A DRS for Turkey

Final Report for Reloop & ISBAK

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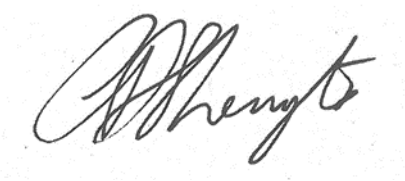

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Version Control Table

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V0.2	13/05/19	Orla Woods	Internal draft
V0.3	22/05/19	Orla Woods	Internal draft for review
V0.4	28/05/19	Orla Woods	Internal draft
V1.0	31/05/19	Orla Woods	Completed draft report Issued
V1.1	07/08/19	Orla Woods	Revisions following feedback from client
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Executive Summary

Following the Turkish Government's announcement that a deposit return system (DRS) for single-use beverage containers would be introduced by 2021 (and complete by 2023), Reloop commissioned Eunomia to investigate a possible DRS design. The purpose of this study is to:

1) Establish how a DRS could work effectively in Turkey by reviewing DRS design features associated with high return rates and design features that have proven less effective in other systems; and
2) Model the proposed design to arrive at indicative costs and benefits of a DRS in Turkey.

E.1.0 DRS Design

Under a DRS a small, refundable deposit is applied to beverage containers to incentivise consumers to return their used beverage container to be recycled or reused. There are a number of benefits to a well-designed DRS, including:

- Increased recycling rates;
- Reduced littering of deposit-bearing containers;
- A reliable supply of high-quality recycled material;
- Reduced greenhouse gas emissions and air pollutants; and
- Increased employment.

A DRS is also an effective means of implementing extended producer responsibility (EPR) for beverage containers.

The Turkish Government is introducing a DRS as part of Turkey's Zero Waste project to reduce marine and terrestrial litter. A DRS should also support Turkey's new ban on the landfilling of packaging waste by diverting used beverage containers from the residual waste stream. Deposit return systems can achieve high recycling rates and significantly reduce littering of deposit-bearing containers, so this study has proposed a DRS design for Turkey based on existing best practice around the world. This involved an analysis of the following design elements:

- Governance – how the system is set up, who operates it and how;
- Deposit value – the level of the refundable deposit added to beverage containers to incentivise returns;
- Return infrastructure – where and how consumers can return their used containers to claim a deposit refund;
- Scope (beverage containers) – the type of beverage containers on which a deposit is applied;
- Scope (beverage type) – the range of beverages included in the scheme;

- Handling fees – the amount paid to retailers to compensate them for the costs of taking back used containers;
- Material ownership – who is responsible for the returned material and who collects the revenues from it;
- Unredeemed deposits – what happens to the deposits that are paid by consumers but not claimed for a refund;
- Producer funding – how the net costs of the system can be covered fairly and efficiently;
- Labelling and fraud prevention – how to identify containers that are part of the scheme and to reduce the losses from fraudulent claims or free-riders;
- Supporting policy instruments – additional policy measures that could support the scheme objectives and 'level the playing field' in respect of containers outside of the scheme; and
- Targets – the return rate the DRS is required to meet and a means for the Government to hold the system operators to account for the scheme performance.

Table E 1-1 summarises the design recommended for Turkey. The key relationships and transactions are illustrated in

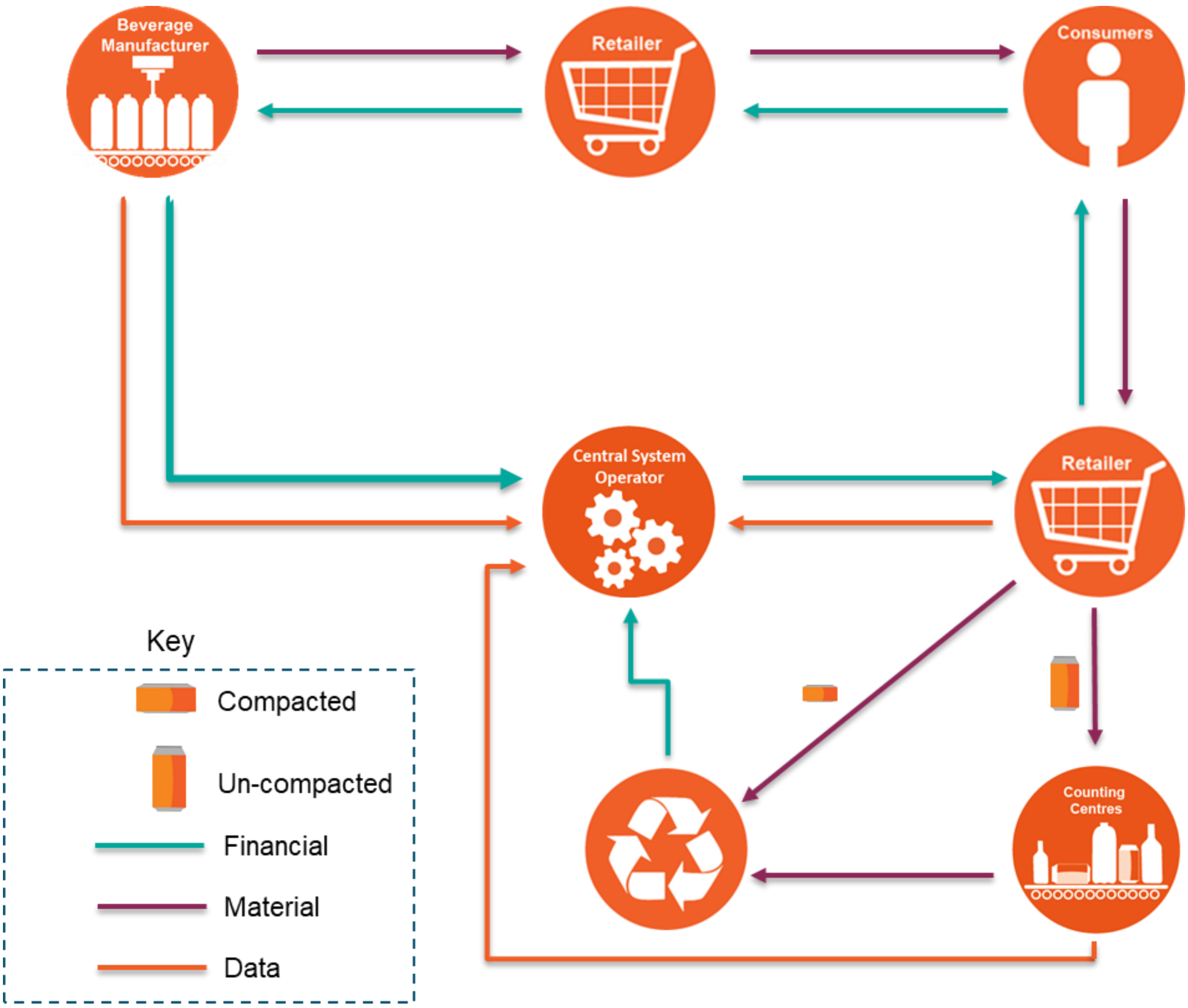
Figure E 1-1.

Table E 1-1: Summary of Selected Design Options for Turkey

Element	Option Chosen for Turkey
Governance	Centralised, privately owned and operated, targets set by government (and/ or Beverage Container Tax)
Scope – Containers	PET, HDPE, metal, glass
Scope - Beverage	Water, soft drinks, juices, beer, cider, spirits and wine
Deposit Level	₺0.30
Labelling	Deposit logo and choice of international or national barcode, with lower fees for a Turkey-specific 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 savings.

Material ownership	System operator
Funding	Material Revenues Unredeemed deposits Producer fee for every container placed on the market
Supporting Economic Instruments	Beverage Container Tax for container types with a collection rate below 95%

Figure E 1-1: Flow of the Deposit, Fees, Containers and Information in the Turkish DRS

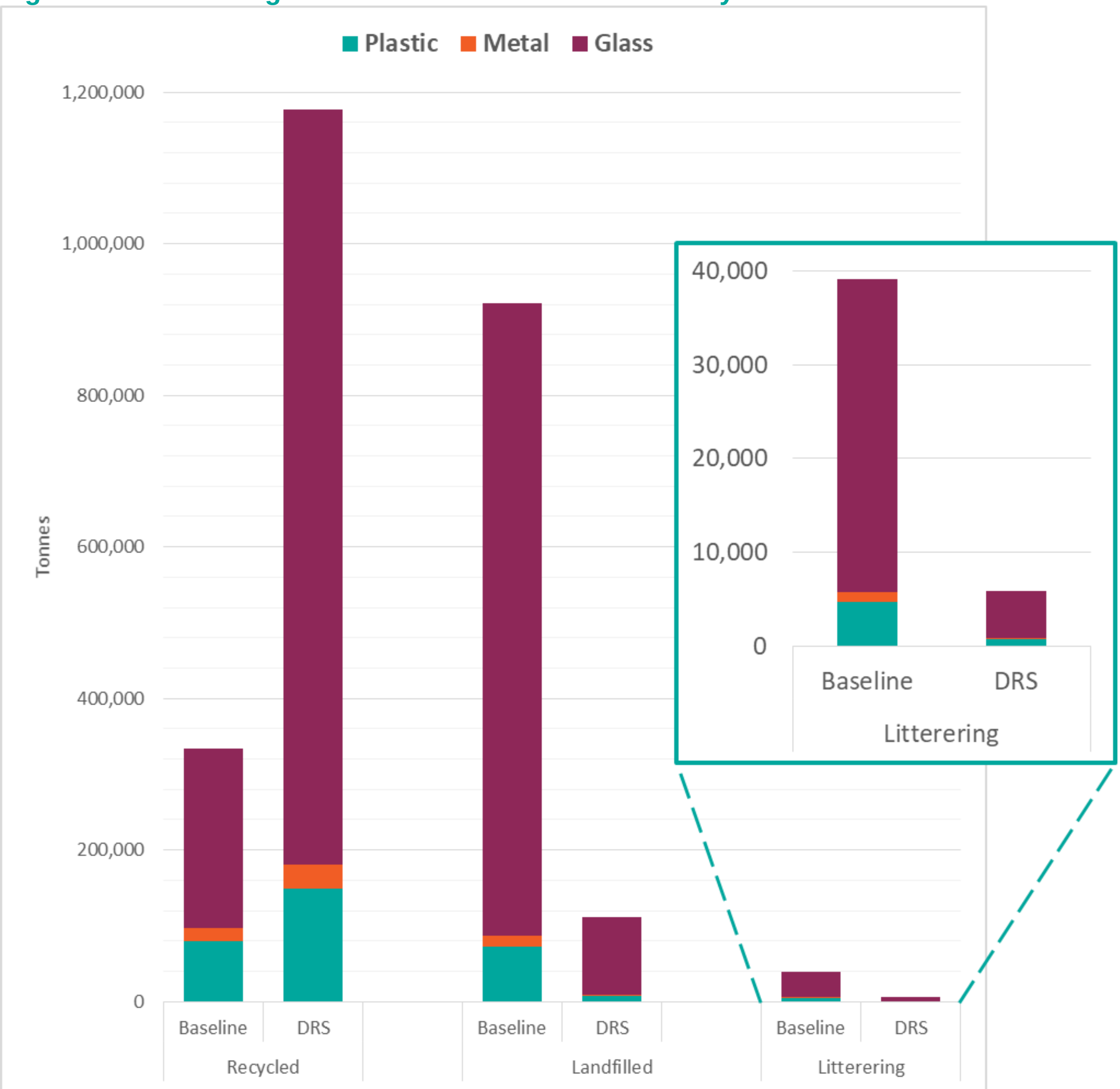


E.2.0 Costs and Benefits

After establishing a possible DRS design for Turkey, the study modelled the indicative annual costs of the system and the effects on beverage producers and retailers. Additionally, as an effective DRS removes the majority of beverage containers from the existing waste stream, the potential impact on residual (mixed, landfilled) waste and recycling services was calculated. Eunomia's DRS model also calculates the change in greenhouse gas emissions and other air pollutants as a result of a DRS.

If the DRS achieves a **90% return rate**, the change in the weight of beverage containers recycled, landfilled and littered in a year is shown in Figure E 1-2.

Figure E 1-2: Beverage Container Waste Flows Currently and with a DRS



The total annual costs of the system, including the annualised set-up costs, and the sources of funding are shown in Figure E 1-3. The majority of the system costs are to compensate retailers for the costs they incur in providing a take-back service. These costs are covered by a handling fee, which the system operator pays to retailers for every container they take back. There are two levels of fees, depending on whether the retailer provides an automated service with a reverse vending machine (RVM) or a manual service. The modelling indicates that, based on current costs in Turkey, the handling fees would be as listed in Table E 1-2.

Figure E 1-3: Distribution of DRS Costs and Revenues

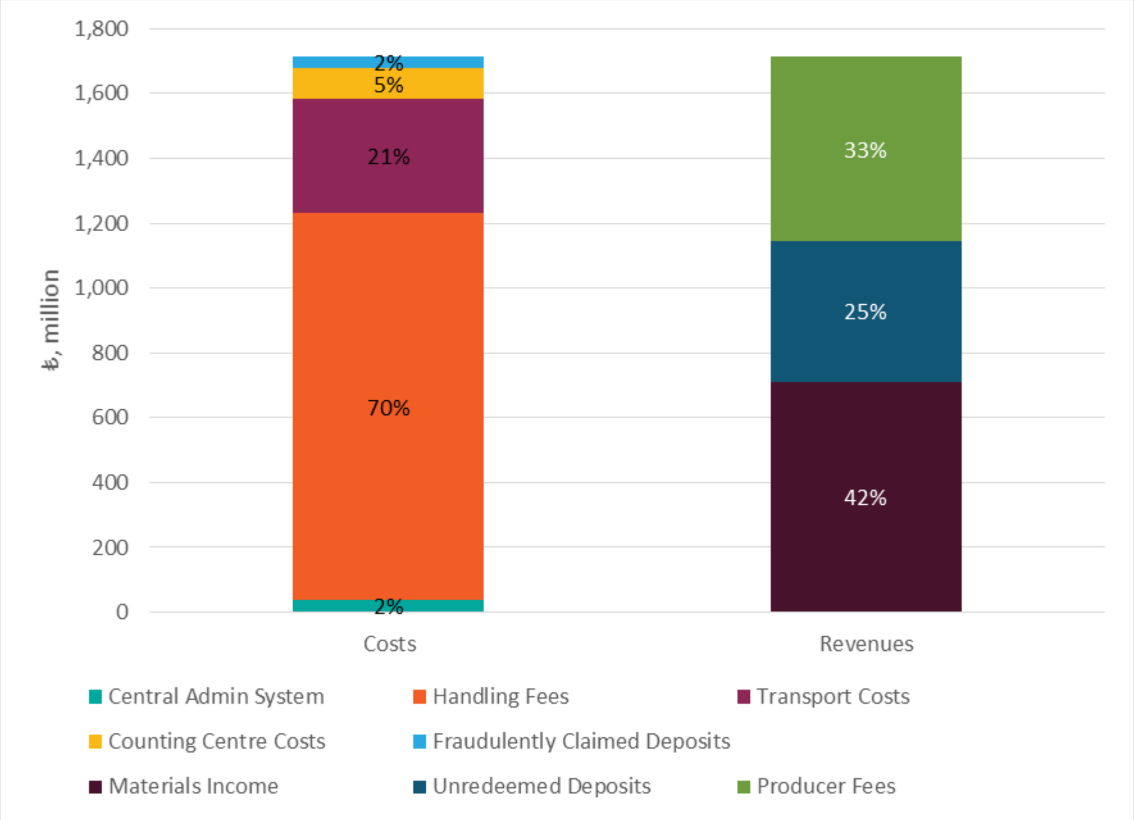


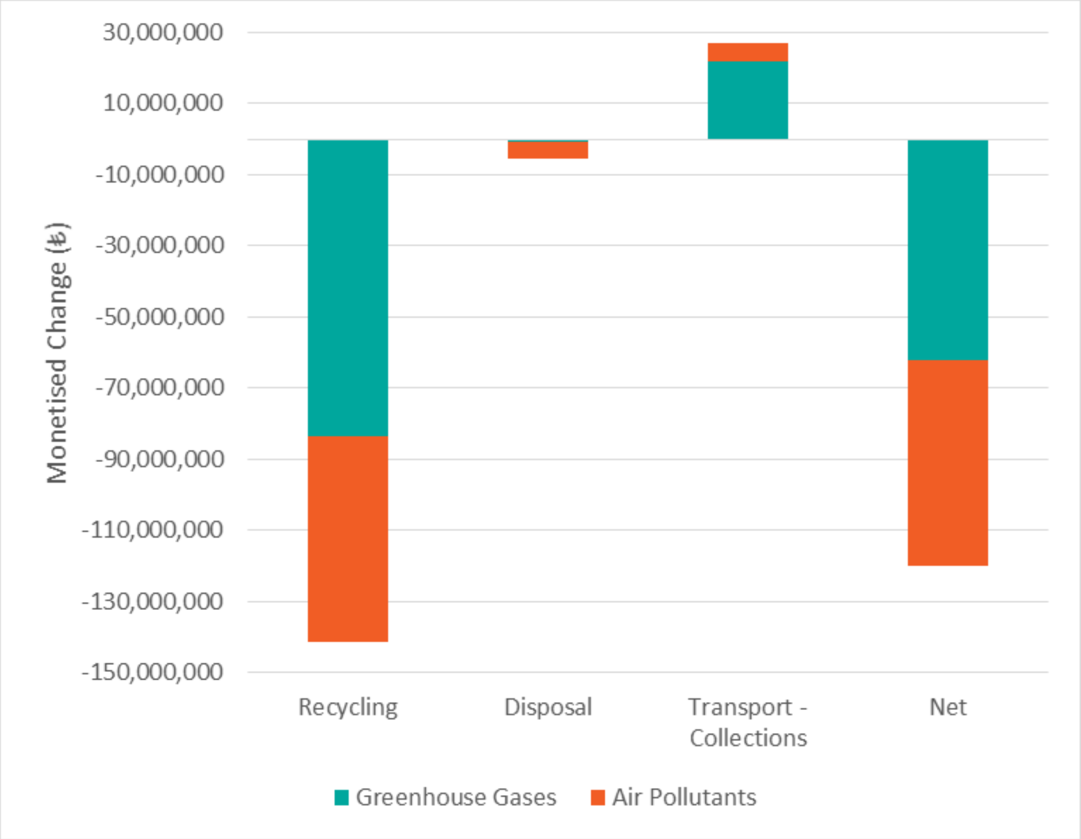
Table E 1-2: Retailer Handling Fees

	Cost/Unit Redeemed, ₺
Handling Fees - Reimbursing Retailers (RVMs, Labour and Space)	0.155
Handling Fees - Reimbursing Retailers (Manual collection, Labour and Space)	0.040

