018.[74] As an indication, however, a study by Eunomia for Keep Britain Tidy in the UK found that a DRS could lead to savings for litter and street cleaning services in the order of £0.22 (€0.24) to £0.45 (€0.50) per household per annum (smaller for more rural authorities).[75] There could well, therefore, be savings for Councils in Ireland, although, under the SUP Directive, plastic-related litter costs will be borne by producers.

Producers would no longer pay membership fees to Repak for those beverage containers covered under the DRS. As a result, waste collectors would also no longer receive subsidies from Repak for the collection of these beverage containers.

5.1.5.1 Impact on Collection Costs

At the kerbside and bring sites, boxes and bins will fill up less quickly as deposit containers are returned instead to vendors and reverse vending machines. For the material remaining for waste collectors, it is anticipated that the reduction in volume will be greater than the reduction in mass, since compared with other materials, plastic bottles are less dense and take up a comparatively greater proportion in terms of volume than weight in collections.

At bring sites, the slower fill rate can directly translate into savings as fewer collections per week are needed. Most household kerbside collections, on the other hand, are on a fixed timetable, so potential savings are more limited. In addition, kerbside collectors also experience a loss of revenue from lost sales of material they would otherwise have collected, and from reduced subsidy payments from Repak. This is outlined in Section 5.1.5.2.

However, it is possible that slower fill rates will bring kerbside collectors some savings because vehicles will not need to leave collection rounds as frequently to go and unload their contents. Whether this results in savings in individual circumstances depends on a number of factors:

- the current utilisation and fill-rates of vehicles;
- at what point in the day vehicles are needing to tip;
- how far it takes to return to tip;
- whether there is time for additional collections during the day; and
- the extent to which collections and shift patterns are optimised in the current services.

Savings can mostly be made only in specific circumstances in which vehicles are currently returning to tip because they are full (whether after a 1st or 2nd tip) and then don't have

[74] https://www.dccae.gov.ie/documents/20190501-Local%20Authority%20Street%20Cleaning%20and%20Litter%20Expenditure%202018.pdf
[75] Eunomia (2017) *Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services.* Final Report for KBT. 11th October 2017.

time left in the day to return out to the round. For other rounds constrained more by the number of households that can be reached in a day, overall costs are likely to be unaffected, while less material will be collected per vehicle.

In a study for Keep Britain Tidy (KBT), Eunomia reviewed the impact of a DRS (including glass bottles as well as plastic and metal beverage containers) on collection costs across four case study local authorities with a range of recycling rates and kerbside collection schemes. This study concluded that, overall, local authorities (responsible for collections in the UK) could make some modest savings; however, the precise impacts depend on existing recycling rates and the nature of recycling services provided to households.[76] While the UK has different funding arrangements and does not have a competitive market for household waste collections, the findings from this study – in terms of the impacts on collection costs and revenues – are still relevant.

Unlike in Ireland, glass was included in the proposed UK DRS and is included in some co-mingled collections. Within the KBT study, no kerbside collection cost savings were found for the co-mingled recycling authority, despite glass being included in the proposed DRS (collection savings were more pronounced in areas with kerbside sort schemes or dual collections). This evidence therefore suggests that overall kerbside collection costs for Ireland can be expected to remain unchanged following introduction of a DRS (especially where glass bottles are not deposit bearing).

In Ireland's competitive system, waste collectors only service those households which are customers on their rounds, and therefore can experience operational inefficiencies because it difficult to maximise the number of households visited on any given route. When kerbside material yields drop as a result of the implementation of a DRS, this is likely to compound this inefficiency. In short, vehicles will have to drive further to collect the same quantities of material, and collectors will have limited ability to respond to this inefficiency by increasing the efficiency of their routing.

The impacts of a DRS on residual waste tonnage and volume are less pronounced than they are on dry recycling collections. Therefore, if the proposed DRS has no overall significant impacts on kerbside recycling costs, then it is safe to assume that it will have no overall significant impacts on kerbside residual collection costs.

5.1.5.2 Impact on Processing Costs, Material Revenues and Subsidies

The costs of processing mixed dry recycling are taken from Bacon (2008), which was highlighted by a stakeholder, and estimated at €70 per tonne, which is offset by revenues from the sale of recovered material. The baseline basket price of materials

[76] Eunomia (2017) *Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services.* Final Report for KBT. 11th October 2017.

from Material Recovery Facilities was set at €112.[77] This price changes continually due to price fluctuations in individual material markets.

The introduction of a DRS affects the typical kerbside MDR mix in some key ways:

- reducing the tonnage sent to the existing MRFs;
- changing the bulk density of the material, potentially changing the sorting facility throughput per hour and changing the operating cost per tonne; and
- reducing material revenues and changing the basket value of the output mix due to the loss of aluminium cans and PET plastic bottles from MRF outputs.

The change in tonnage collected at the kerbside was taken from the overall mass flow analysis. The change in bulk density was calculated based on the composition of the MDR bin reported in the 2018 national waste characterisation, together with assumptions on overall and individual material fraction bulk densities. Material revenues for PET bottles and aluminium cans were assumed to be in line with the values used above.

The cost impacts on the existing processing system depend on the following factors:

- how easily MRF operators are able to adapt and re-optimise to changed material volumes and mixes;
- the resulting impact on through-puts per hour of the sorting process; and
- MRF operators' abilities to source additional material to cover resulting spare capacity.

With the majority of PET bottles and aluminium cans removed from the mix, the resulting material is higher in paper and card relative to plastics and metals, and of a higher material density. This may either have beneficial effects on tonnage through-put per hour (if processing speeds are constrained by the volume of material) or negative impacts (for instance if the initial fibres sorting process is operating currently at capacity). Therefore, neutral impacts are assumed, with operators assumed to maintain through-put and/or over time adapt processes to the changed material mix. It is assumed that, given the broader drivers, increasing packaging recycling collection in Ireland (including PAYT), MRFs will still be able to operate with throughputs of overall MDR material equivalent to current levels.

One impact on net system costs comes from the removal of the subsidies from Repak, previously paid by producers of PET beverage bottles based on MRF outputs, and currently helping to cover the costs of collection/sorting. Once the subsidies stop, the collection/sorting system will have to make up the shortfall in funding; and because the only payments going in to the collection/sorting system come from householders and

[77] Bacon & Associates (2008) *Examination of Impact of Recent Price Collapse in Markets for Recyclate Materials and Required Intervention.* Final Report, November 2008.

Repak, once the Repak subsidies stop the replacement funding will have to come from householders through the charges for their kerbside collections.

Finally, it is expected that a proportion of deposit-bearing containers will still be collected in MDR bins. In this case (and providing the containers are still intact), household waste collectors or MRF operators could redeem the deposits on these containers through the DRS system, even if they are not the operator directly involved in collecting the deposit-bearing containers through the official DRS collection points. This would mean that some or much of the lost material revenue and subsidy can be mitigated, as the deposit value per container is greater than the material value and Repak subsidy per tonne combined.

5.1.5.3 Impact – Rural and Urban Areas

No data is available with which to distinguish co-mingled yields from different urban and rural areas in Ireland, either in tonnage or composition. There is also no evidence that in Ireland baseline recycling rates are lower in rural than urban areas or vice versa (though recycling rates tend to be lower in flats than street-level properties with individual waste containment, and this can depress urban recycling rates).

Collection costs per tonne are generally higher in more rural areas as driving times are longer, leading to lower pass rates (i.e. households passed per day) and higher fuel costs. Processing costs at MRFs and material revenues are not relevantly different.

The impacts on rural and urban areas are therefore presented in Table 5-2 with a view to illustrating the potential scale of the cost impacts in both an 'average urban' and 'average rural' area, with illustrative rather than actual baseline costs.

Table 5-2: 'Average' Urban and Rural Areas for Cost Illustration

	Urban	Rural
Population	273,000 (5.7% of total population)	121,000 (2.5% of total population)
MDR Tonnage Collected	14,516	6,415
MRW Tonnage Collected	39,025	17,245

5.1.5.4 Impact on Households

In the absence of any further changes in the subsidies for MDR collections provided by Repak, the change in net costs for the provision of kerbside waste collection services can be expected to be largely passed through to consumers. However, incentivised charging may result in an increase in the material captured in MDR collections (and Repak is aiming to increase the capture of MDR through various initiatives) which would counteract some of the loss of volume from the introduction of a DRS.

5.2 Environmental Impacts

While establishing and running a DRS incurs financial costs, there are also a number of benefits arising from a DRS, not least environmental improvements. In order to provide a more holistic assessment of the DRS, the model calculates the change in greenhouse gas emissions and air quality as a result of the DRS, taking into account the effects of:

- transport (primarily of the returned containers from retailers to counting centres/ processors);
- recycling;
- landfilling; and
- incineration

These impacts are given a monetised value in order to put the societal impacts of the DRS in context. In terms of transport, the return to retail model is designed to enable consumers to return their used containers when they do their shopping, thereby avoiding additional journeys. The modelling assumes that a small percentage of journeys to retailers will be solely for the purpose of redeeming deposits in order to provide a more conservative estimate of the net environmental benefits. Full details on the methodology are provided in Appendix A.7.0.

Additionally, it is important to consider the change in littering of beverage containers. The DRS is likely to generate savings in litter clean-up costs; these are not included in the analysis due to the absence of an objective way to allocate litter clean-up costs and potential savings to beverage containers specifically. Unlike the collection of waste bins, which it can be assumed will require less frequent collections, it is not clear if litter pickers would be needed less frequently or take less time. The potential savings for municipalities have consequently not been calculated.

There is also, however, a value to society in having less litter in neighbourhoods, on beaches and in the seas and oceans. As a result, a disamenity value is calculated for the change in litter, as detailed in Appendix A.7.6.

5.3 Modelling Results

5.3.1 DRS Annual Operating Costs

The results of the DRS cost modelling are shown in Table 5-3 and Figure 5-7. While the annual cost is €67.1 million, 47% of this is covered by unredeemed deposits and 23% by material revenues, meaning the net cost is €20.0 million. These costs incorporate annualised figures for the initial set-up costs (such as counting machines, RVMs and collection vehicles, which are paid for by the system operator). These are discussed in more detail in Section 5.3.1.1.

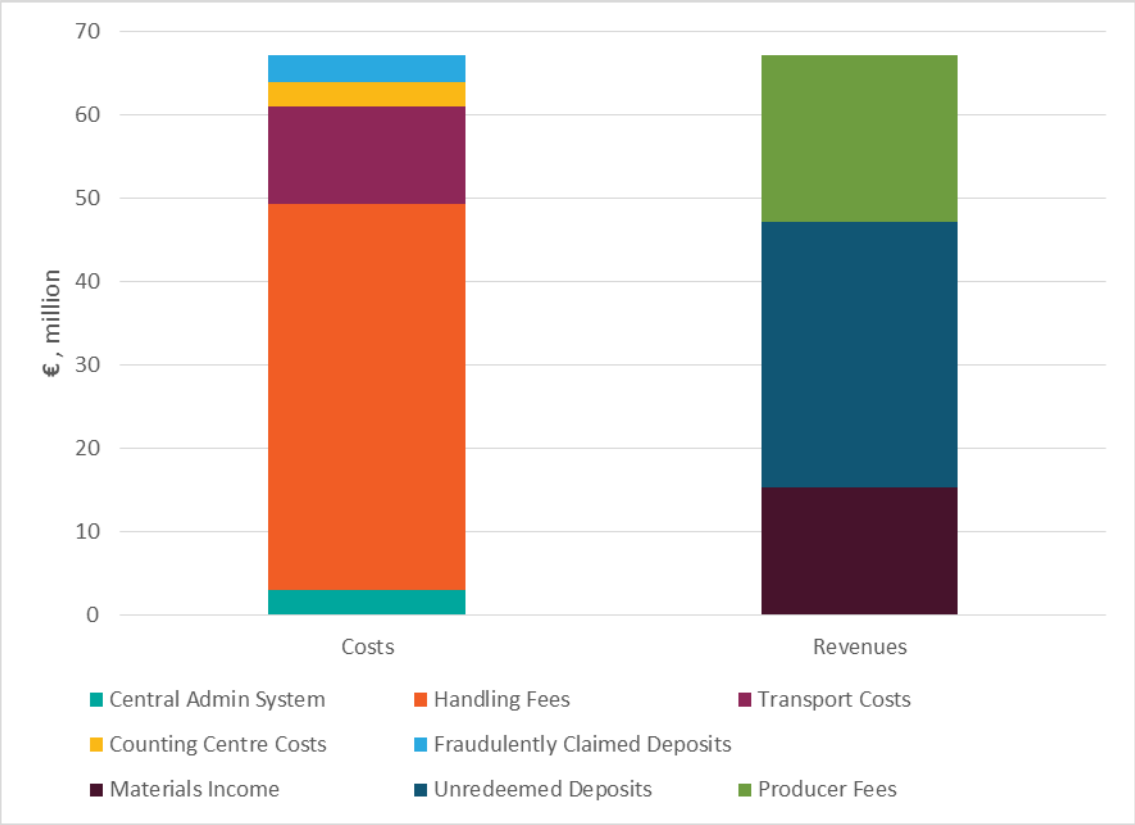
Table 5-3: Annual Costs and Revenues of a DRS for Ireland

Item	Total Cost, € million	Cost/Unit Placed on the Market, ¢
Central Admin System	2.95	0.17
Handling Fees	46.28	2.65
Transport Costs	11.71	0.67
Counting Centre Costs	2.98	0.17
Materials Income	-15.35	-0.88
Unredeemed Deposits	-31.74	-1.82
Fraudulently Claimed Deposits	3.15	0.18
Net Cost	**19.99**	**1.14**
Funded by Producer Admin Fee	**-20.0**	**-1.14**

This means the net cost to producers is €0.011 per container placed on the market. This is an average cost, which would in reality be higher for PET than for aluminium due to the high value of aluminium. As discussed above, the fee could also be varied to incentivise design for recyclability, meaning the fee would be lower for clear PET than for coloured PET.

The DRS modelling has used the same material prices as the modelling for the impact on kerbside collections, so has conservatively assumed that there is no premium for the higher quality material. If a system operator secured higher prices for the PET and aluminium, the net cost to producers would be lower.

Figure 5-7: Breakdown of Annual System Costs and Revenues



5.3.1.1 DRS Set-Up Costs

It is likely that the system operator would take out a low-interest loan – supported by the positive cash-flow created by the time-lag between producers initiating the deposit and consumers redeeming their deposits – to cover the initial infrastructure costs. As the return rate is usually lower in the first couple of years, the value of unredeemed deposits will be higher, providing more revenue with which to pay the loan.

While the set-up costs are not paid in one lump sum, the costs are listed for clarity in Table 5-4. The number of years over which the costs have been spread – i.e. the number of years over which they will be repaid using the unredeemed deposits, material revenues and producer fees – is shown in the final column. The annualised portion of the set-up costs are included in the annual operating costs listed in Table 5-3.

The most significant cost is the €70.79m for RVMs. This analysis has assumed that these costs are borne initially by retailers, using a loan to be repaid with their income from handling fees – so the costs are ultimately covered by the system operator. Alternatively, if the RVMs were leased or paid for on a container through-put basis, the initial capital requirements would be significantly reduced.

The analysis assumes that the remaining €11.13m set-up costs are covered by the system operator's loan, paid back through unredeemed deposits, material revenues and producer fees. These initial capital costs could once again be reduced if the collection vehicles are leased or if back-hauling and existing distribution vehicle are used. The land

and premises for the system operator and counting centres are not included in the set-up costs, as it is assumed that these are leased, so the rents are counted as an annual operating cost.

Table 5-4: Initial Capital Requirements

	No. Units	Capital Cost/Unit	Total Capital Cost	Number of Years to Repay
RVMs				
RVMs - Smaller shops	1,689	€20,000	€33.79m	7
RVMS – Supermarkets	902	€41,000	€37.00m	
RVMs - Total			***€70.79m***	
Collections				
Collection Vehicles	67	€122,500	€8.24	9
Collections - Total			***€8.24***	
Counting Centres				
Counting Machines	5	€185,000	€0.93m	5
Compactor & Baler	5	€230,000	€1.15m	
Installation in Counting Centre	5	€20,000	€0.10m	
Counting Centre - Total			***€2.18m***	
Central System Operator Setup Costs				
IT - capital investment			€400,000	7
Office - furniture and Equipment			€20,000	
Project (setup) management			€100,000	
Communication			€300,000	
Central Set Up Costs - Total			***€820,000***	
Total Initial Capital Requirement			***€82.02m***	

5.3.1.2 Retailer Handling Fee

The majority of the annual system costs (€46.3 million) are to reimburse retailers for the cost of providing a take-back service. As shown in Table 5-5 retailers with an RVM would be paid €0.0316 per container redeemed and retailers providing a manual service would be paid €0.0255 per container they take back to compensate them for the costs they incur.

Table 5-5: Retailer Handling Fees

	Handling Fee per Container Redeemed, ¢
Retailer – RVM	3.16
Retailer – Manual	2.55

5.3.2 Impact on Kerbside Collections

Table 5-6 shows the key cost results per tonne and overall cost impact for each main collection stream as a result of removing the majority of deposit-bearing containers from the existing waste management system.

Table 5-6: Net Impact of DRS on Existing Waste Management

	Net Cost Impact/tonne	Net Cost, Ireland	
MDR – Household Kerbside			
Collections	€8 /tonne	-	Based on a baseline collection cost of €130/tonne (Bacon, 2008), with same collection cost spread over reduced tonnage
Processing	-	-€230,00	This may be up to €4/tonne or 5% of processing costs if MRF operators are unable to adjust processes to maintain tonnage through-puts

	Net Cost Impact/tonne	Net Cost, Ireland	
Material Revenue	€13 /tonne	€4,730,000	Based upon MDR composition and kerbside waste flow assessment – an 11% reduction in baseline basket value of €111
Loss of Subsidy	Approximately €5/tonne overall	€2,100,000	
Total MDR Kerbside Impact	*€21/tonne*	*€4,500,000*	*Equivalent to €3.0/hhld (based on circa 1.2m households)*
MRW – Household Kerbside			
MRW	-	-€1,560,000	No change in collection cost and reduction in disposal cost, equivalent to -€1.3/hhld
Other Material Revenues			
Bring Site Collections	-	€2,800,000	The Repak subsidy and material revenue approximately covers the cost of bring site collections for plastics, so the impact is relatively minor. However, there would be a significant loss of revenue from aluminium cans collected in bring sites – bring sites account for 17% of collected recyclable aluminium.
Commercial/Other Collections	-	€1,400,000	
Other Disposal Costs			

	Net Cost Impact/tonne	Net Cost, Ireland	
Other Disposal Tonnages	-	-€125,000	Other disposal cost reduction not counted in kerbside analysis (i.e. commercial/litter)

The net cost impact across all parts of the waste management service, taking into account collection cost changes, lost material revenue and reduced disposal costs, is estimated at €6.8m, with an additional approximately €2m reduction in subsidy.

The cost impact on household kerbside collections (taking into account collection cost changes, reduced material revenues and reduced disposal costs) is estimated at €2.9m, equivalent to €2.50 per household (less if MRFs are able to adjust processes to maintain tonnage through-puts). With an additional €1.8 per household reduction in subsidy no longer paid on deposit-bearing PET bottles, the net additional cost impact on household waste collection services €4.30/hhld. EPR subsidies are expected to in any case increase when producers are required to pay the full net costs. With an average cost to households of €275 per annum, this would represent an increase of 0.62% - 0.91%, or 1.5% including the loss of subsidy.

Total MDR collection costs are not expected to change significantly overall despite a lower collected tonnage (see Section 5.1.5.1). If MRF operators can adapt processes to maintain the same tonnage or volume throughput, supported by increases in other MDR, a DRS may reduce operating costs more in line with the reduction in tonnage. If MRFs are constrained by the speeds of fibre sorting, then overall processing costs will only reduce slightly overall, and there is significant lost material revenue from aluminium cans in particular. Cost savings come from reduced disposal costs of MRW and of waste from street bins.

A further €3.2 million of material revenue diverted from other parts of the existing waste management system, predominantly from bring-site collections of aluminium.

Table 5-7 shows the impact on an illustrative urban and rural areas, reflecting the typical size of impact. In areas where baseline recycling rates are lower, the lost revenue is lower and the disposal savings higher.

Table 5-7: Impact on Existing Waste Management System by Urban and Rural

Net Cost Impact	Urban	Rural
MDR Collection and Processing	-€10,000-60,000	-€5,000-25,000
Material Value – Lost Revenue	€430,000	€190,000
Residual Disposal	-€90,000	-€40,000
Net Cost Impact	€280,000-330,000	€125,000-145,000