Based on current material values in Turkey and a 90% return rate, material revenues and unredeemed deposits cover two thirds of the annual costs of the DRS. The remaining 33% is paid by producers in the form of a producer fee for every container they place on the market. The average producer fee is estimated to be **₺0.042 per container**, but will be higher for glass bottles and lower for aluminium cans due to aluminium's higher value and lower processing costs.

Figure E 1-4 shows the environmental benefits resulting from producers' investment in the DRS, with the annual reduction in greenhouse gas emissions and air pollutants valued at **₺62.3 million** and **₺57.7 million** respectively.

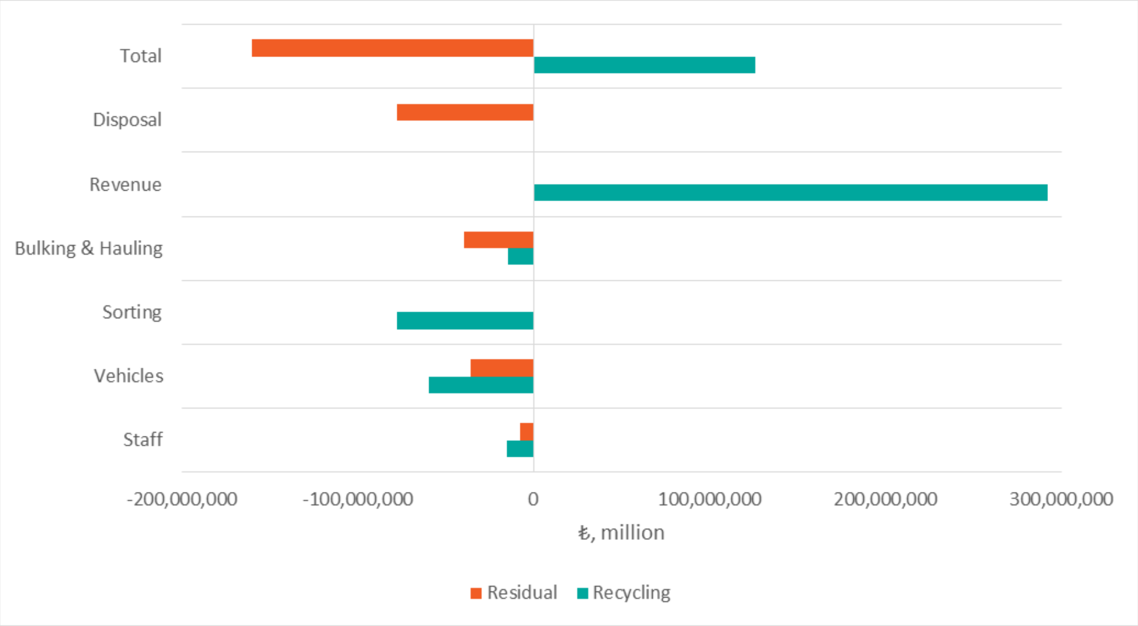
Figure E 1-4: Monetised Annual Change in Environmental Impacts



Additionally, the reduced litter on the streets, in parks, on beaches and in Turkey's seas provides a significant benefit for communities. This can be estimated in monetary terms using an approach based on citizens' 'willingness to pay' for a less-littered local environment. The change in litter 'disamenity' (a term used by economists to describe the negative perception of littering and the effect this has on people's sense of wellbeing) is significant. There are a variety of ways to calculate this, but the study has sought to use a relatively conservative approach, and has calculated that a DRS could generate an annual **reduction in litter disamenity of ₺585 million**. Consequently, the environmental benefits of a DRS far exceed the DRS annual operating costs.

In addition to the impact on beverage producers, retailers and society, by removing the majority of used beverage containers from existing waste collection routes, the DRS will affect municipalities and waste operators that currently provide residual waste and recycling services. The study modelled a version of Turkey's current container-based system, with an assumption that all municipalities provide street containers for residual waste and for mixed recycling. If Turkey is currently recycling 26% of beverage containers (this is based on official figures but there is limited data, especially for beverage containers specifically), both recycling and residual waste collections can reduce the costs of collecting, transporting, bulking, hauling and sorting/ disposal, as indicated in Figure E 1-5. Recycling services will, however, lose some of the revenue they currently receive for the beverage containers they collect. The net impact is **losses of ₺125.8 million** for recycling services, which would be offset by **savings of ₺160.1 million** for residual waste collections.

Figure E 1-5: Savings and Losses for Existing Waste Services



Cost savings are negative and increased costs are positive figures.

Table E 1-3 provides a summary of the modelling results for Turkey. With Turkish law requiring producers to design packaging for reuse or recycling and to meet the costs of collecting packaging waste, a DRS could enable producers to do this for approximately ₺0.04 per container. This would generate savings for municipalities and deliver significant environmental benefits. If comparing the costs of a DRS to other collection methods, it should also be remembered that, based on existing evidence, a well-designed DRS is more likely to achieve a higher recycling rate and provide high quality recycled material that can be manufactured into new beverage containers.

Table E 1-3: Summary of Annual DRS Costs and Benefits

	Impact (₺)
Net Cost of DRS	568,860,000
Cost to Producers per Container	0.042
Litter Disamenity	584,900,000

Environmental Benefits	120,000,000
Recycling Services Losses	125,800,000
Residual Waste Savings	160,100,000

Costs and losses are shown in red savings and monetised benefits are shown in green.

Contents

Executive Summary ..... **iv**

1.0 Introduction **1**

2.0 What is a Deposit Return System? **2**

2.1 Why Introduce a DRS? 3

2.2 How Does a DRS Work? 4

3.0 The Current Context in Turkey **5**

3.1 Existing Waste Management 5

3.2 Marine Litter 11

3.3 The Beverage Market 11

4.0 DRS Design Options **13**

4.1 DRS Components and Terminology 14

4.2 System Governance 15

4.3 Deposit Value 18

4.4 Return Infrastructure 21

4.5 Scope – Beverage Containers 25

4.6 Scope – Beverage Type 26

4.7 Handling Fees 27

4.8 Material Ownership 29

4.9 Unredeemed Deposits 30

4.10 Producer Funding 31

4.11 Labelling & Fraud Prevention 33

4.12 Supporting Policy Instruments 35

4.13 Targets 37

4.14 Summary 37

5.0 DRS Design for Turkey **39**

5.1 Governance 39

5.2 Deposit Value 39

5.3 Return Infrastructure 41

5.4 Scope – Beverage Type 42

5.5 Scope – Beverage Containers 43

5.6 Retailer Compensation ... 43
5.7 Funding ... 44
5.8 Labelling and Fraud Prevention ... 45
5.9 Supporting Policy Instruments ... 45
5.10 Targets ... 46
5.11 Summary ... 46
6.0 Modelling Methodology ... 48
6.1 Mass Flows ... 49
6.2 Baseline Analysis ... 51
6.3 DRS Model ... 52
6.4 Environmental Impacts ... 54
7.0 Turkish DRS Costs and Benefits ... 55
7.1 Impact on Existing Waste Services ... 55
7.2 DRS Costs ... 57
7.3 Retailer Handling Fees ... 59
7.4 Set-Up Costs ... 60
7.5 Environmental Impacts ... 62
8.0 Conclusions ... 64
TECHNICAL APPENDIX ... 68
A.1.0 Material Mass Flows ... 69
A.2.0 Bring Site Collection Modelling ... 73
A.3.0 DRS System Return Network ... 76
A.4.0 Environmental Impacts ... 87

1.0 Introduction

Reloop commissioned Eunomia Research and Consulting (Eunomia) to undertake a study on the design of a deposit return system (DRS) for Turkey. This followed the November 2018 amendment to Turkey's Environmental Law, which allowed for the introduction of a deposit system on packaging in order to prevent environmental pollution, and the Minister for the Environment and Urbanisation's confirmation that a DRS would be introduced for drinks containers by 2021. The DRS will be part of Turkey's Zero Waste project and will be used to reduce marine and terrestrial litter.[1]

The Environmental Law states that points of sale for packaged products are obliged to take part in the "deposit application collection system". Further procedures and principles guiding the implementation of a deposit system are to be specified in a regulation issued by the Ministry.[2]

The purpose of this study is to propose a DRS design for Turkey, based on existing best practice features in such systems in other countries, and to model the indicative costs and benefits. At the outset, it should be noted that access to reliable data during the study was limited (and local government representatives were not available due to the local elections), so the modelling was based on the best available data and reasonable assumptions informed by experience in other countries. Where there are uncertainties about the data, a conservative approach has been adopted so as to, if anything, underestimate the potential benefits of the DRS and overestimate the costs. TÜÇEM, ISBAK and Fors Atık Yönetimi ve Danışmanlık provided information and reviewed modelling inputs where possible.

The following chapters set out:

- An introductory overview of a DRS (Section 2.0).
- The current situation in Turkey (Section 3.0).
- DRS design options, with examples from Europe, North America and Australia (Section 4.0).
- The proposed DRS Design for Turkey (Section 5.0).
- The methodology for calculating the costs and impacts of a DRS (Section 6.0).
- The results of the costs and impacts modelling (Section 7.0).
- A summary of the study's key findings and conclusions (Section 8.0).
- A technical appendix detailing the modelling methodology and assumptions (starting on page 68).

[1] http://www.hurriyetdailynews.com/bottles-deposit-return-scheme-gets-green-light-in-turkey-140671

[2] Çevre Kanunu Ve Bazi Kanunlarda Değişiklik Yapilmasina Dair Kanun - https://www.tbmm.gov.tr/develop/owa/kanunlar_sd.durumu?kanun_no=7153

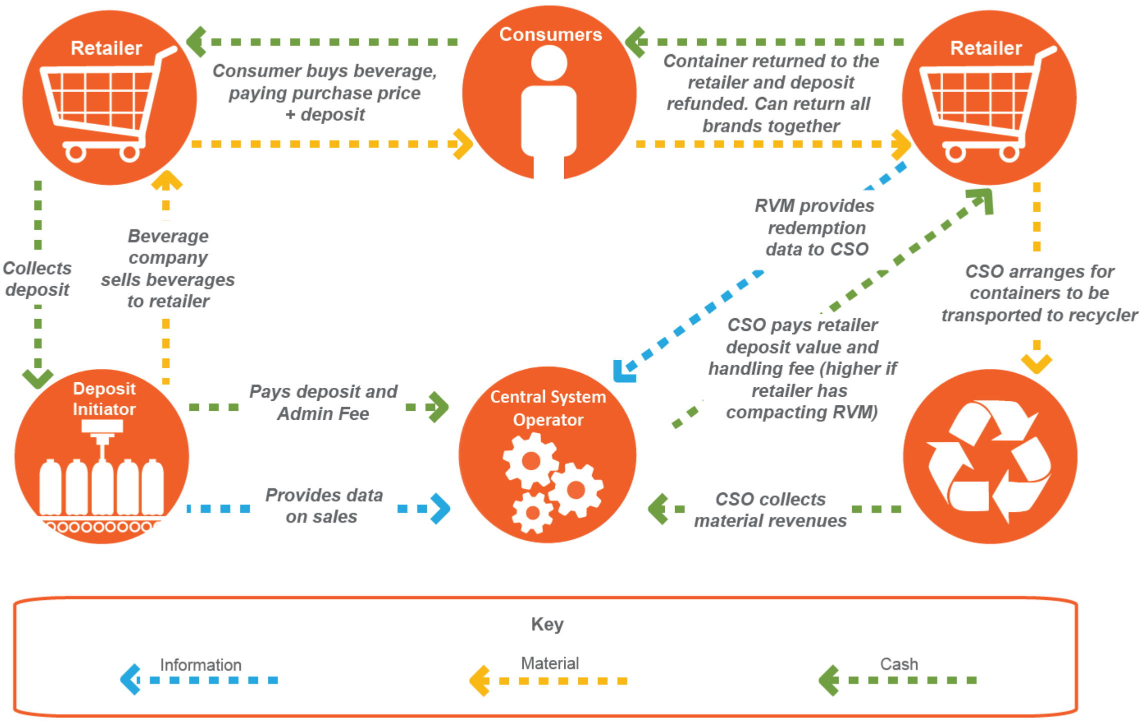
2.0 What is a Deposit Return System?

A DRS for beverage containers involves the application of a small, refundable deposit in order to incentivise consumers to return their beverage containers to be recycled. A DRS can apply to one-way (single-use) containers and/ or to refillable containers (in which case the refillable bottles are returned to be reused rather than recycled). While in principle it is possible for a DRS to include a wider range of containers, for instance household products or food, beverage containers are typically chosen because:

1) Beverages are consumed relatively quickly and in high volumes, so are a significant source of packaging waste;
2) Beverages are often consumed ‘on the go’, increasing the risk that they are littered or disposed of in residual waste;
3) Beverage containers are easily cleaned, with beverages leaving little residue in the containers; and
4) If 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.

Figure 2-1 illustrates a simplified organisational structure of a DRS to signify the key relationships between producers, retailers, consumers and the deposit system for a container returned via a reverse vending machine (RVM). Not shown in the diagram, as it is an external component, is the role of the Government as a regulator.

Figure 2-1: Key Relationships and Transactions in a DRS



2.1 Why Introduce a DRS?

A DRS is primarily used to increase the recycling rate and reduce littering of beverage containers, but a DRS delivers additional benefits, connected to these direct impacts.

Increased Recycling

A number of European DRSs achieve return rates above 90%, successfully diverting significant numbers of beverage containers from landfill and incineration. By contrast, the maximum recycling rate for plastic bottles without a DRS is currently considered to be around 70%.[3] Indeed, the European Union's Single Use Plastic Directive names a DRS as a potential mechanism for securing their 90% separate collection target.[4]

Reduced Littering

In terms of littering, research indicates that a well-designed DRS could reduce the littering of beverage containers by 95%, meaning that, on the basis that roughly 40% by volume of litter is comprised of beverage containers, the volume of all litter could reduce by approximately a third.[5]

A Reliable Supply of High Quality Recyclate

As a DRS provides a well-defined single stream collection, the material collected is generally of a higher quality and less contaminated than that obtained through other collection methods, such as kerbside or bring-banks. This means the recycled material is of food-grade quality and can be used to manufacture new beverage containers, helping producers who have committed to increasing the recycled content of their containers.

Reduced Greenhouse Gas Emissions

As the DRS diverts material from landfill and incineration plants, it can reduce greenhouse gas emissions and other air pollutants.

Increased Employment

A DRS has been shown to boost employment, with the potential to create jobs (full or part-time) in admin, retail, transportation, processing and recycling.[6]

To Fulfil Producer Responsibility Obligations

A producer-led scheme is an effective form of producer responsibility, as the system is not only funded by producers (in line with the polluter pays principle) but producers should have the authority to design the most cost-effective system.

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[3] ICF & Eunomia (2018) *Plastics: Reuse, Recycling and Marine Litter.* Report for the European Commission. May 2018.

[4] Directive 2019/904 - https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2019:155:TOC

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

[6] Eunomia (2019) *Employment and Economic Impact of Container Deposits*. January 2019.

2.2 How Does a DRS Work?

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.

Figure 2-2 illustrates the circular flow of the deposit, with the container going in the opposite direction, as shown in Figure 2-3. Evidence from other countries indicates that, in the most effective systems, these processes are managed by a single organisation operating on behalf of producers, with a limited role for Government (as explained in Section 4.0).

Figure 2-2: Journey of the Deposit in a DRS

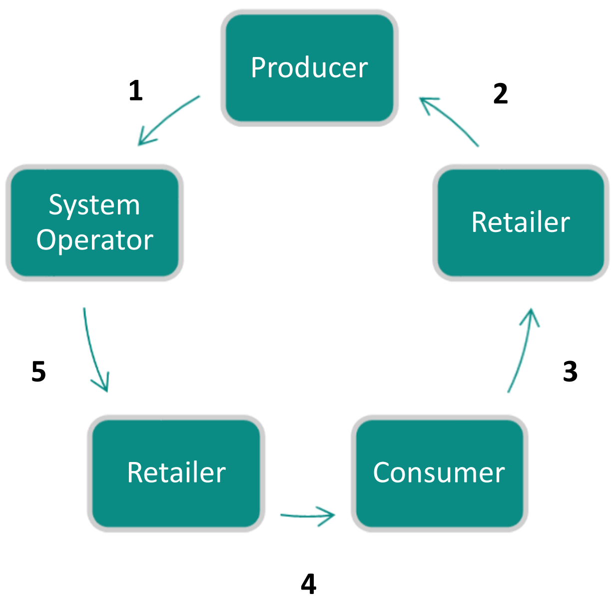
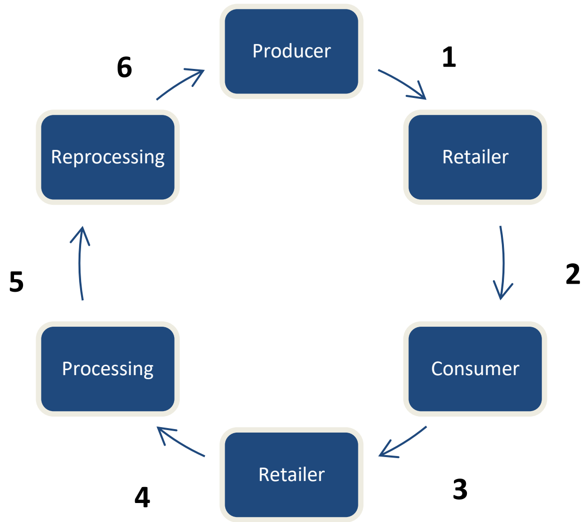


Figure 2-3: Journey of the Container in a Closed-Loop DRS



3.0 The Current Context in Turkey

3.1 Existing Waste Management

The Turkish Government is working to improve Turkey's waste infrastructure to reduce reliance on landfills and dumping sites. A review of Turkey's current performance and challenges, summarised below, indicates that a well-designed DRS will help to improve data on the tonnages of beverage containers that are placed on the market and recycled. A DRS could also support a recycling culture in Turkey by raising awareness of the benefits of recycling and encouraging consumers to recycle more of their waste.

It seems that Turkey is well placed to profit from a DRS, given that the country already has a thriving recycling industry and imports waste from other countries. This indicates there is potential to re-process the used beverage containers within Turkey, supporting jobs and industry. Indeed, PAGÇEV reports that Turkey boasts the 6th largest plastics industry in the world, which already supports 250,000 jobs.[7]

3.1.1 Regulatory Context

Turkey's updated Regulation on the Control of Packaging Wastes (Official Gazette number 30283) came into effect on 1st January 2018. Under the Regulation:

- the disposal of packaging waste in sanitary landfills is prohibited;
- municipalities are responsible for the separate collection of packaging waste;
- municipalities are required to develop packaging waste management plans;

[7] http://pagcev.org/upload/files/PAGCEV%20BULTEN%202018.pdf

- producers are required to design packaging to minimise waste production and so that it is suitable for reuse or recycling; and
- producers are responsible for the costs of collecting packaging waste for recycling.

The Regulation specifies recovery obligations and targets, which those responsible for placing packaging on the market can meet by either applying a deposit or delegating their responsibilities to an organisation authorised by the Ministry. If a deposit system is used, the Regulation specifies recycling targets for each type of material, as set out in Table 3-1.

Table 3-1: Turkey's Recycling Targets for Deposit-Bearing Packaging

	Glass (%)	Plastic (%)	Metal (%)	Paper/ cardboard (%)
2018	54	54	54	54
2019	54	54	54	54
2020 onwards	60	55	55	60

3.1.2 Waste Generation & Collection

Turkey is introducing a regulatory framework to support waste reduction and recycling. It will, however, take some time to develop the necessary infrastructure and it is understood that waste management service development is more advanced in some municipalities than in others.

There are also challenges in respect of data collection, meaning that there is sometimes limited information about the quantities placed on the market and processed at the end of life. However, according to the Turkish Statistical Institute's latest figures, for 2016, 1390 of Turkey's 1397 municipalities (99%) are served by municipal waste services. The rate of coverage has steadily increased from 72% of municipalities in 1994.[8] However, as of 2014, only 492 municipalities had approved municipal waste plans and the Ministry of the Environment reported in 2016 that only around 500 districts and towns had separate collections of packaging waste.[9]

While there are some reports indicating that door-to-door collections are common in Turkey, others indicate that such services have not yet been rolled out extensively.[10, 11] As such, it is understood that residual waste, and separated waste in municipalities with

[8] http://www.turkstat.gov.tr/PreTablo.do?alt_id=1019
[9] Ministry of the Environment and Urbanisation (2016) *Ulusal Atik Yönetimi Ve Eyelem Plani 2023*.
[10] Ministry of the Environment and Urbanisation (2016) *Ulusal Atik Yönetimi Ve Eyelem Plani 2023*.
[11] Private communication from TÜÇEM.

separate collections, is collected from bring banks in public areas. It is also understood that most recycling collections are co-mingled, so glass, metal and plastic are generally collected in the same container, along with textiles. Residents accordingly bring their waste from the homes to the nearest bring bank, which could cause some inconvenience to them, while the co-mingled collections could lead to contamination and a lower quality of recyclate. In addition to on-street facilities, recycling bins are also provided in some shops, offices and public buildings, as shown in Figure 3-1; plastic, metal and glass are collected in the same bin.

Figure 3-1: Residual and Separated Waste Bins at Istanbul Airport

Source: Eunomia

In addition to the municipal waste services, the informal sector is believed to play an important role in waste collection in Turkey. There are reported to be 500,000 informal collectors who collect 3.5 million tonnes of waste each year to sell the material for scrap.[12] As a result of new legislation, however, more regulation is being introduced and street collectors are becoming more formalised.

The reported destinations of the 31,584,000 tonnes of municipal waste collected in 2016 are shown in Table 3-2. Municipal dumping sites, which receive over a quarter of Turkey's waste, are being phased out in favour of properly managed landfill sites.

[12] https://www.theguardian.com/environment/2018/oct/18/uk-plastic-waste-imports-to-turkey-boom-but-at-what-cost

Table 3-2: Summary of 2016 Waste Statistics

	% of waste	Tonnes
Delivered to municipality dumping sites	28.8	9,095,000
Delivered to controlled landfill sites	61.2	19,338,000
Burned in an open area	0.032	10,000
Disposed of in rivers and lakes	0.002	500
Burial	0.021	7,000
Other disposal methods	0.130	41,000
Delivered to composting plants	0.5	146,000
Delivered to other recovery facilities[13]	9.3	2,946,000

Source: Turkish Statistical Institute

While approximately 9% of waste is currently recovered (this is not limited to recycling), there is a target to recycle 35% of waste by 2023, so the roll out of separate collections will be crucial to this.[14]

3.1.3 Packaging Waste

There are a number of estimates relating to waste composition in Turkey. Some reports estimate that packaging waste accounts for 15% of waste generated by weight, or 35% by volume.[15] The National Waste Management Action Plan 2023 reports that packaging was 7.69% of waste (excluding construction waste but including municipal waste, hazardous waste, special waste and medical waste) in 2014.[16] Of the packaging waste collected by municipalities, 30% is reported to be plastic, 9.7% is metal and 10.9% is glass. Elsewhere in the Action Plan, the waste characterisation (which does not only cover packaging) lists plastic as 5.86%, glass as 3.38% and metal as 1.37%.

While more than a third of packaging is reported to be collected separately (1,527,960 tonnes out of 4,200,000), it seems that not all of the waste that is separately collected is

[13] Includes facilities for recovering glass, metal, paper and plastic, as well as biogas facilities
[14] http://pagcev.org/upload/files/PAGCEV%20BULTEN%202018.pdf
[15] https://www.cevko.org.tr/index.php?option=com_content&view=article&id=11&Itemid=133&lang=en
[16] Ministry of the Environment and Urbanisation (2016) *Ulusal Atik Yönetimi Ve Eyelem Plani 2023*.

sent for recycling. The Action Plan reports that 8% of packaging waste was recovered, 5% was composted and 87% was landfilled.[17]

While the Turkish Statistical Institute reported that 9% of all waste was recovered in 2016, and the Ministry has reported that just 8% of packaging waste is recovered, the Environment Ministry's Packaging and Packaging Waste Bulletin 2017 reports higher recycling rates for the three material fractions of relevance to this study. The figures in the Bulletin are shown in Table 3-3 (which also lists the targets from Table 3-1 for comparison).[18]

Table 3-3: Packaging Recovery Rates (2017)

	Packaging Produced (Tonnes)	Packaging Placed on the Market (Tonnes)	Packaging Recovered (Tonnes)	Recovery Rate	2019 target
Plastic	3,150,000	915,301	497,089	54%	54%
Metal	373,682	142,482	81,146	57%	54%
Glass	1,331,265	845,615	193,563	23%	54%

Source: Türkiye Cumhuriyeti Çevre Ve Şehircilik Bakanliği

It is notable that a significant proportion of packaging seems to be produced in Turkey but not placed on the market, indicating that a large volume of packaging is exported. This will potentially make data collection more challenging. Nevertheless, the reported 2017 figures meet the plastic and metal targets for 2019. It is not, however, known whether all packaging that is recovered is collected specifically to be recycled – not least because recovery can include incineration – and, if it is sent for recycling, what the loss rates are (for instance due to contamination). Another potential reason for the difference between the 9% overall recovery rate and the recovery rate for packaging is that the 9% figure may only correspond to the waste officially collected by the authorities, which may exclude the waste removed from public bins, prior to collection, by the informal sector. Nevertheless, the differences in the reported recovery rates appear to highlight the current uncertainties with data collection.

In addition to the waste collection services, it is reported that some municipalities have trialled the use of reverse vending machines (RVMs) to increase their recycling rates of beverage containers. These trials are based on rewards, rather than refundable deposits, because consumers are not required to pay a deposit in the first instance. In Istanbul for

[17] Ministry of the Environment and Urbanisation (2016) *Ulusal Atik Yönetimi Ve Eyelem Plani 2023*.
[18] https://cygm.csb.gov.tr/atik-yonetimi-dairesi-baskanligi-i-85475

instance, consumers can use their used containers to claim a discount on their Metro tickets. The fare reduction depends on the size of the container:

- 0.33 litre plastic bottle = ₺0.02
- 0.5 litre plastic bottle = ₺0.03
- 1 litre plastic bottle = ₺0.06
- 1.5 litre plastic bottle = ₺0.09
- 0.33 litre aluminium can = ₺0.07
- 0.5 litre aluminium can = ₺0.09.[19]

Such initiatives are not, however, believed to be widespread and the results achieved by the pilots are not known.

3.1.4 Producer Responsibility

There are five producer responsibility organisations (PROs) for packaging in Turkey. Some of these are still in their infancy, but will in time be registering packaging placed on the market and recovered, and charging producers fees to contribute to the costs of waste management. Based on the data that is available, however, it does not seem that the PROs are yet consistently achieving the high recycling rates that have been shown to be possible in other countries. It is understood that some PROs charge fees, although the fee levels are not known, and it seems that not all PROs are yet charging their members.[20]

The PROs facilitate agreements between producers, municipalities and waste operators, with municipalities contracting waste operators to collect residual waste. These operators also collect separated waste in exchange for the material, meaning they are not paid by municipalities for these collections but generate revenue by selling the material.

It also seems that specially designed bins are used in public spaces to raise awareness of packaging recycling, as shown in Figure 3-2, from the Çiğli municipality. Litter bins in public spaces can, however, be susceptible to contamination.

Figure 3-2: "Beverage Bottle" Bin

Source: Çevko

[19] *Bottles deposit return scheme gets green light in Turkey - Turkey News*, accessed 13 August 2019, http://www.hurriyetdailynews.com/bottles-deposit-return-scheme-gets-green-light-in-turkey-140671
[20] Private communication from TÜÇEM.

According to the PRO, Çevko, PET that is collected and recycled is used for synthetic fibre, filling material, furniture and detergent bottles. This may indicate that the quality of PET collected may not be particularly high if it cannot be used as a food-contact material. Çevko reports that they worked with municipalities to collect 178,795 tonnes of plastic packaging in 2017.[21] Corroborating the impression that door to door collections in Turkey are very limited, Çevko indicates that these collections are in the pipeline.

3.2 Marine Litter

Turkey has over 8,000 km of coastline and its tourism agency boasts of 459 blue flag beaches.[22] As a result, the health, cleanliness and sustainability of the marine environment is important for Turkey's own environmental standards, the quality of life for its citizens, and for the Turkish economy. The long coastline also means that Turkey can make a valuable contribution to global efforts to prevent marine litter. At the UN Ocean Conference, Turkey committed to concluding Marine Litter Action Plans by the end of 2018 for each province with a coastline on the Mediterranean Sea, Black Sea or Sea of Marmara. As well as a plastic bag charge, Turkey's conference pledge referred to the aim of recycling 65% of packaging waste by 2023.[23]

According to beach litter surveys, caps/ lids and drink bottles are the third and fourth most frequent items in the Mediterranean, by count. Combined, caps and drink bottles are the most prevalent items, above cutlery/ straws and cigarette butts, whilst drink cans are also in the top 15. Drinks bottles are the third and cans are the sixth most frequently found items amongst Black Sea beach litter.[24] These figures indicate that Turkey's coastline, and the health of its seas, could be improved if more beverage containers were collected, and a well-designed DRS should contribute to this.

3.3 The Beverage Market

A range of both international and domestic brands is sold in Turkey. Table 3-4 summarises beverage consumption in Turkey in 2018. These figures relate to single-use containers only; in addition, 1.335 billion units of soft drinks and beer were sold in refillable bottles (predominantly glass but 0.4% of the refillables market is PET bottles).[25] It is understood that these beverages in refillable bottles are generally sold by the HORECA sector (hotels, restaurants and cafes), so the bottles do not leave the point of sale. As there is an existing system in place for the collection and processing of the refillables, these are excluded from the analysis. Another market report projected that

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21 http://www.cevko.org.tr/index.php?option=com_content&view=article&id=26&Itemid=139&lang=en
22 https://www.goturkeytourism.com/destinations-turkey/coastline-of-turkey.html
23 https://oceanconference.un.org/commitments/?id=19073
24 JRC (2016) Marine Beach Litter in Europe – Top Item. http://mcc.jrc.ec.europa.eu/documents/Marine_Litter/MarineLitterTOPitems_final_24.1.2017.pdf
25 GlobalData (2019) Turkey All Beverages. 22nd January 2019. Provided by TÜÇEM.