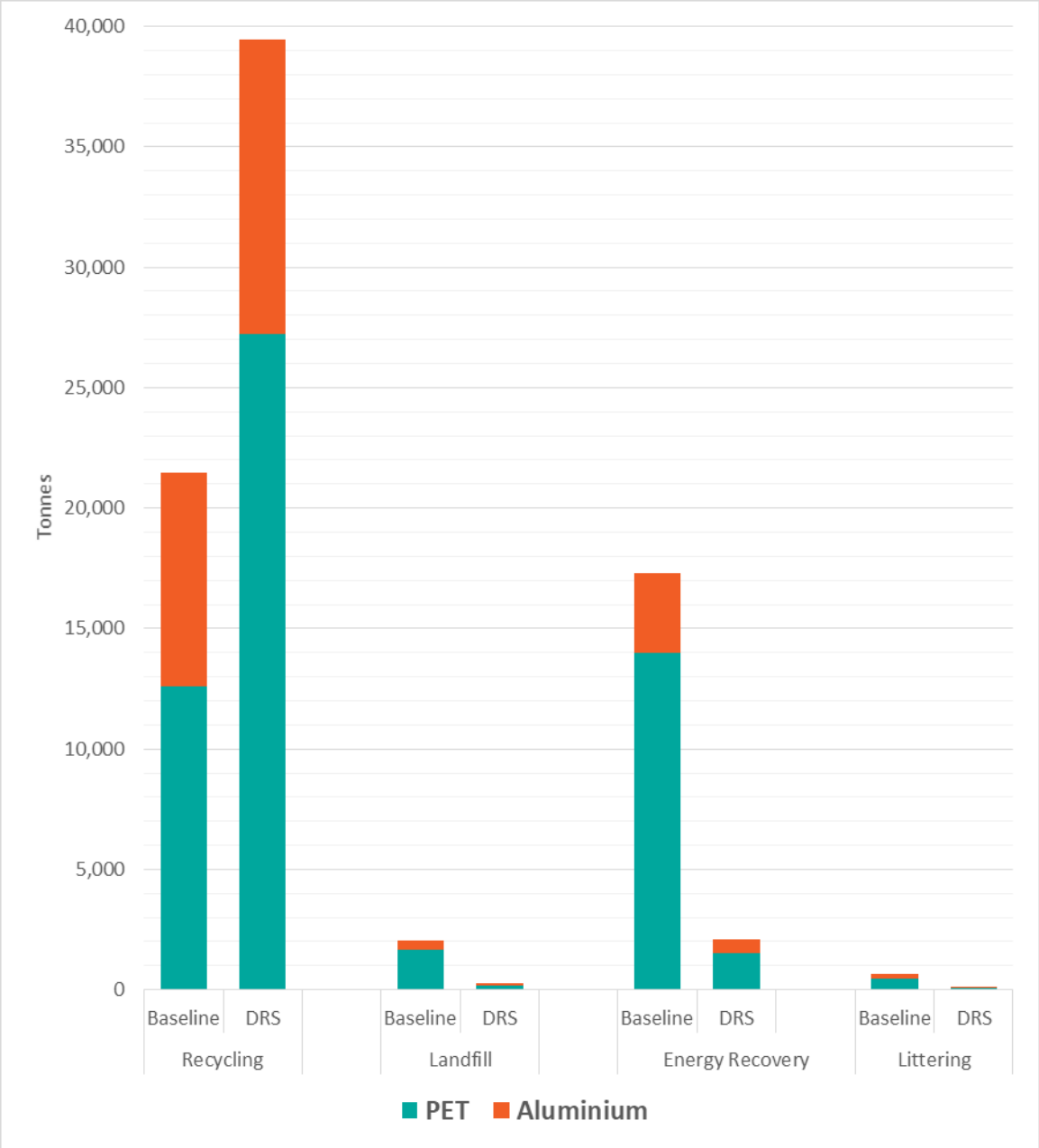
A further breakdown of collection costs impacts for urban and rural case studies is included in the technical appendix.

5.3.3 Environmental Impacts

Figure 5-8 illustrates the estimated final destinations of potentially deposit-bearing containers currently and under a DRS. With a 90% return rate, the tonnage of cans and bottles that is recycled increases by 84%, the amounts sent to landfill and energy recovery reduce by 88% and litter (of deposit-bearing beverage containers) is assumed to reduce by 85%, which is a conservative estimate based on the impact of a DRS in other countries.[78] It should be noted that, with any EPR system that achieves a 90% collection rate, there could be a similar increase in the recycling rate and reduction in landfilling or incineration (although a DRS may reduce loss rates more than potential alternatives and other models would not necessarily have the same impact on litter).

[78] Eunomia (2017*) Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services*, 11th October 2017

Figure 5-8: Projected Change in Final Destinations of Deposit-Bearing Containers



The change in greenhouse gas emissions and other air pollutants as a result of the change in waste treatment have been given monetised values to represent the change in damage costs. As indicated in Table 5-8 the increased recycling and reduced disposal would lead to annual savings in damage costs of €2.7 million from reduced greenhouse gases and other air pollutants.

However, there is also an environmental cost associated with transporting the used beverage containers in a DRS. The net environmental cost impact, therefore, is a reduction in damage costs of €2.4 million.

Table 5-8: Monetised Annual Environmental Impacts

	Greenhouse Gases (€)	Air Pollutants (€)	Total (€)
Recycling	-1,690,000	-560,000	-2,250,000
Disposal	-45,000	-30,000	-480,000
Transport - Collections	310,000	40,000	350,000
Total	-1,830,000	-550,000	**-2,370,000**

In addition to the improved air quality, the DRS is estimated to reduce littering of deposit-bearing containers by 85% (573 tonnes in a year). This is based on research indicating that a DRS can reduce littering of deposit-bearing containers by 95%, but a lower figure has been used in the modelling to be more conservative. Littering not only has a direct environmental impact but is also known to affect personal well-being, businesses and the sense of community, generating what economists call a 'disamenity'. Such disamenity can be expressed in monetary terms in the form of a 'willingness to pay' to reduce such negative impacts. Littering will also arguably affect the perceived attractiveness of tourist areas. Research indicates that this 'willingness to pay' can be valued at €264 per household per year, or €5.07 per week.[79] This is then applied on a national scale (based on the number of households in Ireland) to reach a total litter disamenity value. As not all litter is beverage containers, the whole litter disamenity should not be attributed to deposit-bearing containers. It is therefore assumed that deposit-bearing containers currently account for 35% of litter by volume to arrive at a baseline litter disamenity value. (More details on the evidence and data used to reach this figure are provided in Appendix A.7.6). The current estimated litter disamenity impact associated with PET and aluminium beverage containers, and the litter disamenity under a DRS, are shown in Table 5-9. This analysis indicates that the DRS could be associated with an annual reduction in litter disamenity of €95.8 million.

[79] Based on Wardman et al. (2013) Estimating the Value of a Range of Local Environmental Impacts, Report for Dept. for Environment, Food and Rural Affairs, 1 April 2011, available at http://randd.defra.gov.uk/Document.aspx?Document=9854_LEQFinal.pdf

Table 5-9: Annual Change in Litter Disamenity Resulting from the DRS

	Litter Disamenity (€)
Baseline	112,748,238
DRS	16,912,236
Reduction	-95,836,002

6.0 Conclusions

Ireland needs to introduce measures to:

- achieve the plastic packaging recycling target;
- achieve the separate collection target for single-use PET beverage bottles; and
- to provide more recycled PET to meet the average recycled content target.

The proportion of beverage containers collected at the kerbside, from commercial premises, on-the-go and at events needs to increase, and improvements are also needed to the quality of the material collected.

While many stakeholders suggested that the existing system could achieve a 90% separate collection target, no evidence has been presented to suggest that the current system could be enhanced to reliably achieve a 90% separate collection rate.

Many stakeholders proposed that some form of incentive would be needed and this is exactly what a DRS is intended to provide. As the incentive in a DRS is generated by seeking to obtain a refund of the deposit – and it is well understood that people will work harder to avoid a loss (e.g. of a deposit unredeemed) than to obtain a gain of equivalent monetary value – the financial incentive in a DRS would be expected to be higher than other approaches based solely on the provision of a 'reward'. The DRS also funds the collections infrastructure.

While there was clear support for a DRS from the recycling industry and from environmental campaigners, some stakeholders were more reticent. Many of their reservations, however, could be over-come by a well-designed system. Retailers may be more open to the possibility of a DRS if they know that they will be appropriately compensated through the handling fee payments.

While the average DRS producer fee (€0.01) is higher than the estimated current Repak fee per container (€0.002 and €0.003), EPR fees will need to increase to incorporate the full net costs of collection, transport and treatment (and litter in the case of PET bottles),

so current EPR fees are not representative of future costs. Indeed, Repak estimated that the costs of alternatives to a DRS would be €25 – €35 million, which would be recouped from producers. This cost to producers is 25-75% higher than the estimated annual DRS cost to producers in this study (which was calculated at €20 million). It is also worth noting that the Oireachtas Library estimated the net cost of a DRS to the Exchequer, before producer fees, at €76.1 million – €116 million, or €32.4 million – €72.3 million (with the two estimate ranges depending on the distribution of set-up costs); in this study, the total gross annual costs are estimated to be significantly lower (at €67.1 million) than the first scenario and lower than the higher estimate in the second scenario. In any event, the net costs in this study are lower still, at €20.0 million.[80] Importantly, there is no cost to the Exchequer as the system is funded by producers, as this a form of extended producer responsibility.

In terms of the impact on Ireland's kerbside collection system, revenues from material sales will be lost. The cost to householders, accounting for the lost revenues and Repak subsidies, is estimated to be around €4.30 per household per year, so would add around 1.5% to annual waste collection bills, under the current EPR funding arrangements. If the Repak subsidy is discounted – given that this will need to change under the new minimum requirements for EPR schemes – the lost revenue as a result of the DRS equates to €2.50 per household per year (0.9% of the average annual household charge).

It should also be remembered that, under the Waste Framework Directive and Packaging & Packaging Waste Directive, the costs of packaging waste collections will fall on producers – not householders. Although producers may pass these costs to their customers, it still means that the costs of waste are borne by those creating the waste and not by the public generally.

On the basis of this study, a DRS is a feasible option for Ireland, and indeed the only way in which it can confidently be asserted that a 90% collection rate for plastic beverage bottles can be achieved. While some might argue that a DRS would only manage approximately 4% by weight of Ireland's packaging waste, specific solutions are needed for plastic beverage bottles as a result of the Single Use Plastic Directive and beverage containers are more likely to be consumed on-the-go than some other forms of packaging. Evidence from other countries is that a well-designed DRS is an effective solution for beverage containers and, in these countries, kerbside collections are able to operate effectively alongside the DRS. There is also evidence that the awareness generated by a DRS could encourage householders to recycle more of their waste. In terms of littering behaviour, evidence suggests that a DRS can reduce littering of deposit-bearing containers by 95%. Furthermore, given that beverage containers are a

[80] Oireachtas Library & Research Service (2018) *Cost Estimate: Waste Reduction Bill 2017 and Related Proposals*. 30th April 2018. https://data.oireachtas.ie/ie/oireachtas/libraryResearch/2018/2018-05-14_l-rs-note-cost-estimate-waste-reduction-bill-2017-and-related-proposals_en.pdf

high-volume component of litter, reducing their prevalence, in making an area look less littered, will reduce the rate at which other items are littered.

A DRS is a proven means by which a 90% separate collection rate can be achieved. Other approaches suggested by stakeholders in the course of this study have not been demonstrated in practice. While the Government may wish to undertake further detailed investigations into possible alternatives, a simple way of determining the most cost-effective means of achieving 90% plus return rates would be to introduce a Norway-style beverage container tax, and leave producers to use their expertise to determine how best to achieve it.

APPENDICES

A.1.0 Stakeholder Responses

A.1.1 Views on the Existing System

Eunomia contacted stakeholders selected by DCCAE to collect data for this study and to gain a better understanding of current views regarding the potential of the existing system to achieve a 90% separate collection rate, alternative producer responsibility models and a DRS. The stakeholder responses regarding the potential of the current system are summarised in Table 6-1.