5.51 million drinks would be sold in pouches in Turkey in 2018. According to the data available, these pouches were used for juices and ready to drink teas and coffees.[26] Pouches were not, however, included in the more recent market report, which is the source for most of the data in Table 3-4.[27]

Table 3-4: 2018 Single Use Beverage Sales in Turkey (Millions of Units)

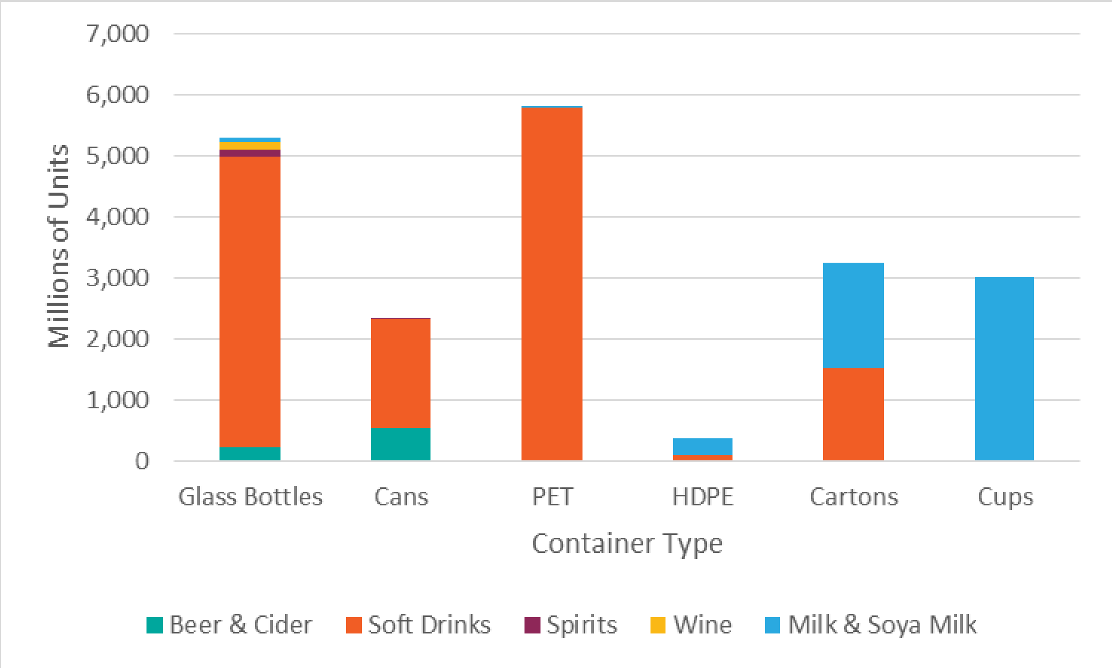
	Glass	Cans	PET	HDPE	Cartons	Cups	Total
Beer & Cider	233.97	553.37	18.67	-	-	-	806.01
Soft Drinks	4,756.64	1,778.99	5,767.74	114.53	1,536.16	-	13,954.06
Spirits	119.46	0.11	-	-	-	-	119.57
Wine	135.99	-	-	-	-	-	135.99
Milk[28]	69.31	-	33.5	266.78	1,726.69	3,004.64	5,100.92
Total	5,315.37	2,332.47	5,819.91	381.31	3,262.85	3,004.64	20,116.55

Source: GlobalData

Soft drinks (including juices and waters) account for 69% of the non-refillables market in Turkey; beer and cider represent 4%; while wine and spirits account for 2%. Based on the two datasets summarised in Table 3-4, milk, dairy drinks and milk substitutes are 25% of Turkey's beverage market. PET has the largest share of the market by material type, at 29%, while non-refillable glass bottles account for 26% and cartons represent 16%.

[26] GlobalData (2018) Market report on the consumption of Plastic Bottles.
[27] GlobalData (2019) Turkey All Beverages. 22nd January 2019. Provided by TÜÇEM.
[28] GlobalData (2018) Milk Packaging Data.

Figure 3-3: Distribution of Turkish Beverage Sales by Container & Beverage



4.0 DRS Design Options

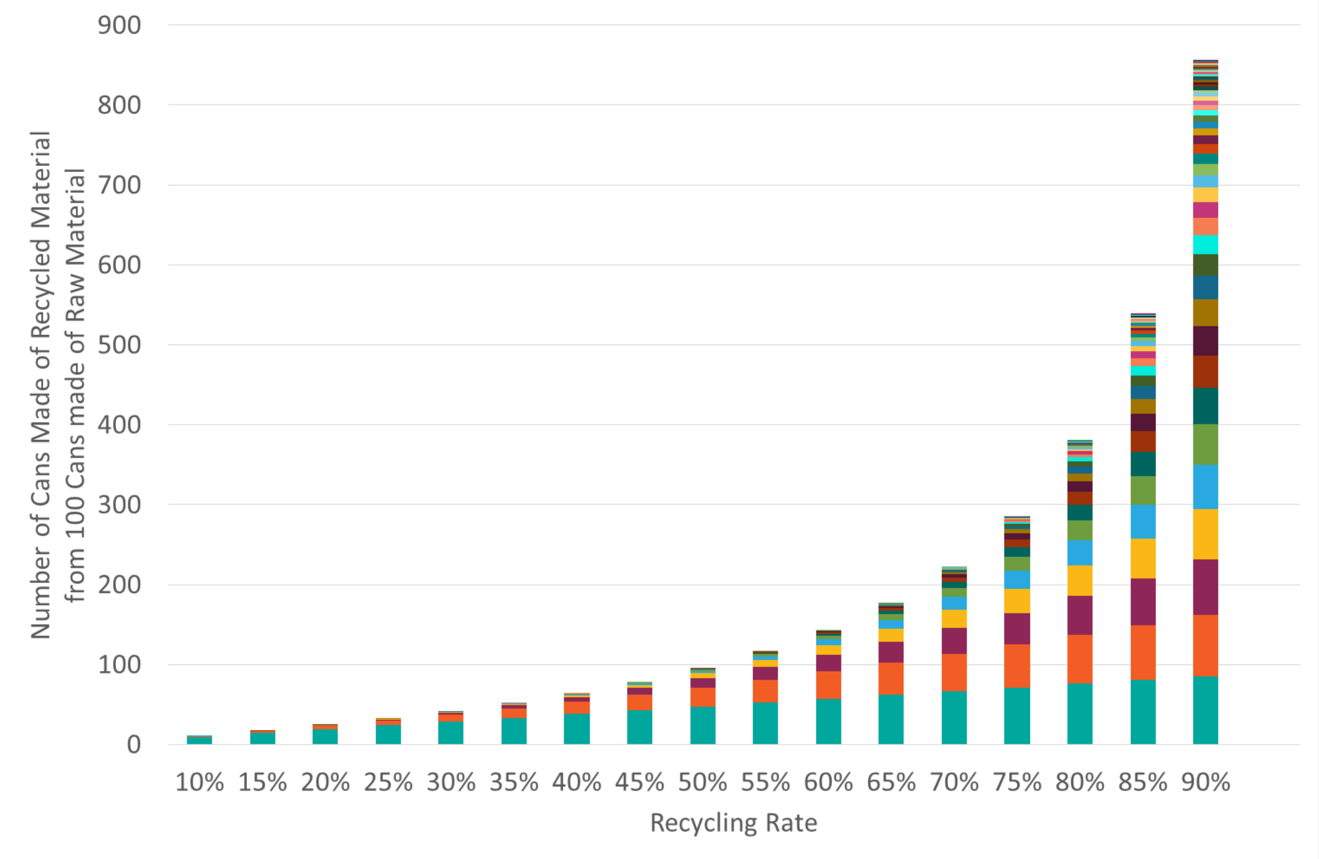
The exact design of the DRS significantly affects its success (measured by the return rate achieved), with some systems achieving less than 50% but others, with very different designs, reliably achieving over 90%. It is important that the Turkish DRS is designed for Turkey specifically, but also that Turkey reflects on best practice in other countries. This section considers lessons from high performing systems, as well as systems that have not achieved the same results, to inform a proposed design for Turkey that is intended to achieve a 90% return rate.

This 90% target is higher than the Government's targets in Table 3-1, but evidence from other countries indicates that such a return rate can be achieved with the right system. The ambition of Turkey's DRS should not be limited if it is to maximise the environmental benefits, support the Government's aim to divert waste from landfill and dumping sites, and increase the supply of recycled material. It is useful to think of this in terms of the cumulative use of recycled material.

If starting with 100 cans, and a 10% recycling rate, then enough recycled material would be available to subsequently make 10 cans, and at a 10% recycling rate from those 10 cans enough material would be available for only 1 can. However, at a 90% recycling rate, from 100 cans, recycled material for 90 cans would be available, from those 90, material for 81 cans, and so on.

As illustrated in Figure 4-1, a 60% recycling rate means 100 cans will only provide enough recycled material to make a cumulative additional 143 cans, whereas a 90% recycling rate would provide the material for a cumulative additional 855 cans – dramatically reducing reliance on energy-intensive and comparatively more expensive virgin aluminium.

Figure 4-1: Cumulative Impact of Higher Recycling Rates on the Availability of Recycled Material



In this section, each component of a DRS is considered separately, as existing systems will have some elements that are recommended and other elements that are considered to be less effective or appropriate for Turkey. It is also important to consider 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 considers the strengths and weaknesses of the different approaches, with the conclusions for Turkey following in Section 5.0. Before this, however, Section 4.1 provides a brief overview of the key terms and elements discussed in this chapter.

4.1 DRS Components and Terminology

- **Deposit**

Refundable amount used to incentivise the return of containers. It is taken at the point of purchase and consumers receive a refund when they return their used containers.

- **Scope**

The range of beverage container types and types of beverages included in the DRS.

- **Unredeemed deposits**

The deposits that consumers have paid but not redeemed by choosing to not return their containers. These can be used to contribute to funding the system.

- **Material revenue**

The returned containers are sold to be recycled; the revenue from the sales can be used to fund the system.

- **Central System Operator (CSO)**

Organisation established to operate a DRS, organise the logistics and provide a clearing house by managing all data, finances and compliance.

- **Return Infrastructure**

The place to which consumers can return their used containers for a deposit refund. This is typically beverage retailers or redemption centres.

- **Redemption Centre**

These are dedicated redemption points established in some systems as an alternative/ supplement to retailers taking back containers.

- **Reverse Vending Machine (RVM)**

Automated machines to which consumers can return their used containers; the machines scan the containers and provide a receipt for the deposit refund owed. Compacting RVMs crush the containers to prevent them being fraudulently returned multiple times and to increase the bulk density of the containers.

- **Manual returns**

Containers that are not returned to an RVM are handed over at the counter. As these are not scanned, counted and stored by the RVMs, these are sent to a counting centre to be counted and verified.

- **Handling Fee**

An amount per container that is paid in some systems to retailers or redemption centres for taking back used containers.

- **Producer Fee**

Paid by producers for every container they place on the market. These are typically calculated on a not-for-profit basis to make up the shortfall in funding after the unredeemed deposits and material revenue.

4.2 System Governance

Governance is primarily a question of how the system is run and by whom. There are three main options, as discussed in more detail in the boxes below.

Decentralised

Decentralised systems have no central co-ordination. Individual beverage producers are responsible for initiating the deposit, collecting their returned containers and reimbursing retailers/ redemption centres. The following are examples of decentralised systems in which details – such as the deposit value, return infrastructure, handling fees (in some cases) and scope – are specified in legislation.

- **Connecticut, USA**
- **Michigan, USA**
- **Massachusetts, USA**
- **New York, USA**
- **Germany**

Centralised

The DRS could be run by a single central system operator (CSO) that is responsible for the whole system, including administrative and logistical arrangements and managing the finances. The examples below are all not-for-profit, private enterprises. Most of these systems, particularly the European ones, give the CSO control over how the system is designed and operated.

Norway – run by Infinitum: owned by beverage industry and retailers; approved by the Climate and Pollution Agency.

Sweden – run by Returpack: owned by Swedish brewers and retailers; regulated by the Swedish Board of Agriculture.

Estonia – run by Eesti Pandipakend: a producer responsibility organisation, owned by soft drinks associations, brewers and retailers; accredited by the Ministry of the Environment.

Oregon, USA – run by the Oregon Beverage Recycling Cooperative: owned by beverage distributors and grocery retailers.

Publicly-Operated

While most systems in Europe and the USA are run by private industry, in some states the government acts as a system operator and takes responsibility for organising the finances, reconciling accounts and ensuring containers are collected to be recycled.

Hawaii, USA – run by the Department of Health.
California, USA – run by CalRecycle (California Department of Conservation).
Croatia – run by the Government’s Environmental Protection and Efficiency Fund.

4.2.1 Assessment

Centralised schemes are generally more transparent and accountable than decentralised ones, as there is a dedicated organisation responsible for the scheme's data management and overall success. The centralised systems listed in Section 4.2 publish annual reports and/ or annual 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, as 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 (discussed in Section 4.10), 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 containers 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 (see Section 4.7). 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.

While decentralised systems give beverage producers more freedom, decentralised systems also mean more responsibilities for producers, as there is not a single organisation to which they can delegate. All else being equal, a centralised system has the potential to be more efficient, in part because the CSO can achieve economies of scale (as they are managing all returned containers), but also because decentralised systems often create duplication, as multiple beverage producers are collecting their own containers, or have the administrative burden of contracting a company 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.

State-run systems do not support extended producer responsibility as, even if they receive a financial contribution from producers, the government will still be incurring administrative costs and dedicating public resources to the DRS. There can be less transparency over the costs in a publicly-operated system, so producers who are paying fees may not know exactly what they are funding and why, which can cause mistrust. As with some decentralised systems, such as Connecticut, unredeemed deposits going to state coffers means the state has no incentive to support a high return rate as the deposits can provide a valuable source of revenue.

4.3 Deposit Value

The deposit is the mechanism that incentivises consumers to return their used container. Consequently, the deposit needs to be set at a high enough level for consumers to feel it is worth returning their containers, without adding a prohibitive amount to the up-front cost of the beverage or significantly affecting producers' and retailers' cash-flow. As well as being proportionate to the price of the beverage, the deposit value should be balanced against the fraud risk, as a higher deposit means the rewards for defrauding the system are greater.

Deposits can be set in legislation or set by the CSO and are either a single flat-rate or varied by size of the container or type of beverage. The boxes below summarise the different approaches to setting the deposit.

Low Deposit Value

- **Connecticut**: $0.05, set in legislation since 1978
- **New York**: $0.05, set in legislation since 1982

High Deposit Value

- **Germany**: €0.25

Deposit Varying by Container Size and Type

- **Finland**
    - Plastic < 0.35 litre: €0.10
    - Plastic 0.35 – 1 litre: €0.20
    - Plastic >1 litre: €0.40
    - Metal: €0.15
    - Glass: €0.10

Deposits Exhibiting Best Practice Characteristics of Simplicity and Flexibility

- **Lithuania**: €0.10
- **Estonia**: €0.10
- **Michigan**: $0.10
- **Norway**: NOK 2 (Containers ≤ 0.5 litres) and NOK 3 (containers > 0.5 litres); increased by the Norwegian Environment Agency in 2018 to support a higher return rate.
- **Oregon**: $0.10; increased from $0.05 in 2017 following a legislative amendment requiring the deposit to be increased if the return rate fell below 80% for two consecutive years.

4.3.1 Assessment

Due to inflation, the deposit in Connecticut and New York has lost value in real terms, so the reward for returning used containers is not as high as originally intended. While there are a number of factors influencing the return rate, the 51% achieved in Connecticut, and New York's 66%, at least partially reflect the low deposit value. Table 4-1 shows how the higher deposit values are associated with higher return rates and Figure 4-2 shows the trend with a broader range of DRSs from around the world.

Table 4-1: Selected Deposits and Latest Return Rates

DRS	Deposit	Deposit in ₺[29]	Latest Return Rate
Connecticut[30]	$0.05	₺0.31	51%
New York[30]	$0.05	₺0.31	66%
Germany[30]	€0.25	₺1.85	98%
Finland[31]	€0.10 - €0.40	₺0.74 – ₺2.95	88-95%
Lithuania[30]	€0.10	₺0.74	92%
Estonia[30]	€0.10	₺0.74	83%
Michigan[32]	$0.10	₺0.62	91%
Norway[33]	NOK 2 – 3*	₺1.40 - ₺2.10	87-89%
Oregon[34]	$0.10	₺0.62	85%

While Germany is reported to achieve a high return rate, the fraud prevention measures are also more expensive than in the majority of systems and the requirement for this more expensive approach is partly attributed to the high deposit value.

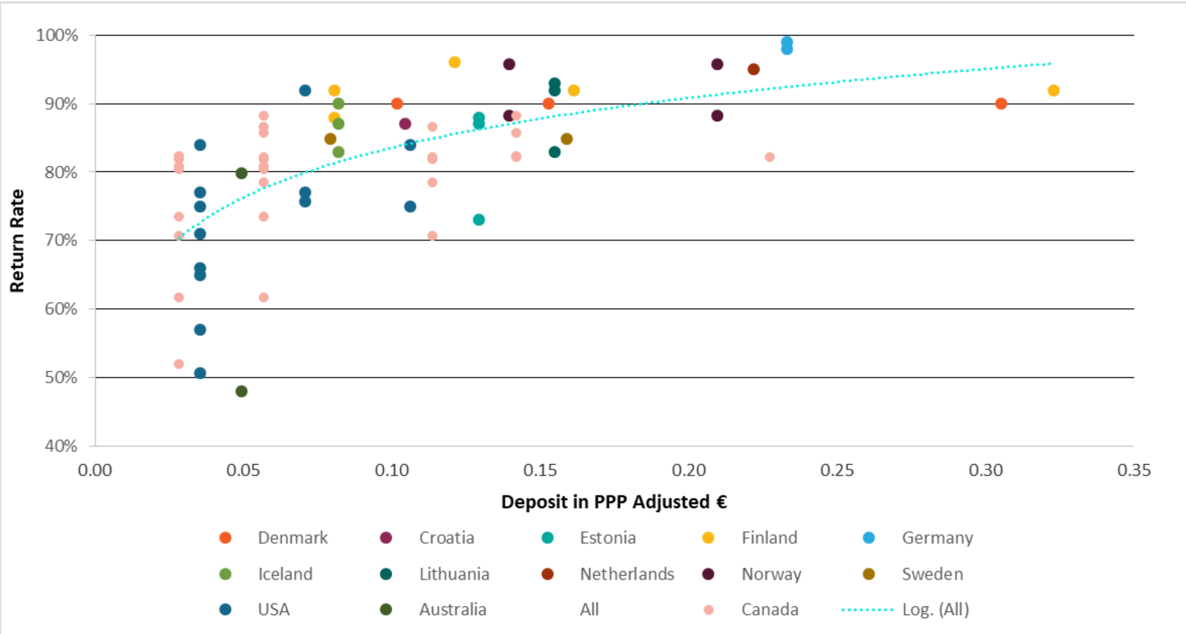
[29] Approximate values using exchange rates of €1 = ₺7.38, $1 = ₺6.16 and 1 NOK = ₺0.70
[30] Reloop & CM Consulting (2018) *Deposit Systems for One-Way Containers: Global Overview 2018*.
[31] https://www.palpa.fi/juomapakkausten-kierratys/pantillinen-jarjestelma/
[32] http://www.bottlebill.org/resources/pubs/2017%20Redemption%20Michigan.pdf
[33] Infinitum (2018) *2017 Annual Report*.
*Infinitum reports on the volume of containers returned to RVMs – which is understood to be over 90% of returned containers. Some containers are, however, returned manually. The deposit increased during 2018, so for part of the year, the deposit was NOK 1 and NOK 2.5.
[34] https://www.obrc.com/Content/Reports/OBRC%20Annual%20Report%202018.PDF

The single value, and to a certain extent the two-tier approach in Norway, provides clarity and simplicity, whereas the four deposit values in Finland 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 'upfront' purchase cost (even though the deposit is refundable).

The fact that Norway and Oregon have kept their deposit values under review means the deposits have been updated to reflect price changes and to increase the return rate as required. Oregon's return rate during January – March 2017, before the deposit increase, was 59%. Subsequently, between April and December 2017, with the increased deposit, the return rate was 82%.[35] In 2018, the first full year with the higher deposit, Oregon reported an 85% return rate.[36]

It is important that the system operator has the flexibility to increase the deposit value if return rates are falling. While 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, and 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 4-2: Return Rates as a Function of Deposit Values



Source: Eunomia

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

4.4 Return Infrastructure

Return infrastructure covers both where and how consumers can return their used containers for a refund of their deposit. Typically, either the return to retail or return to depot model is used (or a combination of the two).

Return to Retail

Return to retail requires shops that sell containers to take them back and refund the deposit to the customer.

Norway, Sweden, Finland, Denmark, Estonia and **Lithuania** enable consumers to return any deposit-bearing container to any beverage retailer, regardless of the brand. Denmark allows retailers near to each other to establish a joint facility, while Finland exempts retailers that have a floor space smaller than 200m^2. RVMs in a supermarket are pictured below.

Redemption Centres

These are specifically for the purpose of taking back used containers and refunding deposits. They could be run directly by the system operator or by private individuals and companies, and can be staffed or simply enable consumers to drop-off their used containers. The picture below is of a redemption centre in the USA.

Northern Territory, Australia only uses depots and mobile collection vehicles.

Hybrid

Connecticut, USA – retailers are obliged to take back the brands they sell and there are also redemption centres.

Vermont, USA – retailers can opt-out if there is a redemption centre nearby.

Oregon, USA – includes return to retail, with opt-outs if there is a nearby redemption centre, but an increasing proportion of containers are returned to BottleDrop facilities (pictured), where consumers can drop-off containers in bags tagged to identify them, and their accounts are later credited.

Source: OBRC

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.

Manual Returns

With a manual system, consumers hand over their used containers at the check-out to obtain a refund and the cashier places the containers in a bag. Containers that are returned manually are firstly transported to a counting centre so that the number of containers returned can be counted and verified.

Source: Returpack

Automated (RVMs)

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. Containers returned to a compacting RVM do not have to be sent to a counting centre and can go straight to processing. (Containers returned through non-compacting RVMs are, like manual-returns, taken first to a counting centre.)

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 Lithuania, the CSO provides the RVMs to retailers.

The picture below shows a bag of containers from an RVM; the bag is stored on a pallet that can be easily loaded onto a collection vehicle. As the containers have been compacted, they take up less space.

S*ource: Infinitum*

4.4.1 Assessment

While redemption centres make it easier for consumers to return their containers in bulk (mass redemption by professional redeemers is common in the USA), 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, whereas the return to retail approach allows consumers to claim their refund while they are doing their shopping or passing a shop, so is generally more convenient. In Norway, for instance, there are 15,000 return locations (shops, kiosks and petrol stations) so consumers do not have to travel far. As retailers are represented on the CSO board, they are consulted over how the system is operated.

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. There are, however, consequences for the logistics arrangements, as there will be more collection points than if only large redemption centres are used.

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. The approach in Vermont could cause uncertainty and inconvenience for consumers, if they go to a retailer and then find out that the retailer has opted out.

The BottleDrops in Oregon are proving popular, as they reduce retailers' involvement, reduce the infrastructure associated with traditional redemption centres and can allow consumers to redeem a significant volume of containers in a short time. They still however, require staff to process the containers. It is also interesting to note that Denmark trialled a similar approach, with 12 deposit return banks or 'pantstationer' (as shown in Figure 4-3). As 97% of consumers reported they were satisfied with these, Dansk Retursystem decided to keep the deposit banks, but opted not to roll them out further because the return volumes were too small and they were not economically viable.[37] This indicates that the return to retail model is the preferred approach, at least in Denmark.

Figure 4-3: A Deposit Return Bank in Denmark

Source: Dansk Retursystem[38]

[37] https://mst.dk/media/133289/annual-report-2016-dansk-retursystem.pdf
[38] https://pantstation.danskretursystem.dk/

In terms of RVMs, these incur purchase/ lease costs but can reduce overall costs incurred by the system operator, particularly if they are equipped with compacting technology. Compacting RVMs increase the bulk density of containers, reducing storage space and transport costs, as well as preventing any attempt to redeem the container more than once (as containers must be intact and have a readable barcode to be eligible for a refund). By scanning the barcodes and providing real-time data, RVMs can enable the CSO to monitor fraud, determine the optimal time to collect returned containers, reimburse retailers more quickly and plan the most efficient collection routes. Not every retailer will have an RVM, however, either because they do not have the space for an RVM and/ or they will not receive the volume of containers to justify an RVM. As a general rule, investment in an RVM is justified if a retailer receives at least 500-600 containers each day.

4.5 Scope – Beverage Containers

The scope is the range of containers included within the DRS, so there are two dimensions to this: container type and beverage type.

In countries with refillable bottles, a separate system tends to operate in parallel with the system for non-refillable containers, as the logistical arrangements are different. If there are two systems, the deposit logos should differentiate between refillable and non-refillable containers.

Broad Scope

- **Northern Territory, Australia** covers all container types, including PET, HDPE, metal, cartons and foil pouches.

Narrow Scope

- **The Netherlands** only includes plastic bottles ≥ 750 ml

Common Scope

- **Finland, Lithuania, Estonia, Germany** and **New York** include PET, metal and glass. Where size limits are specified (for instance in Germany and Lithuania), these are often from 0.1 to 3 litres inclusive. This is for practical reasons relating to the ease of transport and storage, and the ability of RVMs to process them. Systems in Canada, including Nova Scotia and New Brunswick, specify up to 5 litres.

4.5.1 Assessment

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.

The scope that is commonly found across Europe and the USA (plastic, aluminium and glass) means that the vast majority of beverage containers are included within the DRS. Including more container types does increase the sorting requirements, but this is not necessarily a significant obstacle for the system operator, as there is still a limited number of fractions to separate. It should also be noted that the weight and fragility of glass can increase transport costs. Norway and Sweden both claim to have very efficient logistics operations, but their systems are limited to metal and plastic. This could, however, potentially cause confusion if, for instance, a soft drink is sold in both PET and glass bottles, but only the former has a deposit.

There is some variation amongst the European and American systems, as some will include HDPE as well as PET (this may necessitate additional sorting, but is preferable, especially considering the higher value of secondary HDPE.) Where steel cans are used for beverages, these are often included in addition to aluminium.

In terms of cartons and foil pouches, these are not necessarily widely recycled and could increase the costs of the system due to the low, or negative, value. Including a deposit on pouches could also erroneously suggest to the consumer that their container will be recycled.

Excluding certain container types could mean that producers using these derive a financial advantage, but this can be avoided by introducing a supporting policy instrument (see Section 4.12).

4.6 Scope – Beverage Type

Inclusive Scope

- **Alberta, Canada** covers all beverages: alcoholic drinks, carbonated and non-carbonated soft drinks, juices, waters, milk and dairy products. Beer was added in 2001 and milk in 2009.

Intermediate Scope

- **Finland** and **Norway** include all beverages except milk.

Narrow Scope

- **Québec, Canada** only includes beer and carbonated soft drinks.

4.6.1 Assessment

As with the material type, including a broad range of beverage types will increase the potential impact of the DRS in terms of recycling rates and litter reduction. An inclusive scope is also simpler for consumers and retailers as they do not have to check which beverages do, and which do not, have a deposit. If only a limited range of beverages is included, as in Québec, 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.

An inclusive scope is arguably the fairest for all beverage producers, as no beverage or company gains an advantage from being included in, or excluded from, the scheme. It has the added benefit of simplicity for consumers, retailers and producers, and means consumers do not have to sort their containers – for instance if PET bottles for carbonated soft drinks are included but PET bottles for juices are not.

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 and milk is increasingly included, particularly in Canadian DRSs.

If only specific beverages are included, it is important that the scope is kept under review. For instance, the increasing popularity of bottled waters and sports drinks has meant that DRSs in some US states are covering a falling percentage of beverages that are sold.

4.7 Handling Fees

In most systems, retailers or redemption centres are compensated by the CSO (in a centralised system, or by producers directly in a decentralised system) for providing a take-back service.

Handling Fees Based on Costs

- In **Norway**, fees are calculated to reflect retailers' costs – staff time, retail space used and any RVM costs. Retailers with compacting RVMs are paid more in part to reflect their higher costs but also to recognise the efficiency savings they generate for the CSO. Additionally, the different materials entail different storage costs. Handling fees are paid by the CSO from their central pot.
    - Compacting RVM: 20 øre (₺0.14) per can and 25 øre (₺0.18) per plastic bottle
    - Manual/ non-compacting RVM: 5 øre (₺0.04) per can and 10 øre (₺0.07) per plastic bottle

Fixed Handling Fee

- In **Connecticut, USA**, all retailers receive the same fees so any retailer choosing to invest in an RVM will not receive any additional compensation. The handling fees are set in legislation and were last updated in 1986.
  - $0.015 for beer bottles (₺0.09)
  - $0.02 for containers of other beverages (₺0.12)

  Producers pay retailers/ redemption centres directly for each container of their brand they take back.

Variable Compensation

- In **Germany**, retailers are not paid a fee but they own the returned containers to sell for processing, so earn the material revenues.
- Retailers in **Michigan, USA** receive a share of 25% of unredeemed deposits (with the remaining 75% paid to the state), distributed according to the number of containers they take back.
- **California** pays a processing payment to redemption centres, intended to cover their net costs after material revenues (as the centres sell the containers). The fees can change quarterly due to varying material prices.

No Handling Fee

- In **Oregon, USA,** retailers do not receive a handling fee so are not compensated for their role. This may in part be why Oregon is having to extend its network of redemption centres, and consider alternative solutions such as the BottleDrop.

4.7.1 Assessment

The handling fees based on cost recovery mean retailers are fairly compensated, can predict their handling fee income based on anticipated return volumes and can make an informed decision about investing in an RVM. This approach also enables the CSO to incentivise the use of compacting RVMs to reduce the overall costs of the system.

Conversely, the fixed fee approach in Connecticut means that many retailers' costs will not be covered, so they incur 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 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, fees in Norway can be negotiated between the CSO and retailers and, as retailers and producers are represented on the board, all interests are taken into consideration.

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. Meanwhile, variable compensation, as in Germany and Michigan, means retailers cannot plan for their expected income, and their costs may not be covered if, for instance, there is a fall in material prices. Michigan's approach means the price retailers are paid per container falls as the return rate increases.

4.8 Material Ownership

The material returned to a DRS can have a higher value than that obtained through other collection methods due to the high quality and limited contamination associated with 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 feedstock that can be used to manufacture new bottles. There are a number of existing options for the material ownership, as outlined below.

CSO owns and markets the material

- In **Norway, Sweden, Finland, Estonia, Lithuania** and **Denmark**, the CSO arranges for the returned containers to be collected from retailers and processed. The CSO then uses the revenues to part-fund the DRS.

Producers own the material

- In the majority of DRSs in the **USA**, the beverage producer or distributor retains ownership of the material, so collects the revenues but is also responsible for organising transport and processing.

Retailers own the material

- In **Germany**, retailers retain ownership of the returned containers and use the income to cover their DRS-related costs.

4.8.1 Assessment

With CSO ownership, the material can be marketed *en masse* and the higher volumes can attract a higher price (which can then be used to offset producer fees). As more material is transported together, this can also support economies of scale and the CSO can design efficient collection routes. By contrast, individual producer ownership means containers may only be transported and sold by brand, creating inefficient duplication, preventing the use of large volumes to maximise income and creating additional responsibilities for producers, who contract a company to collect and process the containers. The same weaknesses apply to the German approach.

4.9 Unredeemed Deposits

Unredeemed deposits are deposits that have been paid by consumers when they buy their beverage but are not redeemed, either because the used container has been disposed of in residual waste, littered or recycled through a complementary collection system. There are a number of options for unredeemed deposits.

DRS Funds

- In centralised systems like **Norway, Sweden, Estonia and Lithuania**, the unredeemed deposits are retained by the CSO and re-invested into the system.

State Funds

- In **Connecticut, USA**, unredeemed deposits are paid into the State General Fund so are used to support government activities.

Producers

- In **Iowa, USA**, producers who initiate the deposit also keep the deposits that are not claimed.

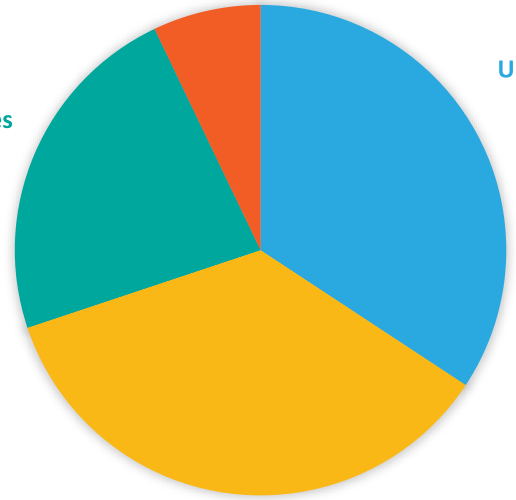
4.9.1 Assessment

If producers are allowed to keep the unredeemed deposits, producers have no incentive to support a high return rate. Similarly, governments that incorporate unredeemed deposits into their general budgets might begin to rely on these as a source of income so could again be less motivated to increase the return rate.