Table 6-1: Summary of Stakeholder Views on the Existing System

Organisation	Potential to Achieve 90% Separate Collection
Convenience Store & Newsagents Association	The target could be achieved under the current system.
Retail Ireland	The current system already collects 90% of plastic beverage bottles; can achieve separate collection with additional investment and collection infrastructure. Recycling in public spaces is a challenge, so could focus on addressing waste in litter bins that is landfilled or incinerated.
Environmental Pillar	The current system could not achieve the target. There are “massive holes” in the collection system for drinks consumed ‘on-the-go’. Nearly 1,000,000 bottles and 50,000 cans are not collected each day. Commercial waste is contaminated, sometimes pre-treated to pull out valuable materials. Street bin infrastructure does not collect bottles or cans separately.
Recycling Industry Representative	The kerbside system cannot reach the separate collection target – it gets closer to 35-55%.

Organisation	Potential to Achieve 90% Separate Collection
Recycling Industry Representative	No. “90% will only be achieved through a DRS”.
National Waste Collection Permit Office	Could collect 90% from domestic and commercial premises. “Ongoing awareness campaigns and enforcement of bye-laws are required to build on existing systems”. Beverage containers consumed in public areas are more challenging.
Irish Waste Management Association	The current system could meet targets “with a lot of effort in the area of education and awareness”. Materials Recovery Facilities and waste collectors already have a financial incentive to maximise PET and aluminium they collect. Increase awareness budgets from €1.3 million currently to €5 million per annum. Install recycling bins on streets and other public areas. Waste collectors could use manual/ automated techniques to check residual waste for recyclables. Repak could provide higher subsidies for waste transfer stations that extract PET/ aluminium from residual waste. Introduce a DRS at major events. Local authorities and waste management companies could sponsor litter clean-ups by local groups and charities.
Repak	The current system collects over 90% of PET bottles, taking into account PET collected in residual waste. Achieving 90% separate collection will require additional investment and collection infrastructure being put in place, with plans to roll out initiatives including: Financial incentives for households and businesses to separate out PET Financial incentives for PET litter collection Increasing on-the-go recycling via DRS-type initiatives (trials currently being carried out in target locations)

Organisation	Potential to Achieve 90% Separate Collection
Irish Beverage Council	Already collecting 90% of all plastic bottles. Segregated collections can be improved, but Repak's investment has improved recycling rates and means they exceed EU targets. Support Repak's Team Green initiative
Waste Planning Offices	Current system could achieve the targets with "considerable effort and some investment". Enhancement of the current segregated collection system through the introduction of additional receptacles at source including additional bins or crates would assist in the achievement of this target. Providing more information to householders has improved waste separation. More facilities for cans could be provided at bring sites and waste separation could be improved at HoReCa establishments (hotels, restaurants, cafes). Provide dedicated recycling bins for beverage containers in schools, hospitals etc. could incentivise institutions through cost savings related to the quality and value of material captured. Consider a mobile DRS at events.
Irish Brewers Association	The current system already achieves 90%. They support the Team Green Initiative.
Other Respondent	Current system for domestic premises could achieve a 90% target with "considerable effort and some investment". Need incentives for the commercial sector. There may be a possibility of adding a DRS to existing bring facilities and mobile units at festivals/ other events.

A.1.2 Views on Alternative Systems to a DRS

In addition to their views about the existing waste collection system and about a potential DRS, stakeholders were asked for their suggestions as to alternative approaches that they thought could achieve a 90% separate collection rate. Their responses are summarised in Table 6-1Table 1-2.

Table 1-2: Summary of Stakeholder Views on Potential Alternative Models

Stakeholder	Alternative Models
Convenience Store & Newsagents Association	A DRS could use existing local authority recycling centre rather than retail channels, as people already visit these to recycle so "it would be a natural extension".
Retail Ireland	Further investment in the current system and on-street recycling bins. Education campaigns.
Environmental Pillar	"We don't believe that there is another system as effective. The DRS model is a tried and tested system".
Recycling Industry Representative	The Fostplus system in Belgium is worth considering, but "a fully functioning DRS would still achieve higher rates".
Recycling Industry Representative	A DRS would be the most cost-effective system. There are other European household collection initiatives, requiring member subscriptions; these achieve good results but are expensive.
National Waste Collection Permit Office	Clubs and charities could be beneficiaries of a DRS (e.g. sports clubs generate large volumes of PET). They could claim deposit refunds for containers they collect or that are donated to them. The waste would still be collected within the existing waste collection system, with funding paid out by Repak or waste operators. Install collection points in clubs, sporting locations or public areas.
Irish Waste Management Association	There may be other models, but this needs further research. All MSW targets should be tackled equally, so an alternative approach that addresses public behaviour in respect of all waste, not just PET bottles and aluminium cans may be preferable. Technology could be used to penalise/ reward householders (One waste company uses an automated camera system to

Stakeholder	Alternative Models
	view materials placed on recycling bins and give warnings to households that contaminate them). Waste collectors could run competitions – inspect bins and give price to best performing customers. Estimate the cost to be €50, 000 per annum.
Repak	Trial financial incentives for householders to separate plastic bottles. Introduce similar incentive for businesses. Waste characterisation study for litter. Target on-the-go areas like colleges, gym, sports clubs – assume 40% take-up. Already have Team Green recycling machines at colleges. Engage 850 Tidy Towns associations and provide financial incentive to collect and recycle litter. Team Green Awareness campaigns. Estimate cost at €25-€35 million, to be recouped from producers.
Irish Beverage Council	Behaviour change campaigns, similar to the Gum Litter Taskforce. Recycling litter bins in public spaces. Belgian blue bag kerbside collections should be examined.
Waste Planning Offices	"Enhancement of existing collection systems and existing infrastructure is definitely a more acceptable alternative to the development of a national DRS system. While DRS or a variation thereof may have a function in driving materials into existing collection systems (e.g. institutional) it should be considered as complimentary, and targeted, to existing arrangements rather than potentially undermining the viability of same." There is an opportunity to look at the impact of introducing prevention projects prior to any DRS. The government could ban the sale of single use plastics in high tourist areas (those

Stakeholder	Alternative Models
	with more than 1 million visitors per year) and ban all SUP under 500 ml in schools.
Irish Brewers Association	Segregated bins in public places. Belgian blue bag system.
Other Respondent	The enhancement of the existing collection systems and existing infrastructure is definitely an alternative than going head first in to a DRS system. Looking at providing further segregated receptacles at bring banks. Sports clubs and event organisers are asking LAs about available systems to segregate at source and pay-back from Repak/ waste collectors. Universities could be incentivised to collect. Repak could extend their recycling machine trials, providing an income generator for student services. Planning offices could only grant licences for events that have plans to separate material – could be a DRS.

A.2.0 Views on DRS Systems

The stakeholders discussed in Section 2.3.2 and 4.3 were also asked whether they would support the introduction of a DRS as a means of collecting 90% of PET and aluminium beverage containers. The responses received are summarised in Table 1-3.

Table 1-3: Summary of Stakeholder Responses

Stakeholder	Comments on the Potential of a DRS in Ireland
Convenience Store & Newsagents Association	It would not be prudent or justified to allocate a mix of public and private funds to only one element of waste products. Concerned about costs for retailers, especially SMEs. Do not support a manual return option and two-tier system with some retailers having RVMs, but small retailers do not have space for an RVM.

Stakeholder	Comments on the Potential of a DRS in Ireland
Retail Ireland	Do not support a DRS. Concerned about increased cost of kerbside collections for households and imports from Northern Ireland affecting the financial viability of any DRS. Concerned about space needed for RVMs, especially when convenience stores account for more than 70% of retailers in Ireland; the administrative, financial and compliance burden on SME retailers; and the impact of risk of litter around shops.
Environmental Pillar	They "fully endorse" a DRS. The system for refillable glass bottles was popular in the 1970s. This could improve the quality of collected material; food-contact containers are generally made of virgin plastic, while companies using rPET use PET from a DRS due to the higher quality. A cleaner stream of rPET is needed to meet the recycled content targets in the SUP Directive.
Recycling Industry Representative	"Strongly support" a DRS. Suggest a 25 cents deposit is needed to provide the necessary incentive.
Recycling Industry Representative	A DRS would increase recovery rates, yields would be "significantly better", and materials would be cleaner with less contamination.
National Waste Collection Permit Office	Removing valuable waste types from the existing waste stream "will likely have negative impacts where such materials currently offset the costs of waste collection." The cost of collecting the waste types and the technology required "is likely to be significant".

Stakeholder	Comments on the Potential of a DRS in Ireland
Irish Waste Management Association	Do not believe a DRS would be successful in Ireland; there is no culture of returning used containers to shops. If people are not motivated to recycle on their doorstep, they will not be motivated to go to a shop. Do not believe that the financial incentive will overcome inconvenience for most people. Concerned that people will remove containers from other households' recycling bins – creating litter and removing valuable material. If householders deliberately leave the containers next to their bins for others to claim the deposit, this could attract vermin. MRF gate fees would increase as a result, which "could make the source segregation system non-viable". Producers may move to cartons and consumers could import drinks from Northern Ireland because they are perceived to be cheaper. A DRS would be expensive and produce little benefit.
Repak	They would support if DCCAE chooses to introduce a DRS on the basis of an environmental impact assessment, cost-benefit analysis and regulatory impact assessment.
Irish Beverage Council	They cannot support an additional scheme that would disrupt the established and successful EPR scheme. Removing cans and bottles from the kerbside scheme will dramatically increase processing costs. Impact of a DRS is unproven, especially where there is an existing EPR scheme. Would need full life cycle assessment and cost benefit analysis of a DRS.

Stakeholder	Comments on the Potential of a DRS in Ireland
Waste Planning Offices	They do not have a specific policy on DRS, but their plans under Policy 22a "support the primacy of kerbside source segregated collection of household and commercial waste as the best method to ensure the quality of waste presented". Regions have developed the My Waste My Impact app – gather credits that can be donated to charity. Regional plans are first focused on prevention. "There are over 120 Civic Amenity Sites nationally and in excess of 1700 bring centres that provide for non-kerbside consumers. This network extends to all corners of the country. The establishment of a DRS with the same reach as existing infrastructure would be a significant undertaking requiring significant investment."
Irish Brewers Association	A full life cycle assessment and cost benefit analysis is needed before disrupting a successful EPR. Removing beverage containers from recycling bins would "dramatically increase processing costs". "It is illogical to jeopardise the recycling system for all plastics to focus on one single polymer type". Ireland has a higher plastic recycling rate than countries with a DRS.
Other Respondent	It is more important to focus on the consequences for the household system. The success of a DRS is very variable.

A.3.0 Summary of Existing DRS Systems

Table 6-4: Summary of Design Features in Selected DRSs

	Norway	Lithuania	Estonia	The Netherlands	Germany	Connecticut
Year introduced	1999	2016	2005	1993	2003	1980
Governance	Established by producers in response to Beverage Container Tax; Tax reduces as collection rates increase above 25%, up to 95%.	Mandated by the Law on Packaging and Packaging Waste. Target increased from 55% in 2016 to 90% in 2020.	Mandated by 2004 Packaging Act – specifies containers and beverages on which a deposit is to be charged and minimum deposit value (€0.03). Exempt from Excise Duty if 85% collection rate is achieved.	Voluntary; some retailers have established their own system. 99.9% of eligible containers are sold with a deposit – if producers do not join the scheme, they pay a very high EPR fee.	Mandated by the Packaging Ordinance; includes scope and minimum deposit value of €0.25.	1978 law requiring deposit to be paid on specified beverage containers and beverages; deposit value and handling fees included in legislation. There is no return rate target.

	Norway	Lithuania	Estonia	The Netherlands	Germany	Connecticut
Organisation	Centralised. Operated by Infinitum (not-for-profit organisation owned by beverage & retail industry).	Centralised. Operated by USAD (not-for-profit organisation owned by beverage & retail industry).	Centralised. Operated by Eesti Pandipakend (not-for-profit organisation owned by beverage & retail industry).	Centralised. Operated by Stichting Retourverpakking Nederland (not-for-profit organisation).	Decentralised. Pfandsystem Gmbh (DPG), owned by producers and retailers, provides the legal and organisational framework to enable producers to fulfil their own responsibilities.	Decentralised. Each producer is responsible for the management of their own containers.
Scope – type of beverage containers	Plastic, metal	Plastic, metal, glass. 0.1-3 litres	Plastic, metal, glass. 0.1-3 litres	PET bottles ≥ 750 ml	Plastic, metal, glass. 0.1-3 litres	Glass, metal, plastic (not HDPE). < 3 litres
Scope – type of beverages	All	Beer, cider, perry, fruit-wine based drinks (unless in glass), soft drinks, waters, juices and nectars	Non-alcoholic beverages; beer; low-ethanol alcoholic beverages; cider; perry	Water; soft drinks	Beer, mixed beer drinks, waters, soft drinks (except fruit juices), mixed alcoholic drinks	Beer, malt, carbonated and non-carbonated soft drinks (excluding juices and still mineral water)
Deposit value	≤ 0.5 litres: NOK 2 (€0.21)	€0.10	€0.10	€0.25	€0.25	$0.05 (€0.06)

	Norway	Lithuania	Estonia	The Netherlands	Germany	Connecticut
	> 0.5 litres: NOK 3 (€0.62)					
Return Infrastructure	Return to retail. 12,000 collection points, 3,700 RVMs.	Return to retail. 2,700 collection points, 1,100 RVMs. Shops ≤ 60m^2 can opt out.	Return to retail. 850 retailers, 670 RVMs. Opt-out for retailers < 200 m² (or 20m^2 in densely populated areas); there must be at least one return location in the local authority area for population densities of less than 500 per square kilometre.	Return to retail (except Lidl and Aldi, which run their own system). Some retailers have RVMs.	Return to retail. Shops < 200 m² are only required to take back the brands they sell.	Retailers take back containers that are the same kind, size and brand as they sell. Opt-out if they sponsor a redemption centre or there is a centre within a mile radius that accepts the type of container they sell.

	Norway	Lithuania	Estonia	The Netherlands	Germany	Connecticut
Handling Fees	Calculated according to retailers' staff, space and RVM costs and to incentivise compacting RVMs for a more efficient operation. Compacting RVM: 20 øre (€0.02) per can and 25 øre (€0.03) per plastic bottle. Manual/ non-compacting RVM: 5 øre (€0.005) per can and 10 øre (€0.010) per plastic bottle.	Compensation negotiated with retailers. System operator provides RVMs. Compacting RVM: €0.0144 per can or plastic bottle; €0.0303 for glass. Manual/ non-compacting RVM: €0.0146 per plastic bottle; €0.0126 per can; €0.0175 for glass.	Calculated according to retailers, staff, space and RVM costs and to incentivise RVMs for a more efficient operation. Compacting RVM: €0.0331 per can or plastic bottle. Non-compacting RVM: €0.0215 per can or plastic bottle and €0.0250 for glass. Manual: €0.0115 per can or plastic bottle and €0.0130 for glass.	N/A	None. See Material revenues.	Fixed in legislation since 1986. $0.015 for beer bottles (€0.017). $0.02 for containers of other beverages (€0.022).
Recipients of Unredeemed Deposits	Infinitum	USAD	Eesti Pandipakend	Producers	Producers	State General Fund

	Norway	Lithuania	Estonia	The Netherlands	Germany	Connecticut
Recipients of Material Revenues	Infinitum	USAD	Eesti Pandipakend	Producers	Retailers	Producers
Funding	Unredeemed deposits; material revenues; producer fees (modulated to promote eco-design).	Unredeemed deposits; material revenues; producer fees (differentiated by container material).	Unredeemed deposits; material revenues; producer fees (differentiated by container size and material).	Producers pay a fee to Retourverpakking per container returned.	Producers	Producers pay direct costs of their containers, including transport and handling fees.
Labelling & fraud prevention	Deposit logo & barcodes. Producer fees recognise choice of national/ international barcode.	Deposit logo and barcodes (national or international).	Deposit logo and barcodes, with producer fee incentivising national barcode.	Deposit logo and barcodes.	National barcodes and DPG logo with security ink.	Minimal. Containers display the deposit value in each state and do not differentiate between different States.
Latest return rate (& year)	87.3% - 88.6% returned to RVMs (2018).	92% (2017)	83% (2017)	Estimated: 95%. Stichting Retourverpakking Nederland does not have access to sales data.	98% (2015)	50% (2018)

	Norway	Lithuania	Estonia	The Netherlands	Germany	Connecticut

Sources: ***https://eestipandipakend.ee/en/packaging-company/;***
https://www.retourverpakking.nl/nl/werkwijze.html;
https://dpg-pfandsystem.de/index.php/en/compulsory-deposit-for-one-way-drinks-packaging/affected-drinks-and-beverages.html;
http://www.bottlebill.org/index.php; https://www.retourverpakking.nl/;
https://www.ct.gov/deep/Lib/deep/reduce_reuse_recycle/bottles/bottle_bill_data_-_thru_Q1_2019.pdf;
https://www.riigiteataja.ee/en/compare_original/524102014004;
https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.150891/NREPaHFPBR;
Balcers, Brizga, Moora, Raal (2019) Deposit Return Systems for Beverage Containers in the Baltic States;
Eunomia (2010) Have We Got the Bottle? Implementing a Deposit Refund System in the UK. Report for the Campaign to Protect Rural England. September 2010.
Reloop & CM Consulting (2018) Deposit Systems for One-Way Beverage Containers: Global Overview;
Infinitum (2018) 2017 Annual Report.
Private communication from Raymond Gianotten, Managing Director, Stichting Retourverpakking Nederland

A.4.0 Material Mass Flows

A.4.1 Overview

Eunomia has modelled the impact of introducing a Deposit Return System (DRS) in Ireland as a method of increasing the collection rate of single use plastic beverage bottles.

Before conducting the modelling, a number of stakeholders were consulted to identify existing relevant data sources. Wherever possible, data published by local and national authorities was used, with data from industry, or consultant reports used where necessary. As many assumptions can change over time, the model presents costs and revenue over a one-year period.

The first step in a cost benefit analysis of a DRS was to consider the current material flows in the region; specifically, how many beverages are sold, and how the empty containers are currently managed through the waste stream once the beverage has been consumed.

A.4.2 Beverage Container Sales / Waste Arisings

The scope of this analysis focussed on most drinks (except milk, dairy, wines and spirits) and included PET bottles and aluminium cans. Only single-use (non-refillable) containers were included as refillable containers would need a separate return system. It is proposed that a deposit applies to any sealed PET bottle or aluminium can containing the following beverage categories:

- Soft drinks – carbonates, energy drinks, flavoured water, juice, nectars, packaged water, sports drinks and still drinks.
- Beer
- Cider

The estimates for total PET and aluminium beverage container sales were taken from figures provided by a range of stakeholders. There was considerable variation in the estimates and the data was provided in a mixture of tonnages and number of units. Where applicable, unit weight assumptions (specified by packaging material and container size) were applied to convert numbers of units to packaging weights. A summary of average weights based on these assumptions is shown in Table 1-5.

Table 1-5: Average Weight per Container Type, g

Material	Average weight (g)
PET bottle	30.0g
Aluminium can	16.2g

Source: Repak

Based on these unit weights, the total number and estimated weight of beverage containers sold in Ireland are presented in Table 1-6. These are necessarily estimates, and the range of estimates received indicates that further research would be needed, should the idea of a DRS be pursued further. The values used in the analysis are from the higher end of the range so as to avoid underestimating the impact of any DRS on kerbside collections.

Table 1-6: Total Beverage Container Sales in Ireland on which a Deposit Would be Applied (2018)

	Number of units, million	Total weight, tonnes
PET bottles	959	28,751
Aluminium cans	790	12,774
Total	**1,748**	**41,525**

Source: Estimates based on a number of reports from industry representatives who wish to remain anonymous

A.4.3 Final DRS Material Destinations

The final destinations of DRS material were estimated based on the best available data. The process for estimating first the current (baseline) mass flows and then the assumptions made for material flows after the implementation of a DRS system are explained below.

A.4.3.1 Baseline Material Flows

The baseline material flows were based on estimates of the recycling rate of each material, the amount littered, and the remainder sent to residual disposal.

Recycling rates for PET were based on tonnages provided by Repak showing the proportions funded by Repak, recycled and recovered. The total tonnage funded as recycling was 16,569 tonnes out of a total 28,751 tonnes funded by Repak, which results

in a rate of 55%. A loss rate in re-processing of 20%, as per data provided by other stakeholders, was then applied to result in a final recycling rate of 44%.

The recycling rate for aluminium was based on data provided by Repak, as shown in Table 1-7. From this it is evident that the percentage collected through separate collections is 55% (kerbside recycling plus bottle banks), and a further 18% is recovered from the residual waste stream (through incinerator bottom ash). After applying these collection rates to the total tonnage generated, a loss rate of 6.5% for aluminium was applied to account for contamination within material sent to reprocessors, slightly lower than the value (8.2%) reported within the waste characterisation study. This resulted in a recycling rate of 69.4%.

Table 1-7: Aluminium Collection Rates

	Aluminium Beverage Cans
Collection rate %	73%
% collected through kerbside recycling	38%
% collected in kerbside residual waste	18%
% collected through bottle banks	17%

The proportion of litter was determined using data published by the Environment Protection Agency (EPA) relating to packaging waste. A total of 1.62% of all generated packaging waste is classed as “unmanaged”, or in other words, littered. As there is no better data available relating to the weight or volume of litter (as the National Litter Survey reports on percentages and the number of units), this rate was used to determine the total beverage packaging container waste assumed to be littered, resulting in a total of 674 tonnes.

The remaining waste was assumed to be sent to residual waste disposal, except for the fraction recovered in the aluminium stream as detailed above. Figures from Repak were used to determine the proportion sent to energy recovery for plastics, and figures from the EPA were used for aluminium, as shown in Table 1-8.

Table 1-8: Residual Waste Treatment Destinations

	PET	Aluminium
Energy Recovery	89.34%	37.65%
Landfill	10.66%	62.35%

Based on these inputs and assumptions, the final material flows used in the analysis are presented in Section A.4.3.3.

A.4.3.2 DRS Material Flows

The objective of a DRS is to get consumers to return their containers for recycling. Return rates above 90% in other countries with a DRS are not uncommon. In particular, higher return rates are associated with a higher deposit level.