By contrast, 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 to meet.

As illustrated in Figure 4-4, unredeemed deposits cover 34% of Infinitum's costs in Norway. More than two-thirds (70%) of the Norwegian DRS is effectively self-funded as a result of the unredeemed deposits and material revenues.

Figure 4-4: Funding the Norwegian DRS in 2018



Source: Infinitum Annual Report 2018. "Other" will include revenue streams such as one-off registration fees and interest.

4.10 Producer Funding

Regardless of material ownership, the material revenues represent a source of funding for the DRS, either as a contribution to the CSO central funds (in a centralised system), as a form of handling fee (in Germany) or by off-setting producers' handling fee and logistics costs (in a decentralised system). The remaining costs tend to be paid in some way by producers but, as discussed above, their contribution could be offset by unredeemed deposits. The following design options are currently in place in different systems:

No Producer Funding

- In **Nova Scotia, Canada**, only half the deposit is refundable, with the remaining half being used to fund the system.

Direct Funding from Producers

- In decentralised systems like **Connecticut, USA**, there are no producer fees. Producers instead directly incur the administrative costs, handling fees and transport costs.

Producer Fee promoting eco-design

- In **Norway**, the net costs (after unredeemed deposits and material revenues) are covered by a producer fee, paid by producers for every container placed on the market. The fees vary by container type to reflect the different processing costs and material values. Consequently, producers are incentivised to design containers that are more cost-effective to recycle. Producers do not pay anything for aluminium because of its high value; on the contrary, aluminium has a "negative fee", meaning producers do not have to initiate the full deposit.
  - Aluminium can: -0.06 NOK (-₺0.04)
  - Steel can: 0.21 NOK (₺0.15)
  - Additional fee for plastic sleeve: 0.03 NOK (₺0.02)
  - PET Bottle: 0.12 NOK (₺0.08)
  - HDPE Bottle: 0.27 NOK (₺0.19)
  - Additional fee for light blue plastic: 0.08 NOK (₺0.06)
  - Additional fee for coloured plastic: 0.15 NOK (₺0.11)
  - Additional fee for standard barcode: 0.06 NOK (₺0.04)

4.10.1 Assessment

While there is an argument that Nova Scotia's approach is more transparent (if it is assumed that producer costs in both Norway and Connecticut are passed on to consumers in the beverage price), avoiding any direct contribution from producers does not support EPR. It also risks creating mistrust and confusion amongst consumers if not all the "refundable" deposit is refunded. Connecticut's approach means that producers' costs increase as the return rate increases (although they can off-set this with material revenues) and there is a lack of transparency over how much each company is contributing. Reports indicate that there is significant opposition from stakeholders to the DRS in Connecticut and it has one of the lowest return rates, which may be at least partially attributable to how the producers' role is configured, as well as the overall design of the system.

Basing producers' contribution on the number of units they place on the market (as in Norway), 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 using materials that will be more efficiently recycled. Moreover, the Norwegian approach avoids cross-subsidies as, if the fees were the same for plastic and aluminium, aluminium producers would effectively be subsidising plastic bottles with aluminium's higher value and lower processing costs.

4.11 Labelling & Fraud Prevention

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

- Producers under-reporting sales, meaning they avoid producer fees and initiating 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 returned, so a deposit that was paid out once is refunded multiple times.
- Retailers/ redemption centres over-reporting return volumes to claim more handling fees and deposit refunds.

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.

In addition to the container label being used to provide information to retailers and consumers, the label provides the primary means of detecting and preventing consumer/ retailer fraud. The different approaches are set out below.

High Security

- In **Germany**, DPG Deutsche Pfandsystem requires producers to use unique, Germany-specific barcodes that are registered with DPG (to avoid imported containers being used to claim refunds). Additionally, the deposit logo uses special DPG security ink that is read by the RVM's infrared scanning technology. Packaging manufacturers and label producers must have a licensing agreement with DPG to certify that they can buy and use DPG ink. Manufacturers of the ink will only supply it to licensed companies, and only licensed companies can acquire the necessary quality assurance unit to check the print quality of the marking.

Medium Security

- In **Norway**, container labels are required to include the deposit logo to signify the level of deposit paid. Additionally, all barcodes are registered with Infinitum and, as in Germany, RVMs scan the barcodes to reject containers that are not registered and so that Infinitum can monitor returns, compare these with sales volumes and identify any unusual patterns that indicate fraud.
  Producers have the choice of using a standard barcode (meaning the container could have been sold in any country) or a Norway-specific barcode. The latter reduces the risk of fraud because containers (on which a deposit has not been paid) cannot be easily imported from other countries. These unique barcodes are, however, more expensive for producers and distributors because they have to keep separate stock keeping units. Consequently, as indicated in Section 4.10, producers choosing a standard barcode pay an additional fee.

Low Security

- In most **US** states with a DRS, the label is simply used to convey to consumers the level of the deposit and is the same for all the deposit states. This means there is no way of verifying whether a container returned to a certain state was bought there, so a deposit may not have been paid at all or, potentially a container is bought in a state where the deposit is $0.05 and brought to a state where the deposit is $0.10.

4.11.1 Assessment

In Germany, there is a higher fraud risk due to the greater reward (the high deposit value) and the opportunity due to the free movement of goods and people across Germany's long land-borders. The ink, however, adds to producers' costs and there is additional bureaucracy in obtaining the ink and DRSs with lower deposits tend to pursue a different approach.

In most US states, the $0.05 deposit does not seem to justify more expensive fraud-prevention measures. It is, however, worth noting that companies like Pepsi have voluntarily added a “deposit code” in Michigan, where the deposit is $0.10. Pepsi’s size and sales volumes mean maintaining separate stock keeping units for individual states is more feasible.

Norway has adopted a compromise approach that is thought to be effective in preventing fraud but does not add prohibitively to producers’ costs. Norway also allows producers to decide which sort of barcode is most appropriate for them, as companies of different sizes and with different markets will decide whether the ease of the standard barcode justifies the additional fee.

4.12 Supporting Policy Instruments

Supporting instruments, such as a packaging tax, are sometimes introduced alongside a DRS and they could serve a number of possible purposes:

- A means of incentivising the achievement of targets;
- To level the playing field if not all containers are included within the scope of the DRS, or for all packaging types;
- To generate additional revenue to cover the costs of processing containers not collected by the DRS; or
- To promote eco-design or design for recycling of beverage containers (although this is not currently a main driver).

Beverage Packaging Tax

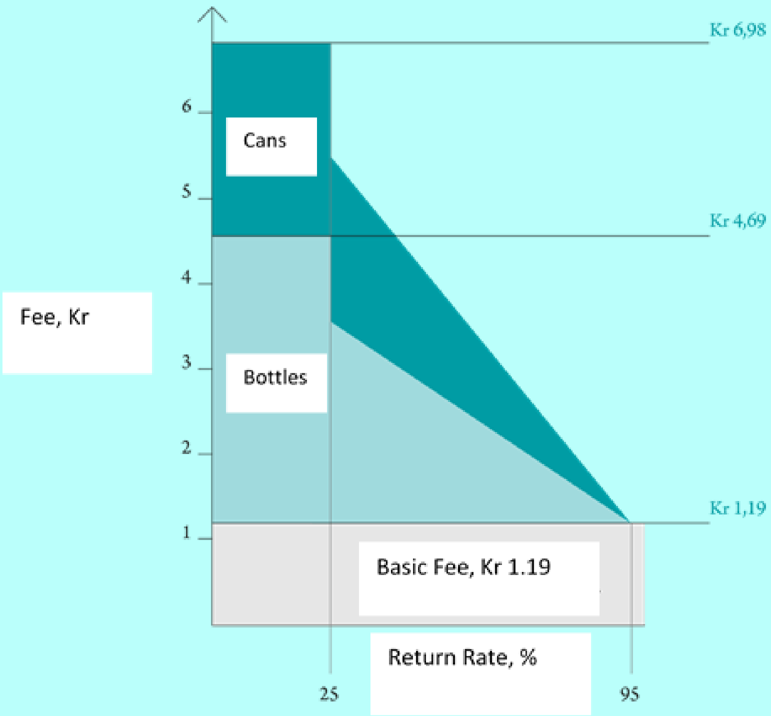
- In **Finland**, the Government imposes a Beverage Packaging Tax of €0.51 (₺3.76) per litre on certain alcoholic beverages and soft drinks, but producers are exempt if these drinks are part of an approved DRS return system, the containers are recycled and the system achieves a return rate of 75% in first year and 95% by the fourth year. Cartons are, however, excluded from the tax.
- Similarly, **Denmark** has a volume-based tax on beverage containers but exempts containers that are included in a deposit system. Non-carbonated soft drinks are exempt from the tax even if they are not part of a deposit system.

Extended Producer Responsibility system

- In **Sweden**, the producer responsibility regulations do not require the producers of cans and plastic bottles subject to the deposit to contribute to the EPR system for packaging. As producers of cartons do have to contribute to the EPR scheme, they are still required to contribute to the costs associated with the packaging they place on the market.

Beverage Container Tax – Norway

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 recycling rate less than 25%, producers pay the full amount of both taxes. Above 25%, the environmental tax is inversely proportional to the recycling rate and containers with a recycling rate of at least 95% are exempt.



Source: Infinitum

4.12.1 Assessment

Norway's Beverage Container Tax provides a financial incentive for producers to secure a high recycling rate. As cartons and glass bottles (which are not included in Infinitum's system) are subject to the tax, producers using these materials are still required to make a financial contribution that recognises the environmental costs of their containers.

The Finnish approach does not provide a completely level playing field because cartons are neither subject to the tax or included in the DRS. Likewise, Denmark's approach means that producers of non-carbonated soft drinks in cartons do not contribute to the DRS or pay the tax.

While a supporting policy instrument is recommended, and such instruments are associated with DRSs with higher return rates, most DRS jurisdictions do not yet use supporting policy instruments. This often means that there is little incentive for producers to achieve a high return rate, or penalty for a low return rate and only some producers incur the costs associated with the DRS (if not all container types or beverages are included in the system). This means producers may choose packaging that is excluded from the DRS.

4.13 Targets

Targets can be crucial to a successful system; Government-set statutory targets can help ensure that the CSO is focusing its efforts on improving the return rate and a target can be a mechanism for stakeholders to hold the CSO to account.

Statutory Targets

- **Finland**: 90%
- **Denmark**: 95%
- **Sweden** 90%

Financial Incentives

- **Norway's** Beverage Container Tax incentivizes producers to support a DRS that achieves a minimum recycling rate of 95% so that producers can benefit from the tax exemption.

4.13.1 Assessment

It is important that Governments, and producers in a centralised system, have a mechanism for monitoring the success of the DRS and holding the operators to account. It is notable that the systems with the lowest return rates (particularly in the USA) tend to not have any targets.

Statutory targets can prove effective, particularly when combined with financial penalties if the targets are missed. Norway's approach, however, has meant that producers have been positively motivated to increase the return rate even in the absence of an explicit government target. Infinitum expects the return rate to pass 90% in 2019 following the 2018 deposit increase, but already ensures that over 95% of containers are recycled by recycling those collected through other means.[39] Both approaches will require Government audits and oversight but, in the most effective systems, this is the limit of the Government's role.

4.14 Summary

It is clear from this chapter that there is a wide range of design options for each element of a DRS. In any system, no element can be properly considered in isolation due to the effect they have on other parts of the system. Taken as a whole, design choices can

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[39] Infinitum (2019) 2018 Annual Report.

significantly affect the success and efficiency of a system. Table 4-2 below summarises two systems at each end of the spectrum, both in terms of design and results achieved.

Essentially, the success of a system when measured by the return rate (this is not the only indicator of a successful system), depends primarily on the deposit level and the convenience of returning containers. How the system is established, however, also plays a key part: in Connecticut, most of the system specification is detailed in legislation and there is no target, so producers have neither the freedom nor the motivation to develop the most effective system. By contrast, the Norwegian Government does not even mandate a DRS – it was the producers' response to the Beverage Container Tax. Consequently, producers in Norway have both the freedom and the motivation to design an effective system, and to continually seek to improve its effectiveness.

Table 4-2: Comparison of Decentralised and Centralised DRSs

	Connecticut	Norway
Governance	Decentralised	Centralised
Target	None	95%
Deposit	$0.05 (₺0.31) Unchanged since 1978	≤ 0.5 litres: NOK 2 (₺1.40) > 0.5 litres: NOK 3 (₺2.10) Updated in 2018
Scope - Beverages	Beer, malt, carbonated soft drinks, water	All except milk products
Scope - Containers	PET, aluminium, glass	Plastic, metal
Return Infrastructure	Redemption centres and retailers	Retailers
Handling Fee	$0.015 (₺0.09) for beer bottles; $0.02 (₺0.12) for all others	Compacting RVM: 20 øre (₺0.14) per can and 25 øre (₺0.18) per plastic bottle Manual/ non-compacting RVM: 5 øre (₺0.04) per can and 10 øre (₺0.07) per plastic bottle
Material Ownership	Individual producers	Infinitum (the CSO)
Unredeemed Deposits	The state	Infinitum

Producer Funding	Producers cover direct costs for each of their containers that is returned.	Fee for every container placed on the market, used to promote eco-design.

5.0 DRS Design for Turkey

5.1 Governance

It is recommended that Turkey pursues a centralised, privately-led approach, with Government's role being simply one of oversight, i.e. verifying the system's performance. Evidence from other countries indicates that centralised systems are more accountable and transparent, as there is a single organisation that is clearly responsible for the system's success. This organisation can also design the system, manage the data, and organise the logistics to reduce costs.

The Ministry for the Environment and Urbanisation has indicated that the guiding principles for Turkey's DRS will be specified in a regulation. While the regulation could specify the containers on which a deposit is to be charged and a target (if a Beverage Container Tax is not used instead), and require retailers to take back used containers, it is important that the system has the flexibility to evolve and that producers – those funding it – can design the most effective system. While a minimum deposit value could be included in legislation, the system operator should be able to determine the exact level. In Estonia, for instance, the legal minimum is €0.03 but the current deposit is €0.10.[40]

Recommendation: Centralised & privately owned and operated

5.2 Deposit Value

While the system operator could consider a two-tier approach to the deposit structure, a flat-rate in the first instance provides simplicity and clarity, particularly while the system is being developed and as producers, retailers and consumers become acquainted with it. In Europe, Lithuania has the most recently implemented system, which has been in operation since 2016, and a flat-rate deposit was selected. The CSO should always keep the level of the deposit under review and, after analysing the return data for the first couple of years, can assess whether a higher value is needed for some or all containers.

In other European countries, a deposit of around €0.15 supports return rates of at least 80% and often over 90%. The deposit value needs to be adjusted for the local economy,

[40] Balcers, O., Brizga, J., Moora, H., & Raal, R., (2019) *Deposit Return Systems for Beverage Containers in the Baltic States*

however, to ensure it is proportionate. Adjusting deposit levels in different countries for purchasing power parity (PPP) means they can better inform decisions on an appropriate deposit value, as the PPP adjusted figures take account of the relative strength of the economies and differences in wealth.

Table 5-1 indicates that the lowest flat-rate deposit is approximately ₺0.078, however this is the value in US states that have not changed since the 1970s and 1980s. Within Europe, the flat-rate deposits range from ₺0.176 to ₺0.519. The average of the 11 values across the seven European countries ₺0.386. These estimates are, however, based on the OECD's 2018 values and the Turkish economy is relatively volatile at the moment, with the value of the Lira falling over the last year and consumer price inflation standing at over 19% between September 2018 and March 2019, peaking at 25.24% in October.[41] This means that the PPP-adjusted figures may not as accurately reflect the current state of the Turkish economy. This is another reason to not include the deposit value in legislation, as the deposit may need to be reviewed regularly, which will be more difficult if any change requires legislative approval and would place unnecessary demands on the Government's time.

Table 5-1: Deposit Values Adjusted for Purchasing Power Parity

	Deposit (national currency)	Deposit (PPP-adjusted ₺)[42]
Denmark	1DKK; 3DKK	0.229; 0.686
Estonia	€0.10	0.287
Finland	€0.10; €0.40	0.179; 0.717
Germany	€0.25	0.519
Lithuania	€0.10	0.347
Norway	2NOK; 3 NOK	0.299; 0.449
Sweden	1SEK; 2SEK	0.176; 0.352
United States	$0.05; $0.10	0.078; 0.156

As a comparison, the plastic bag charge in Turkey is currently ₺0.25. According to the PPP data, this is higher than the lower deposits in Denmark, Finland and Sweden, although the average deposit value in these countries is higher.