The deposit rate is set at €0.20 in the model, with a return rate of 90% assumed. Material-specific return rates were varied based on % differences from the overall rate reported for the Norwegian DRS and adjusted for the different relative amounts of each beverage container material in Ireland (Table 1-9).[81]

Table 1-9: Scenario Assumptions for DRS Return Rate

	PET	Aluminium
Return Rate	90.8%	89.1%

Of the 10% of material not collected via the DRS, it was assumed that, after accounting for litter, similar proportions of material are sent to residual disposal and recycling as modelled for the baseline.

An 85% reduction in litter of deposit-bearing containers was also assumed following implementation of the DRS. This is a conservative estimate based on a comparative review of the effect of DRSs on littering behaviour.[82]

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[81] Infinitum (2016) *Annual Report 2016*

[82] Eunomia (2017*) Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services*, 11th October 2017

A.4.3.3 Summary of Material Flows

The overall baseline and DRS material flows used in modelling are presented in Table 1-10 and Table 1-11.

Table 1-10: Baseline Material Flows, Tonnes

	PET	Aluminium	Total
Total Waste Generated	28,751	12,774	41,525
Collected through DRS	-	-	-
Residual Waste	15,667	3,698	19,365
Recycling	12,617	8,869	21,486
Litter	467	207	674
Recycling Rate, %	43.9%	69.4%	51.7%
Litter Rate, %	1.62%	1.62%	1.62%

Table 1-11: DRS Material Flows, Tonnes

	PET	Aluminium	Total
Total Waste Generated	28,751	12,774	41,525
Collected through DRS	26,106	11,380	37,486
Residual Disposal	1,701	645	2,346
Recycling	27,241	12,212	39,453

	PET	Aluminium	Total
Litter	70	31	101
Recycling Rate, %	94.7%	95.6%	95.0%
Litter Rate, %	0.2%	0.2%	0.2%

A.5.0 Modelled Impacts on the Existing Waste Management System

This appendix contains further information on the tonnage and cost changes behind the modelled results. Two variations of the DRS scenario are displayed, one in which the tonnage per hour throughput (tph) of the MRF is assumed to decrease, and one in which processes are adapted to maintain tph as in the baseline.

A.5.1 Kerbside Impacts

The changed tonnage and composition of collected MDR (mixed dry recycling), as a result of the DRS, was estimated by:

- taking the composition of household MDR collections from the 2018 household waste characterisation study, adjusted to remove glass to create a composition more representative of the typical collection mix (glass is only rarely targeted in the MDR collection);
- applying reduction factors for PET bottles and aluminium cans, taken from the waste flow modelling, set out in Table 1-12 below; and,
- calculating the resulting overall percentage reduction in tonnage.

Table 1-12: Baseline and Adjusted Composition

	Baseline Composition (adjusted for glass)	Reduction due to DRS	Adjusted Composition
PET	5.12%	88%	0.66%
AL	1.33%	83%	0.24%

All	100%	6%	-

The change in basket price was then calculated for the adjusted compositional mix, with:

- The baseline basket value set at an illustrative value of €111/tonne, in line with Bacon (2008); and
- Material values of €145/tonne for clear PET, €39/tonne for coloured PET, and €1,107/tonne for aluminium cans, sourced from stakeholder responses.

Basket values fluctuate significantly over time based on the price fluctuations in each material and the average basket value will have changed between 2011 and 2018. However, the net material revenue impact of a DRS is determined specifically by the loss of material revenues for aluminium and PET, and these values were updated based on stakeholder responses and correspond to recent prices.

Where overall costs were not modelled to change (for instance, collection and MRF processing costs for the tph reduction scenario), the change in costs per tonne are inversely proportional to the change in tonnage (the tonnage decreases by 6%, so the costs per tonne increase by 6%).

To calculate overall cost impacts on MDR collections in Ireland, the cost per tonne impacts were applied to the whole of the collected MDR tonnage (again as reported in the 2018 waste characterisation).

To illustrate impact on typical urban and rural areas, the change in costs per tonne were applied to portions of overall MDR tonnage collected in typical urban and rural areas according to the average population share detailed in Table 5-2.

The subsidy per tonne was estimated for the PET portion of the MDR mix only, based on stakeholder responses.

Table 1-13: Tonnage and Per Tonne Costs Modelled

	Baseline	**With DRS**		
	Baseline	**MRF tph constant**	**MRF tph reduction**	**Change**
Tonnes MDR Kerbside Collection	253,328	237,964	237,964	15,364
Kerbside Collection Cost (€/tonne)	130	138	138	8
MRF Processing Cost (€/tonne)	70	70	74	4

Sale of materials (€/tonne)	-111	-98	-98	13
Net Cost (€/tonne)	**-41**	**-28**	**-25**	**16**
PET subsidy (€/tonne)	-8	0	0	8
Net Cost incl. subsidy (€/tonne)	**-49**	**-28**	**-25**	**25**

A.5.2 Other Material Revenue Impacts

The total change in material revenue (the amount collected for recycling regardless of the source of collections) follows from the overall mass flows, with material values as above.

The total change in residual waste treatment and disposal costs was similarly based upon the overall decrease in PET and aluminium arising in any residual waste stream.

A.6.0 DRS System Return Network

A.6.1 Return Points

In the system modelled, containers can be returned to participating retailers to obtain a deposit refund, either through a compacting Reverse Vending Machine (RVM) or through manual redemption. A handling fee is included in the DRS to compensate the retail industry for the additional cost of handling returned beverage containers. The number of units and tonnage of material that will flow through each redemption route are set out in Table 1-14. It should be noted that, over time, the proportion of containers returned to RVMs is expected to increase, while the proportion of manual returns decreases.

Table 1-14: Volume of Material through each Redemption Route

Redemption Method	Description	Number of locations	Percent of Redemption Volume	Rationale
Retail stores, manual	Any dealer that sells a deposit-initiated beverage must also accept empty containers and return the deposit to the customer.	13,809	29.99%	Approximately 95% of independent, plus 75% of petrol stations and convenience stores that will have enough throughput to require collection are assumed to not have enough volume for an RVM.
Retail stores, RVMs	Most larger retail stores have installed RVMs to automate the process of redeeming containers.	1,915	70.01%	Most supermarkets, 25% of convenience stores and petrol stations, and 5% of independent grocers are assumed to have enough throughput to install RVMs.

A.6.2 Retail Landscape and System Design

The types and total number of retail outlets modelled in Ireland which could participate in the DRS system are shown in

Table 1-15. These figures were based on data provided by stakeholders relating to chain stores and their respective size bandings.[83]

Table 1-15: Number of Retailers

Type of Retailer	Number of Retailers
Discount Retailers & Supermarkets	1,128

[83] Data provided by the Convenience Store and Newsagents Association

Type of Retailer	Number of Retailers
Convenience Stores	2,683
Petrol Stations	285
Independent Grocers	900
HORECA (Hotels, Restaurants, Cafes)	10,728

The next assumption to consider was which retailers in the scheme would have RVMs and the average number of RVMs per retailer. These assumptions were based on discussions with and estimates provided by RVM suppliers, and are presented in Table 1-16. Overall this results in a projection of 2,592 RVMs in total for the system.

Table 1-16: RVM Assumptions

Type of Retailer	% in the DRS Scheme	% Using RVM vs Manual	Number of RVMs per Redemption Point	% Compacting
Discount Retailers & Supermarkets	100%	100%	1.6	100%
Convenience Stores	100%	25%	1.0	100%
Petrol Stations	100%	25%	1.0	100%
Independent Grocers	100%	5%	1.0	100%
HORECA	100%	0%	0.0	-

A.6.3 Retailer Costs and Handling Fee

In many DRS systems, the costs of handling containers at retail outlets are initially borne by the retailers themselves, but they are reimbursed by handling fees, which reflect all retailers' average costs. For this system, the handling fee was calculated using a 'bottom-up' methodology, which enables retailers to be fully reimbursed for their costs.

In determining the handling fee, the key considerations centre on the collection of returned beverage containers e.g. where the containers are returned to, and how they are transferred back to the retailer during the redemption of the deposit. Both these aspects clearly affect the nature of the collection logistics required. It is therefore important to understand the retail landscape, prior to determining the system specification. This is described in Section A.6.2, along with the outline design of the container take back and collection system.

The retailer cost overview on a cost per container basis is shown below in Table 1-17. The assumptions behind these costs are detailed in Sections A.6.3.1 to A.6.3.4. It is worth noting that although the costs to the retailer for an RVM are higher than manual redemption (meaning handling fees are consequently higher), RVMs reduce other costs in the system, most significantly transport costs through the compaction of material. Overall a system operating with RVMs tends to be less expensive than a system with manual redemption.

Table 1-17: Retailer Cost Overview per Container

Retailer	RVM, ¢	Manual, ¢
Space Costs	0.59	0.88
Labour Costs	0.40	1.60
RVM and Maintenance Costs	2.10	0.00
Containment Costs	0.07	0.07
Total	**3.16**	**2.55**

A.6.3.1 Space Costs

Retailers provide storage space for the returned containers and, if used, space for the RVMs. This is a cost to the retail industry, and as such should be compensated for by the central system.

The costs for retailers who install RVMs are based on the actual cost to lease the floor space in the sales area. All retailers require storage space at the back of the store for redeemed containers waiting for collection. It was assumed that each cubic meter of material will on average require 2m^2 of storage space. A rental value of €31.69 per

square metre per month was used for retail cost calculations, which was calculated using average retails rents in neighbourhood areas in Dublin, where retail rents are considerably higher, and the rest of Ireland, weighted by population.[84]

Table 1-18: Space Requirement and Costs

	RVM Redemption	Manual Redemption
RVM floor space, m^2	4.0	-
Storage floor space, m^2	1.0	1.0
Total number of RVMs	2,592	-
Total number of retailers	1,915	13,809
Total floor space required, m^2	17,174	10,951
Total cost, €m	**6.53**	**4.16**

A.6.3.2 Labour Costs

The additional handling and collection of containers from retailers demands labour time, and therefore additional costs are incurred. The two main activities requiring additional labour are:

1) Take back of containers from customers, paying the deposit and placing in storage locations; and
2) Facilitating pickup of containers from the contracted logistics company.

The calculation of these cost elements is described below.

Labour Costs for Customer Take Back via RVMs

Labour costs for retailers with RVMs were based upon the following assumptions:

[84] It was assumed that most retailers that would be selling beverage containers would be located in neighbourhood shopping centres, secondary city centre streets and retail warehouses, compared to prime retail spaces in city centres, and so an average price was calculated on this basis using data taken from https://www.scsi.ie/insight/annual_commercial_property_review_2018.

- each customer returns 15 containers in one go to RVMs at retailers;
- RVMs have on average a storage capacity of 1,000 plastic and 5,000 metal containers;
- the time taken to empty the RVM when it is full and store the containers at the back of the store is 5 minutes;
- the time taken to clean each RVM per day is 12 minutes; and
- RVM receipts are processed alongside retail purchases and it is assumed this adds three seconds to the transaction.

Labour Costs for Manual Customer Take Back

For retailers with manual takeback, the labour costs for redemption are associated with the additional time to collect the containers from the customer, pay the deposit, and place the containers in the designated storage area. It was assumed that customers will return an average of 10 containers per visit, and that the time taken for the store attendant to accept these containers and store them is estimated at 48 seconds.[85] Labour costs assume that staff are unskilled and paid an hourly rate of €11.50 per hour, which includes employer costs.

Transport Labour Costs for Container Collection

These labour costs are for the time spent by retailers in setting out containers for collection. It was assumed that pickups from larger retailers take 20 minutes and smaller stores take 5 minutes. Estimates for the number of pickups required per week for each of the main retail categories were also made.

Table 1-19: Labour Hours Required at Retail Stores

Labour	Total Time (hours per annum)
Emptying Bins	95,787
Cleaning Machines	162,247
Processing RVM Receipts	61,235
Manual Takeback	629,423
Total	**948,691**
Cost/Container Redeemed - RVM (¢)	0.33

[85] Previous communication with an RVM supplier

Labour	Total Time (hours per annum)
Cost/Container Redeemed – Manual Takeback (¢)	1.53

A.6.3.3 Reverse Vending Machine Costs

RVM costs were modelled using a 'bottom up' approach which builds up the total RVM costs within the system based on the actual number of RVMs required and the associated annualised capital costs, installation fees, service costs and so on. It was assumed that all RVMs are compacting and a total cost to the retailer of €0.03 per container for the RVM based on average prices.[86]

Table 1-20: RVM Summary Table

	Value
RVM Capital Cost/Container *	2.7¢
Containers Through Retail RVMs	1,102m
Average RVM throughput/Month	35,440
Total Cost per RVM per annum	€11,317
***Only capital and service costs – labour costs are calculated separately above.**	

A.6.3.4 Containment Costs

The costs of the containment systems for the transportation of beverage containers were also modelled. It was assumed that:

- Containers collected in RVMs are compacted; and
- All plastic and cans, compacted and uncompacted, are transported in plastic bags.

The number of bags required per year was estimated from the total number of containers requiring collection and the number of containers that can be transported in each bag. Each bag was assumed to take approximately 150 PET bottles or 200 cans.[87]

[86] Previous communication with an RVM supplier
[87] TOMRA (2001), Zentrale Organization Einweg Pfand Deutschland: Business Model Development Guide

For compacted containers, each bag was assumed to take a greater number of containers based on the difference in bulk densities between compacted and uncompacted containers. The cost of a manual bag was modelled at €0.25 per use, with some being suitable for reuse, and the cost of an RVM bag was modelled at €2.20. 3.24 million bags (3,097m manual bags and 144m RVM bags) in total are needed per annum, which would cost €1.09m.

A.6.4 Collection Costs

This section sets out the transport assumptions for containers that are collected from retailers. The analysis estimated the costs of transport from retailers to the first onward destination, whether this is a counting centre for manually redeemed containers or if containers are transported directly to material processors.

It was assumed that all material redeemed via RVMs is compacted, and that all manually redeemed material is not. Non-compacted cans and plastic bottles are assumed to be contained in bags. Two separate rounds were modelled: a large shop round with an HGV collecting large quantities from fewer shops; and a small shop round with a 12-tonne collection vehicle collecting smaller quantities from a larger number of shops.

A simple collection model was developed to estimate the number of vehicle days required per annum to collect the containers, and the cost of operation per vehicle. The key assumptions are listed below:

- Bulk densities of the containers:[88]
  - Plastic bottles – 36 kg/m^3 compacted and 15 kg/m^3 un-compacted; and
  - Cans – 80 kg/m^3 compacted and 13 kg/m^3 un-compacted.
- Vehicles will be filled to no greater than 90% of capacity (90% of 86m^3 for large round vehicles and 39m^3 for small round vehicles);[89]
- Drivers work an 8-hour day and 5-day week;
- Retailers are located an average drive time of 30 minutes from the vehicle depot and it takes 15 minutes to travel between pick up points;
- It takes an average of 14 minutes to pick up containers from a retailer;
- The vehicle costs are calculated based on the following assumptions:
  - €122.5k capital costs for collection vehicles, with a 9-year depreciation period;
  - Drivers earn €15.00 per hour;
  - 0.20 litres/km fuel consumption for large shop vehicles (HGVs) and 0.25 litres/km fuel consumption for small shop vehicles (12 tonne);
  - A fuel price of €1.40 per litre of diesel.

[88] Previous communication with RVM supplier
[89] Cerasis (2015) *Trailer Guide – Standard Freight Trailer*, http://cerasis.com/wp-content/uploads/2015/08/2015TrailerGuide.pdf

The total number of pickups per week for each type of retailer is another key assumption for the modelling. It is understood that, in a standard system, collection vehicles will usually collect from eight retail stores during an 8-hour shift. This information was used to guide the pickup assumptions, as was the typical number of containers redeemed per week at each store type. The number of pickups per week, based on these assumptions, are shown in Table 1-21.

Table 1-21: Pickups per Week for Participating Retailers

Type of Retailer	Number of Pickups per Week
Discount Retailers & Supermarkets	1.50
Convenience Stores	1.24
Petrol Stations	1.09
Independent Grocers	1.05
HORECA	0.25

A.6.5 Counting Centres

Any containers redeemed via manual redemption will not have been accounted for within the system, i.e. the redemption barcode will not have been scanned, and therefore must first be transported to a counting centre for this function, before being delivered to a re-processor. The number of counting centres required will depend on geographical factors and total container throughput. More centres will reduce the financial and environmental impacts of transportation, but will also require more capital investment. The model calculates the centres required based on a throughput of 111.8m containers per counting machine per annum. A total of 472m containers is estimated to be collected manually, which would require 5 machines.

The costs of the system operations are offset by material revenues. The cost of unloading and preparation for offtake of collected material is estimated at €70 per tonne[90], which will impact on the overall revenues received. Revenues are shown in Table 1-22.

[90] Previous communication with RVM supplier

Table 1-22: Material Revenues

Material	Revenue per tonne (€)	Total Revenue per annum, €M
PET Bottles	145	3.79
Aluminium Cans	1,016	11.56

A.6.6 Unredeemed Deposits

With a modelled 90% return rate, a total of 174 million beverage containers will not be redeemed which will generate €31.7 million of revenue when system losses are accounted for. System losses are deposits paid out in error due to fraud. The model assumes that around 1% of all deposit refunds is attributed to fraud, which equates to €3.1 million.

A.6.7 Central System Operator Administrative Costs

Administrative functions associated with maintaining the IT systems to support tracking and processing deposit flows around the system would be handled by a Central System Operator. High-level costs for these functions were estimated based on experience of costs of similar central operations in Europe and Oregon, USA, and estimates from industry operators. Assumed annual costs are shown below in Table 1-23.

Table 1-23: Central System Operator Annual Costs

	Cost, €M
Annualised Set Up Costs	0.14
Staff Costs	0.56
Office Space Costs	0.07
Administration & Marketing Costs	2.20
Total	**2.97**

Included within the costs in the table above are staff, legal and capital costs associated with:

- set-up of the central system operator including the establishment of the organisation, developing the clearinghouse model, and procuring financing;
- constructing the system, including building the container database, clearinghouse and billing systems;
- procuring logistics and transport providers;
- stakeholder communication, enrolment and wider public advertising;
- staff recruitment;
- database population; and
- legal and consultancy fees.

A.6.8 Producer Admin Fees & Handling Fees

Table 1-24 shows a breakdown of the net system costs and total producer admin fees by total cost and cost per unit placed on the market.

Table 1-24: Breakdown of Producer Admin Fee by Net System Costs

Item	Total Cost, € million	Cost/Unit Placed on the Market, ¢
Future System Operator Costs		
Central Admin System	2.95	0.17
Handling Fees	46.28	2.65
Transport Costs	11.71	0.67
Counting Centre Costs	2.98	0.17
Materials Income	-15.35	-0.88
Unredeemed Deposits	-31.74	-1.82
Fraudulently Claimed Deposits	3.15	0.18

Net Cost	**19.99**	**1.14**
Funded by Producer Admin Fee	**-20.0**	**-1.14**

Table 1-25 shows how the total system costs and costs per unit and kg redeemed are split across redemption methods.

Table 1-25: Breakdown of Handling Fees by Redemption Method

	Total Cost, €million	Cost/Unit Redeemed, ¢
Handling Fees - Reimbursing Retailers (RVMs, Labour and Space)	34.8	3.16
Handling Fees - Reimbursing Retailers (Manual collection, Labour and Space)	11.5	2.55

A.7.0 Environmental Impacts

Environmental impacts associated with the introduction of a DRS will occur from the following processes:

1) Recycling of additional beverage containers;
2) Reduction in disposal of beverage containers;
3) Additional collection and transportation of containers to recyclers; and
4) Reduction in impact to a person amenity associated with litter.

Each of these processes is described in further detail in the Sections below.

The two main elements considered for processes 1) to 3) are greenhouse gas (GHG) emissions and air quality impacts. The approach to valuing these two elements is set out in Section A.7.1 and Section A.7.2. However, there is another environmental impact to be considered relating to the disamenity impact associated with litter. There is a dearth of relevant studies allowing the valuation of this, but this seems too important to be assigned (implicitly) a zero value. The approach is set out in Section A.7.6.

A.7.1 Greenhouse Gas (GHG) Valuation

Greenhouse gas valuation was based on estimates of the damage cost of carbon used by the European Environment Agency (EEA) to value the climate impacts of introducing legislation. The damage cost is a measure, in Euros (€), of the long-term damage done by a tonne of carbon dioxide or equivalent (CO_2e) emissions in a given year. This financial figure also represents the value of damages avoided for a small emission reduction (i.e., the benefit of a CO_2 reduction).

The approach used in this study is the same as that used in the cost benefit analysis of a report on landfill bans undertaken by Eunomia. Full details of the calculations used can be found in the appendices of that document.[91]

Estimates of the damage cost of greenhouse gases increase over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climatic change, and because GDP is growing over time and many damage categories are modelled as proportional to gross GDP.

Given that the benefits associated with GHG emissions reduction are posited to increase in the future, the year in which the modelling is set will affect the overall monetised value of emissions. Ideally, waste flows would be modelled over time, applying the

[91] Eunomia (2010) *Landfill Bans Feasibility Research*, Final Report for WRAP, March 2010, http://www.wrap.org.uk/downloads/FINAL_Landfill_Bans_Feasibility_Research.f5cf24f9.8796.pdf

correct value year-by-year, and calculating the net present value of the total benefits. Given that the study is forward looking, the value for 2020 has thus been used in the calculation of greenhouse gas associated damage costs. The official EEA value of €32 per tonne of CO_2e was used.

A.7.2 Air Quality Valuation

The study considered the impacts on air quality that are expected to result from the treatment processes, including both direct and indirect impacts (the latter relating to avoided impacts associated with energy generation and the recycling of materials).

The approach is to apply external damage costs to emissions of a range of air pollutants, allowing for the quantification of impacts in monetary terms.

The analysis that follows is focussed upon emissions to air. Whilst waste treatment processes may also in some cases affect soil and water quality, data regarding the precise nature of these impacts is less robust, and valuation data is scarcer still.