[41] TÜIK: http://www.turkstat.gov.tr/UstMenu.do?metod=temelist. Accessed 29/04/19.
[42] Data extracted on 18 Feb 2019 12:28 UTC (GMT) from OECD.Stat

Plastic bag charges are typically nominal values to deter the use of “single use” plastic bags and encourage consumers to think whether they actually need a bag. A deposit on a beverage container serves a different purpose, as it is intended to incentivise consumers to actively return their used container. As a result, it makes sense for the deposit to be slightly higher than the plastic bag charge.

As a result, a deposit of ₺0.30 will be used in the modelling. This is possibly on the low side, but it is easier for the CSO to subsequently increase the deposit than to reduce it (partly for practical reasons, and partly because it may send the wrong message to consumers as they may think it is less worthwhile returning their containers if the deposit falls). Given the changing economic situation in Turkey, the CSO will need to review appropriate deposit values when it begins to introduce the DRS in 2021. If Turkey’s rate of inflation continues at around its current levels, ₺0.30 will be too low and will not support a high return rate.

At the point of sale, the deposit should be marked separately to the price of the beverage and should not be subject to sales tax, as this would not be refundable.

Recommendation: ₺0.30

5.3 Return Infrastructure

The Government’s Environmental Law includes an obligation for points of sale to take part in the system, but it is not clear at this stage if this relates to the refunding of deposits, or just to charging a deposit at the point of sale. Nevertheless, the return to retail model is most convenient for consumers (supporting a high return rate) and reduces the up-front investment needed to establish the DRS. Allowing consumers to return their containers when they do their shopping avoids the DRS creating additional consumer journeys (and the associated environmental impact of such travel). As there will be more collection points, however, it will be important for the CSO to design efficient collection routes that minimise distances. It may be that the CSO uses some back-hauling, whereby distributors delivering new stock to retailers take back returned containers to their distribution depots, from where the CSO will arrange onward transport. This avoids the CSO having to visit every single retailer and utilises the empty space in delivery vehicles on the return journey.

Including all retailers in the system avoids advantaging/ disadvantaging some retailers (in other countries, retailers have reported that the DRS is good for business by increasing footfall to their shops and giving customers cash to spend in store). In countries with exemptions or opt-outs for small retailers, it is understood that these retailers sometimes still choose to refund deposits and then take the container to a larger retailer so that they can be reimbursed for the deposit. As they are not a registered collection point, such retailers forego a handling fee but seem to have decided that it is worthwhile providing this service to their customers.

With the growth of chain stores in Turkey and the decline of bakkals, it seems unlikely that bakkals would risk discouraging footfall by not participating in the system and the handling fee could be a valuable source of income. Universal retailer take-back also means that consumers will not be turned-away when trying to return their container to a retailer that is not participating in the scheme. It may be that, in areas with a high density of beverage retailers, some retailers group together to provide RVMs in a central location, so not all retailers will necessarily need collections.

It is likely that larger retailers will have RVMs and, where these are used, it is recommending that they are equipped with compacting capabilities. For the purposes of the modelling, it will be assumed that retailers buy the RVMs (paid back over a number of years), however retailers could have a lease agreement with the RVM manufacturers, or the CSO could supply the RVMs to retailers.

Containers returned to retailers with an RVM can be transported directly for processing, as they have been counted and verified by the machines. 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. The CSO is responsible for arranging collections; they sometimes put the logistics operations out to tender and retailers/ distributors back-hauling the used containers can charge for this service.

While online sales have represented a relatively small share of the market in Turkey, the popularity of online shopping is expected to increase. It will therefore be important that the same obligations apply to online retailers. This is in part to be fair to competing retailers, but also to ensure that people shopping online have the same opportunities to return their containers for a refund, especially as people may opt for online shopping because they do not have time to visit the shop or because health or mobility issues makes it difficult for them.

In Norway, consumers can buy special bags from their online retailer, which they can use to return their used containers when they next receive a grocery delivery. The bags are barcoded and embedded with a code to track their contents and ensure the consumer receives the correct refund.[43]

HORECA establishments will need collections for the containers of the beverages they sell on the premises, however it is not expected that consumers will return containers bought elsewhere to restaurants and other hospitality businesses.

Recommendation:	Return to retail. Compacting RVMs where justified by return volumes.

5.4 Scope – Beverage Type

An inclusive scope will maximise the impact of the scheme and provide simplicity. It is therefore recommended that Turkey includes all beverage types, with the exception of

43 https://kolonial.no/sok/?q=infinitum

milk. Milk could be added at a later stage, as happened in Alberta, Canada, but Turkey can wait to see how other systems adapt to milk being included. There is an argument for excluding wine and spirits because they represent a small percentage of the market and are more likely to be imported (which also means the fraud risk could be greater). However, Turkey needs to increase its recycling rates for all types of packaging and including more drinks within the scope of the DRS will help to achieve this. Glass can be difficult and expensive to collect and process and has a low material value, but a DRS can be the most effective method to collect glass – reducing contamination levels so that the glass can be used to manufacture new glass bottles and reducing wear and tear on material recovery facilities.

Recommendation: Carbonated and non-carbonated soft drinks (including waters and juices); beer; cider; wine; and spirits.

5.5 Scope – Beverage Containers

Glass bottles, cans (aluminium and steel), and PET bottles are to be included. While including HDPE could increase the need for sorting, it is proposed that such containers are also included, partly because HDPE has a high value. Additionally, consumers may not necessarily distinguish between HDPE and PET so it could cause confusion for retailers and consumers if some juices in plastic bottles (PET) are included while other juices in plastic bottles (HDPE) are excluded.

Pouches are excluded from this design, in part because they do not represent a significant proportion of the market and they are not included in many schemes, but also because they are not commonly recycled.

It is also proposed that cartons are not included at this stage, but the Turkish CSO should monitor their inclusion in other, longer-established systems, and consider expanding the scope in the future.

Recommendation: Glass, metal, PET, HDPE are included.

5.6 Retailer Compensation

Retailers should be paid a handling fee that recognises:

- The retail space they have given up to allow space for RVMs and/ or returned containers;
- The staff time taken to service RVMs, refund consumers and help with collections, and the associated staff wages;
- The purchase, installation and operating costs of RVMs (where used);
- The efficiency savings compacting RVMs generate for the CSO; and
- The different costs of managing each material type (the size, density and fragility of glass bottles meaning they can be more costly to store than metal cans).

As such, handling fees are likely to be reviewed annually to take account of inflation and changes in rental/ staff costs, or efficiencies that mean costs have reduced.

It is not proposed that handling fees are paid to HORECA establishments, as restaurants and cafes will not be incurring any additional costs as a result of the DRS. As most beverage containers will not leave the premises, restaurants do not need to pass on the deposit to customers and consumers will not be bringing in used containers to claim a refund. As businesses in many countries pay for their waste collections, a DRS could actually save them money because the DRS will be responsible for collecting the used beverage containers.

Recommendation: Variable handling fee based on retailers' costs and CSO's savings.

5.7 Funding

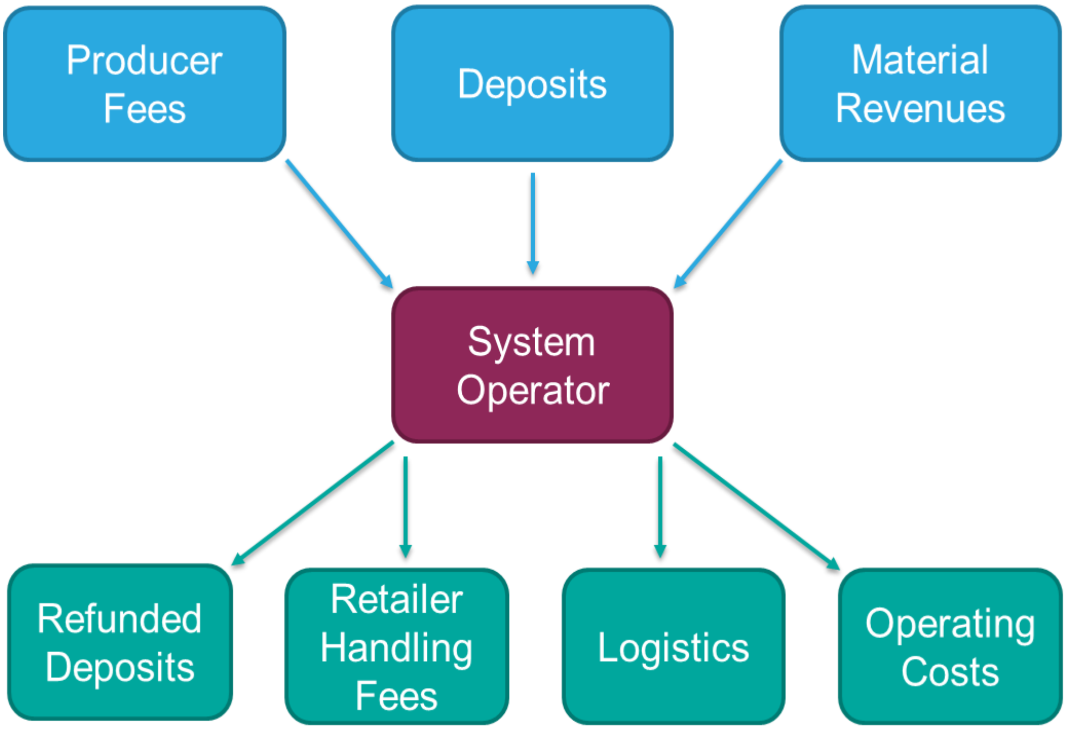
In line with best practice, the CSO should be the material owner so that it can collect and market the material in bulk and secure the best prices. The revenues will then be used to part-fund the system. This helps to incentivise the CSO to increase return rates and the high quality of the returned material means it can be used to meet recycled content commitments for new beverage containers. Beverage companies are increasingly making voluntary commitments to increase the recycled content of their containers, and the EU's single use plastic directive includes a minimum recycled content of 30% for PET bottles by 2030 (with an interim 25% target for 2025).

Similarly, unredeemed deposits are to be retained by the CSO and re-invested in the system.

The net costs, after unredeemed deposits and material revenues, should be covered by producer fees, paid on each container placed on the market. As in Norway, the fees should reflect the different costs and values of each material and can discourage the use of, for example, plastic sleeves, by charging an additional fee that recognises their negative impact on the recycling process. This will support the requirement under the Government's Regulation on the Control of Packaging Wastes for producers to design packaging in such a way as to minimise waste production and to support recycling.

The proposed funding structure for the DRS is illustrated in Figure 5-1: there is one central budget from which all the DRS costs are paid.

Figure 5-1: CSO Sources of Funding and Costs for Turkish DRS



5.8 Labelling and Fraud Prevention

The CSO should introduce a deposit logo to indicate to consumers and retailers that the container is part of the system and the value of the deposit to be paid/ refunded. Producers should be required to register all containers, and their barcodes, with the CSO. The size of the Turkish market may well justify the use of national barcodes for some producers. However, given that some producers may use their Turkish distribution lines to supply neighbouring countries, it seems preferable to maintain a flexible approach, with a financial incentive for producers choosing a national barcode by increasing the producer fee for containers with a universal (international) barcode.

Recommendation:	CSO-issued logo and choice of national or international barcode, with a higher producer fee for international barcodes.

5.9 Supporting Policy Instruments

The ideal approach is for the Government to introduce a Beverage Container Tax to incentivise a high return rate, as in Norway, and reward producers for exceeding a statutory target (if targets are set in law). Such a tax would be a political decision for the Government, however. If this approach is not considered feasible or desirable, the Government should ensure that beverage containers within the scope of the DRS are exempt from PRO fees and that the PRO fees on beverage cartons and pouches are high enough to prevent producers switching to these to avoid the DRS.

Recommendation:	Beverage Container Tax to incentivise a return rate ≥ 95% and so that producers of pouches and beverage cartons are not given a financial advantage over formats within the DRS.

5.10 Targets

If the Government does not introduce a Beverage Container Tax, it is important that Ministers include a recycling target in the regulation to increase the likelihood of a high return rate and that returned containers are recycled.

Ultimately, the DRS should be aiming for 90%, albeit this should not be expected in the first year. The Finnish regulation, for instance, stipulated that the DRS should be able to achieve its targets after the third full year.[44] Lithuania only required two years to achieve a 92% return rate after 74% in the system's first year.

As Turkey is in the process of rolling out its waste infrastructure and recycling services are not yet well-established in all areas, its current recycling rates are thought to be significantly below 90% but this should not inhibit Turkey's ambitions for a DRS. A well-designed system should still be able to secure a high return rate even if there is not an established culture of recycling and widespread complementary collection systems. Particular attention may need to be paid to popular tourist areas, as tourists may not be familiar with the deposit system or know how to redeem their deposit. While this could pose challenges, Turkey's informal waste sector could compensate for low returns in some areas, as they may pick-up discarded containers to claim the deposit.

With a legislative target, a Beverage Container Tax could still be used to provide an incentive to achieve and indeed exceed the target.

Recommendation:	90% target

5.11 Summary

Table 5-2 lists the recommended design options for Turkey. These are based on existing best practise from established systems. As such, the design features have proven to be effective in other countries, but the CSO will be best placed to discuss with producers and retailers the exact design and adapt details as necessary.

[44] https://www.finlex.fi/fi/laki/alkup/2013/20130526

Table 5-2: Summary of Design to be Modelled

Element	Option Chosen for Turkey
Governance	Centralised; privately owned and operated; targets set by government (and/ or Beverage Container Tax)
Scope – Containers	PET, HDPE, metal, glass
Scope - Beverage	Water; soft drinks; juices; beer; cider; spirits and wine
Deposit Level	₺0.30
Labelling	Deposit logo and choice of international or national barcode, with lower fees for a Turkey-specific 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.
Material ownership	System operator
Funding	Material Revenues Unredeemed deposits Producer fee for every container placed on the market
Supporting Economic Instruments	Beverage Container Tax for container types with a collection rate below 95%

Figure 5-2: Flow of Data, Money and Containers in the Turkish DRS

6.0 Modelling Methodology

Eunomia's DRS model calculates the overall system resources and costs associated with implementing a DRS. The model has been specifically adapted for Turkey and the system detailed above. To compare the costs of the DRS with the current costs of collecting and processing containers that are littered, recycled or treated as residual waste, the bring-site system is also modelled to provide a baseline and assess the impact of removing most deposit-bearing containers from the existing system. The component parts of the models – illustrated in Figure 6-1 – are discussed in brief in the following sections, with full details provided in the technical appendix.

Figure 6-1: Elements Included in the Modelling Process

6.1 Mass Flows

The first step in an analysis of the costs and benefits of the DRS is to consider the material flows in Turkey, 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 provided by TÜÇEM is combined with existing data on average weights of containers to calculate the total tonnage of each fraction placed on the market.

The next step is to determine what percentage is currently recycled, littered or landfilled. Recycling rates are taken from the Ministry of Environment and Urbanisation's 2017 Packaging and Packaging Waste Bulletin; as recycling rates for beverage containers specifically are not available, the rates for each material fraction are used. The recycling rates in the Bulletin are higher than the more general recycling rates reported elsewhere; the higher rates are used to avoid underestimating the potential impact on existing recycling services and so that, if anything, the environmental impact of the DRS and the impact on residual waste collections are under-stated.

A littering rate of 4.6kg per person per year is assumed, based on average littering rates in the EU28. This gives the total tonnage of all litter each year so information from litter composition studies is used to calculate the tonnage of beverage containers that are littered and left in the environment.

The remaining waste is assumed to be sent to residual waste disposal. Data from the Turkish Statistical Institute (TÜIK) indicates that nearly all residual waste disposal is via landfill, either at the municipal dumping sites or controlled landfill sites. 0.19% of waste is sent to 'other disposal' (burning in an open area, lake and river disposal, burial, other disposal methods). These unconventional disposal methods are associated with a high environmental disamenity, and are therefore grouped with litter in the modelling.

Based on these inputs and assumptions, the final material flows used in the analysis are shown in Table 6-1.