The damage costs used in this study are sourced from the European Environment Agency.[92] This report provides damage costs in 2005 prices, these are converted by applying local currency GDP deflators to convert to 2019 prices.[93] Two methodologies were used to estimate damage costs: value of statistical life (VSL) and value of a life year (VOLY) approaches. The former approach gives higher damage costs – these were used here to provide a conservative estimate of environmental impacts due to air emissions.

Table 1-26: Air Damage Cost Assumptions

Compound	Damage costs (2019 Prices)
	€ / tonne
NH_3	8,254
PM2.5	14,594
SO_2	4,059

[92] The methodology used is summarised in: European Environment Agency (2011) Revealing the Costs of Air Pollution from Industrial Facilities in Europe, EEA Technical Report No 15/2011, November 2011
[93] The World Bank (2019) *Inflation, GDP Deflator (Annual %)*, Accessed 16th May 2019, https://data.worldbank.org/indicator/ny.gdp.defl.kd.zg?end=2017&start=2005

NOx	3,002
VOCs	483

A.7.3 Recycling of Beverage Containers

GHG emissions factors for recyclables were taken from WRATE, an environmental model which is used to assess the environmental impacts of waste management activities. Whereas a number of authors have considered the climate change benefits of recycling, much less data is publicly available regarding the air quality impacts of recycling. A cost benefit analysis of landfill bans undertaken by Eunomia provides some information on a limited number of pollutants taken from some of the studies included within its review.[94] Otherwise, however, the main source of information in this respect is life cycle databases such as Ecoinvent, although some trade associations have also created life cycle inventory datasets for certain of the commonly recycled materials.

GHG and air quality damage costs are calculated using the values discussed in the section above and shown in Table 1-27.

The total monetised benefit associated with additional material recycled as a result of the DRS is €1.6m per annum.

Table 1-27: Recycling Impacts for GHGs and Air Emissions

Material	Kg of emissions per tonne of recyclables						Total Monetised Impact, € per tonne
	CO_2	PM2.5	SO_2	NO_x	NH_3	VOCs	
PET	-1,150	-0.11	0.005	-2.27	0.01	-3.51	-305
Aluminium	-10,721	-4.62	-0.01	-18.00	-0.15	-2.20	-3,662

Sources: WRATE2 / Prognos / Environmental Resources Management / Ecoinvent

[94] Eunomia (2010) *Landfill Bans Feasibility Research*, Final Report for WRAP, March 2010, http://www.wrap.org.uk/downloads/FINAL_Landfill_Bans_Feasibility_Research.f5cf24f9.8796.pdf

A.7.4 Disposal of Beverage Containers

Emissions factors for landfill were taken from the landfill bans study and air quality damage costs are calculated using the values discussed in the section above. The GHG and air quality impacts are given per tonne of waste landfilled in Table 1-28.

Table 1-28: Landfill Impacts for GHGs and Air Emissions, per kg

Material	Kg of emissions per tonne of landfill						Total Monetised Impact, € per tonne
	CO_2	PM2.5	SO_2	NO_x	NH_3	VOCs	
PET	4.3	0.004	0.008	0.17	5.0E-07	0.04	6.7
Aluminium	4.3	0.004	0.01	0.17	5.0E-07	0.04	6.7

Source: Eunomia (2010) Landfill Bans Feasibility Research, Final Report for WRAP, March 2010, http://www.wrap.org.uk/downloads/FINAL_Landfill_Bans_Feasibility_Research.f5cf24f9.8796.pdf

Plastics and metals are inert materials and so do not biodegrade and release greenhouse gases. For these materials, the unit landfill impacts are low as they only relate to transport and operating emissions at the landfill site(s).

The total monetised benefit associated with the reduction in residual waste disposals as a result of the DRS is €16,264.

A.7.5 Collection of Beverage Containers

Beverage containers are collected and transported large distances to reach reprocessing facilities using trucks and other vehicles. These vehicles emit greenhouse gases, and a number of other compounds and particles, which cause damage to the environment. It is important to include these impacts in the cost benefit analysis.

Emissions were modelled for three vehicle types: HGVs (articulated trucks), 12 tonne collection vehicles and passenger cars.

Air quality emissions factors (grams per kWh) for heavy-duty trucks were based on Euro Class 5 standards (2008).[95] These were converted to grams per km based on average fuel densities, engine efficiencies and fuel consumption for these vehicle types (see below for fuel consumption estimates). For passenger vehicles, emissions factors (grams per km)

[95] Dieselnet (2018) *EU: Heavy-Duty Truck and Bus Engines*, Accessed 3rd July 2018, https://www.dieselnet.com/standards/eu/hd.php

are based on Euro Class 5 standards.[96] Equal numbers of petrol and diesel vehicles were assumed.

GHG emissions factors for diesel and gasoline fuel were sourced from the US EPA.[97] These were converted into emissions per km travelled based on average fuel consumptions for each vehicle. These are 37 litres per 100 km for HGVs, 27 litres per 100 km for 12 tonne vehicles and 8 litres per 100 km for passenger cars.[98,99]

The total monetised cost associated with additional vehicle movements as a result of the DRS is €0.54m.

A.7.6 Disamenity Impact of Litter

A number of studies have sought to quantify, in monetary terms, the 'welfare loss' - i.e. the extent to which citizens are negatively impacted – from the existence of littered items in their local neighbourhood. This welfare loss is often referred to as the 'disamenity impact ' arising from litter, much of which is considered to be due to the 'visual disamenity impact' which is understandable given that litter can transform the look and feel of a place.[100] The studies have typically sought to place a monetary value on this disamenity impact through determining the amount that respondents would be willing to pay for a marginal improvement from the current situation, in terms of a proportional reduction in the levels of litter.

While it is possible to measure litter by weight, number of items, and volume, it is likely that visual disamenity impact is most closely related to the overall volume of litter, which depends both on the number and unit volume of littered items, rather than the weight, or only the number. While litter is composed of a number of different materials and items, of which single use plastics will comprise a proportion, no research has been found relating to how the impact varies by material and item type.

The approach in this study to estimating the litter disamenity impact for Ireland was based on a study recently conducted by Eunomia for DG Environment of the European Commission. A review of the literature found no studies relating to litter disamenity impact in Ireland. EU28 data was consequently used, which, while sparse, provides a

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[96] Dieselnet (2018) *EU: Cars and Light Trucks*, Accessed 3rd July 2018, https://www.dieselnet.com/standards/eu/ld.php

[97] U.S. Environmental Protection Agency (2015) *Emissions Factors for Greenhouse Gas Inventories*, 19th November 2015, https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors_nov_2015.pdf

[98] UK Government (2018) *Statistical Data Set: Fuel Consumption (ENV01)*, 23rd November 2017, https://www.gov.uk/government/statistical-data-sets/env01-fuel-consumption

[99] Global Fuel Economy Initiative (2014) *Fuel Economy State of the World 2014*, Report for FIA Foundation, https://www.fiafoundation.org/media/44209/gfei-annual-report-2014.pdf

[100] The association between a littered environment and perception of public safety / fear of crime is an example.

basis for estimating the disamenity impact associated with litter. Eunomia calculated the overall willingness to pay for reduced litter on land as follows.

The approach taken draws on the findings of Wardman et al. (2011), considered to be the most relevant available study which explored UK resident's 'willingness to pay' (WTP) for a reduced level of neighbourhood litter.[101] WTP was established for an improvement to 'best status' and also for a 'one-level' improvement (based on photographs illustrating different levels of littering). This research (and other studies on the topic) were reviewed by Eunomia in a report for Zero Waste Scotland in 2013, with the findings used to determine a national WTP for a less-littered environment.[102]

WTP was, as would be expected, higher for a move to 'best status' than for a 'one-level' improvement. The unweighted average WTP per respondent for a 'one-level' improvement was £10.79 per month in 2011, and for a move to 'best status' was £14.18 per month. (The original sterling values are included for clarity, but have been converted to Euros for this project).

For Ireland it was considered appropriate to apply separate urban and rural figures. Whilst the 'one-level' improvement of £10.79 is an average across inner city, suburban and rural, an urban value was taken of the first two categories to reach £11.30, alongside the rural value of £11.33. Table 1-29 summarises this.

Table 1-29: Urban and Rural Litter Disamenity Values

	Number of Households	Disamenity per Household per Month, 2011, £	Disamenity per Household per Year, €	Total Litter Disamenity, €m
Urban Households	748,360	11.30	264.13	197.66
Rural Households	470,010	11.33	264.83	124.47

[101] Mark Wardman, Abigail Bristow, Jeremy Shires, Phani Chintakayala and John Nellthorp (2013) Estimating the Value of a Range of Local Environmental Impacts, Report for Dept. for Environment, Food and Rural Affairs, 1 April 2011, available at http://randd.defra.gov.uk/Document.aspx?Document=9854_LEQFinal.pdf

[102] Eunomia (2013) *Exploring the Indirect Costs of Litter in Scotland*, Report to Zero Waste Scotland, available at https://www.zerowastescotland.org.uk/sites/default/files/Exploring%20the%20Indirect%20Costs%20of%20Litter%20in%20Scotland.pdf

In applying these valuations, we, conservatively:

- use the WTP for a 'one-level' improvement to account for total litter disamenity;
- do not inflate to 2019 values; and
- apply the monthly WTP figures, adjusted to Ireland on a PPP-adjusted per capita GDP basis, to each Irish household, rather than each Irish adult.

Ideally, detailed analyses of litter composition and prevalence would have been used in scaling the disamenity values. However, there are very few composition analyses and those available are not readily comparable. Ireland does produce a national litter survey, however the data is based on the number of littered items and a proportion of all littered items is then attributed to each product category. There is, therefore, insufficient information on which to assess the weight or volume of beverage container litter.[103] Accordingly, it is appropriate to simply scale by PPP-adjusted GDP, noting that the figure may lead to a slight overestimate in some less-littered locations, and an under-estimate in other more-heavily littered locations. After determining the total litter disamenity, a baseline litter disamenity specific to beverage containers was calculated assuming that beverage containers make up 35% by volume. This is based on research indicating that beverage containers account for 40% of litter by volume, but a small proportion of these will be glass bottles, which are not included within the scope of this study. A conservative estimate of an 85% litter reduction – of deposit-bearing containers – was then applied to reflect the impact of the DRS (based on evidence that a 95% reduction of deposit-bearing containers has been achieved elsewhere).

It is important to note that the calculated disamenity impacts relate only to neighbourhood disamenity, and do not cover the impact of litter that might be found on journeys to areas beyond one's neighbourhood, such as on walking excursions for example. Therefore, these estimates do not provide a complete picture of the total land-based disamenity impact associated with littered items. Indeed, in terms of neighbourhood litter, citizens may to an extent start to see this as somehow 'normal' (while still having a strong preference for it not to be there). However, for litter encountered on a walking trip in a beautiful area, for example, the sense of upset, and indeed potentially anger, that might be experienced when littered items are encountered, might be proportionally higher than when it is seen in a day-to-day context.

Proportional reductions in disamenity impact were calculated linearly based on anticipated reductions in volume. In respect of land-based litter, to assume a linear reduction (given the argument of diminishing returns) could well be to underestimate the benefit of such reductions. However, this approach was adopted in order to derive a conservative estimate.

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[103] http://www.litter.ie/system_survey_results/index.shtml