Table 6-1: Beverage Container Mass Flows Currently and under a DRS

	Baseline (Tonnes)				DRS (Tonnes)			
	Plastic	**Metal**	**Glass**	**Total**	**Plastic**	**Metal**	**Glass**	**Total**
Put on the market (incl. free riders)	156,130	33,948	1,104,742	1,294,820	156,130	33,948	1,104,742	1,294,820
Collection								
DRS returns (including cross border)	-	-	-	-	141,767	30,241	993,330	1,165,338
Other collection routes & littered	156,130	33,948	1,104,742	1,294,820	14,363	3,706	111,413	129,482
Final Destination								
Recycled	79,318	18,086	236,551	333,954	148,355	32,065	997,319	1,177,739
Residual disposal (landfill & incineration)	72,054	14,847	834,848	921,750	7,067	1,729	102,417	111,214

	Baseline (Tonnes)				DRS (Tonnes)			
	Plastic	Metal	Glass	Total	Plastic	Metal	Glass	Total
Litter that remains in the natural environment	4,758	1,015	33,343	39,116	707	154	5,006	5,867
Recycling Rate, %	50.8%	53.3%	21.4%	25.8%	95.0%	94.5%	90.3%	91.0%
Litter Rate, %	3.0%	3.0%	3.0%	3.0%	0.5%	0.5%	0.5%	0.5%

6.2 Baseline Analysis

Bring-site (container-based) collection modelling is undertaken to assess the impact on current waste services. A simplified version of the European Reference Model on Municipal Waste Management is used to calculate the effects on the recycling and mixed waste schemes associated with the change in waste flows under a DRS.[45]

There are challenges in assessing the most likely impact on existing mixed and separated waste collections, given that the services vary significantly between municipalities and, due to the local elections in Turkey occurring during the study period, local government representatives have not been available for interviews.

However, a 'baseline' model is created that represents the current service for areas with urban, semi-urban and rural housing densities. Inputs are based on values provided by TÜÇEM where known, and are otherwise Eunomia assumptions (more information is provided in the technical appendix). Key variables are then adjusted to calculate the changes in waste flows, collection frequency, and associated costs in terms of vehicles, staff, sorting and disposal costs.

It is assumed that all municipalities provide collection containers for residual waste and a collection container for mixed recyclables. TÜÇEM provided information on the numbers of collection containers required and the distance between these containers depending on the population of different municipalities.

The introduction of a DRS entails a reduction in beverage containers collected within the recycling containers and in residual waste. It is assumed that, with a DRS, the collection site distribution remains the same but each collection container fills more slowly.

[45] Eunomia (2015) *Further Development of the European Reference Model on Waste Generation and Management. Final Report for the European Commission*. May 2015. https://publications.europa.eu/en/publication-detail/-/publication/d188ce6e-9cac-11e5-b792-01aa75ed71a1

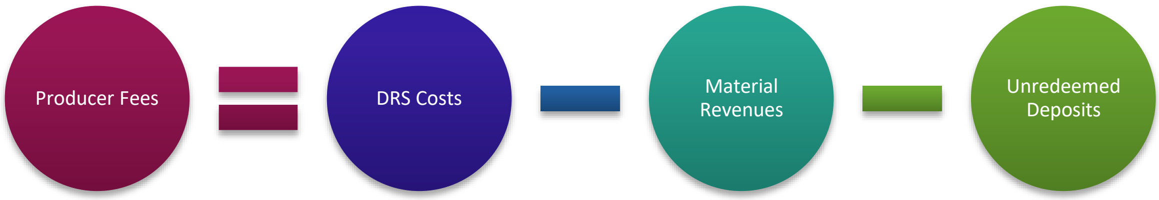
Similarly, the collection containers are assumed to be collected at the same level of fill, meaning less frequent collections are required under a DRS than at present.

The model calculates the resulting changes in staff and vehicle requirements, sorting costs, bulking and hauling, disposal costs and material revenues. For residual waste, a gate fee of ₺93 per tonne is applied, based on information from landfill sites in Istanbul. While it appears that this is higher than at some landfill sites (others were found to charge ₺85 per tonne), the higher figure has been used because, if Turkey is to meet the Government's recycling targets, the price of residual waste disposal may have to increase.

6.3 DRS Model

The DRS model is used to calculate the initial set-up costs of the DRS, 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 6-2.

Figure 6-2: Calculation of the Net Costs to Producers



6.3.1 System Costs

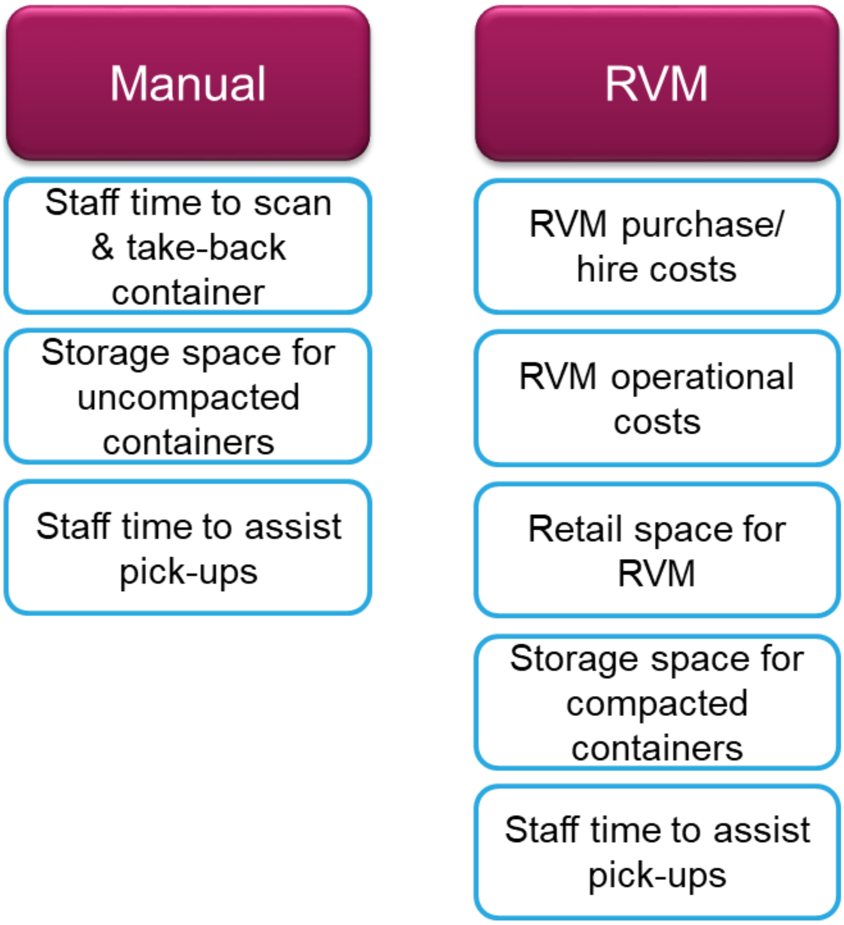
This section gives a brief overview of the methodology used to calculate the system costs associated with the set-up and ongoing operation of the DRS. A more in-depth methodology, including detailed assumptions, can be found in Section A.3.0.

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 6-3: Costs Used to Calculate Retailers' Handling Fees



As indicated in Figure 6-3, 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. [46] It is assumed that retailers would use only one method and so would not provide both a manual service and RVMs at one

[46] Retailer numbers provided by TÜÇEM

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. It has been calculated that 10 counting centres is the optimal number for Turkey, taking into account transportation efficiency and capital costs.

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 Section A.3.4. Some of the main assumptions that drive the calculations are:

- all material collected through RVMs is compacted, and all material collected manually is uncompacted; and
- there are two collection rounds, a "large shop" round which collects from the largest three retailer size bands, and a "small shop" round which collects from everywhere else.

6.3.2 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 two places: sale of materials and unredeemed deposits. Revenue from materials is calculated based on the total recycled tonnage taken from the waste flows (see Section 6.1) and average price per tonne figures for each material stream.[47] 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% losses to the system from deposits paid out in error (fraud).[48]

6.4 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; recycling; and landfilling.

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[47] Provided by TÜÇEM

[48] There is little reliable data on fraud, but fraud is not generally considered a significant problem in European DRSs with similar fraud prevention measures to those proposed for Turkey. 1% has been chosen as a reasonable assumption that ensures the potential losses are represented in the system costs.

These impacts are given a monetised value in order to put the societal impacts of the DRS in context. In terms of transport, while the return to retail model is designed to enable consumers to return their used containers when they do their shopping – 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.4.0.

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 baseline analysis due to the absence of reliable data on litter-related expenditure and an objective way at present to allocate any cost estimates to beverage containers specifically. Unlike the collection of waste from litter bins, which may require less frequent emptying, 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.4.6.

7.0 Turkish DRS Costs and Benefits

7.1 Impact on Existing Waste Services

Table 7-1 summarises the results of the bring-site modelling, with savings shown in green and losses shown in red. On the basis that Turkey is currently achieving a 54% recycling rate for plastic beverage bottles, a 57% recycling rate for metal cans and a 23% rate for glass bottles via co-mingled bring banks, it is estimated that the recycling services can make annual savings of ₺166.2 million. These savings will, however, be offset by the lost material revenue, meaning an overall loss – for the recycling services specifically – of ₺125.8 million.

There are, however, more significant savings to be made with the collection and disposal of residual (mixed, landfilled) waste. The ₺160.1 million savings mean that, overall, the costs of existing waste services could be reduced by ₺34.3 million.

Table 7-1: Estimated Impact of Removing 90% of Containers from the Waste Stream

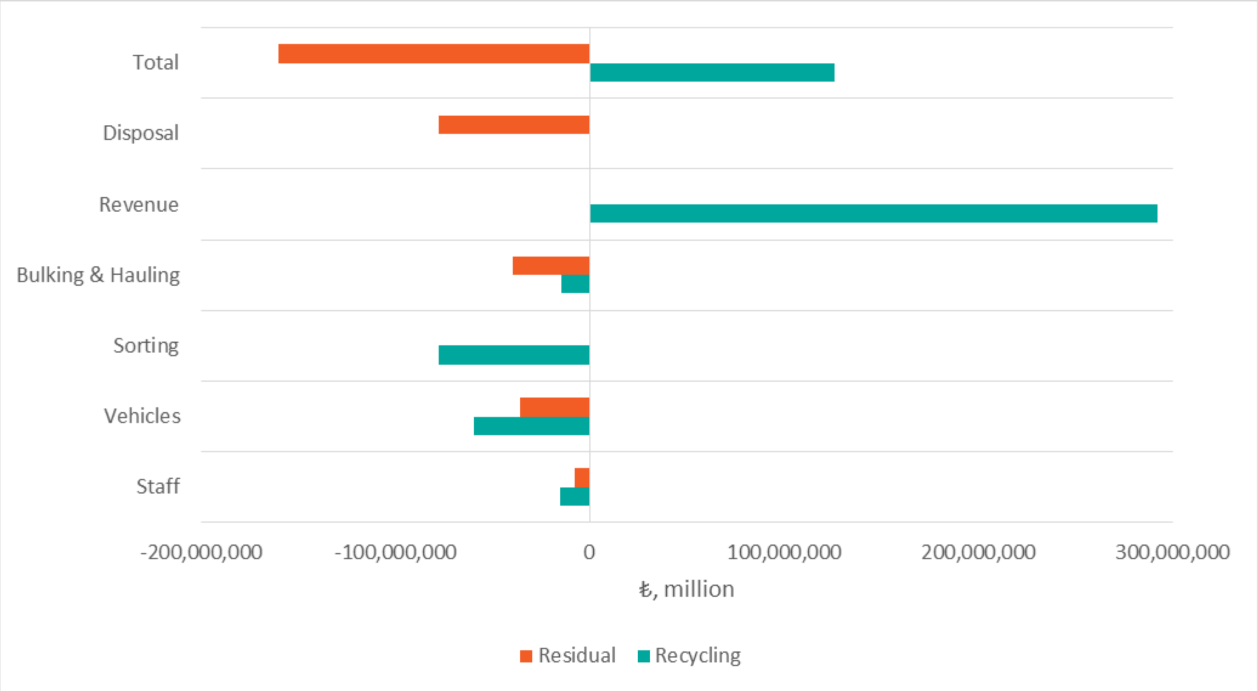
	Recycling (₺)	Residual (₺)
Staff	-14,900,000	-7,600,000
Vehicles	-59,300,000	-35,900,000

Sorting	-77,700,000	0
Bulking & Hauling	-14,200,000	-39,300,000
Revenue	292,000,000	N/A
Disposal	N/A	-77,300,000
Total	125,800,000	-160,100,000
Savings are negative; lost revenue and additional costs are positive figures shown in red.		

As it is understood that waste operators are not paid for the recycling collections, they will be losing the ₺125.8 million, although it is not known how much of the existing revenues are collected by official waste operators, and how much is collected by the informal sector. The lost revenue resulting from the diversion of beverage containers to the DRS could be at least partially offset by increasing the recycling rate of other packaging types. It may also mean that waste operators will in future need to be paid by municipalities or PROs for the service they provide. As it seems that municipalities pay for the residual waste collections, they are likely to benefit from the ₺160.1 million in savings.

Municipalities that do not currently provide recycling collections, or that have a lower density of bring-sites and/ or lower recycling rates, would be expected to save more as they have less revenue to lose and will have more to save in disposal costs.

Figure 7-1: Savings and Costs Resulting from the DRS



Cost savings are negative and increased costs are positive figures.

7.2 DRS Costs

Table 7-2 provides a breakdown of the total annual costs of the DRS, and the cost per container placed on the market. These costs incorporate annualised figures for the initial set-up costs (see Section 7.4).

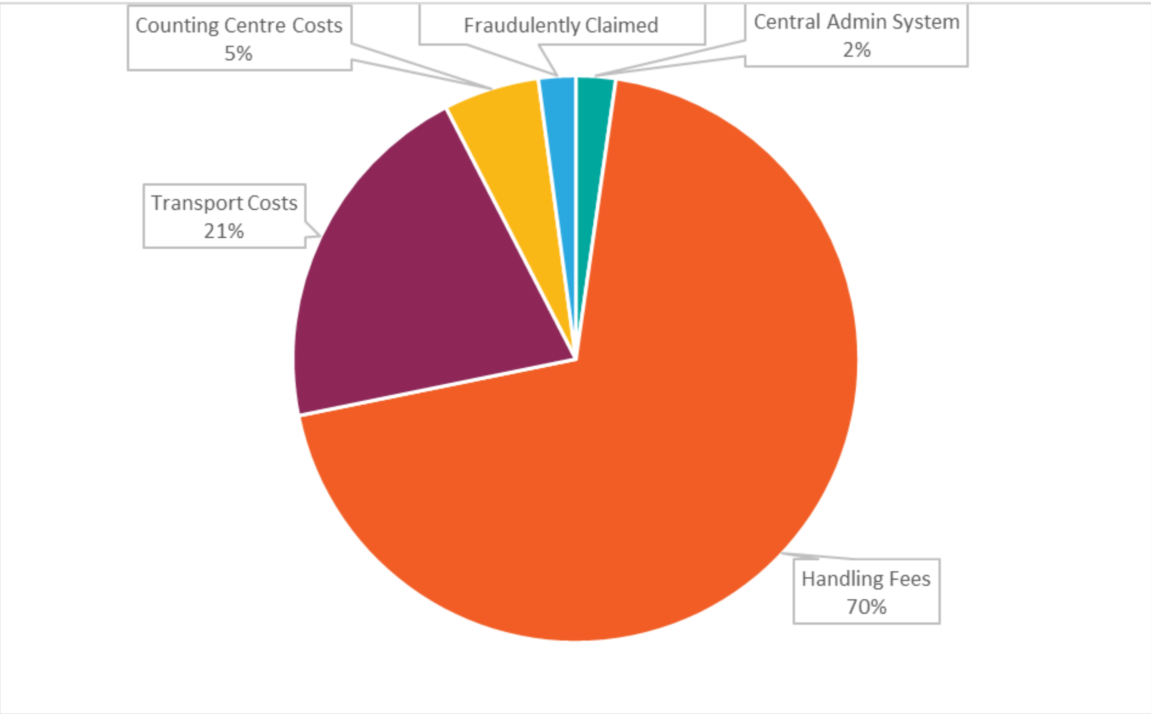
Table 7-2: Annual DRS Costs and Revenues

	Total Cost, ₺million	Cost/Unit Placed on the Market, ₺
Central Admin System	38.86	0.0029
Handling Fees	1,191.83	0.0884
Transport Costs	353.19	0.0262
Counting Centre Costs	93.71	0.0070
Materials Income	-710.76	-0.0527
Unredeemed Deposits	-434.43	-0.0322
Fraudulently Claimed Deposits	36.46	0.0027
Net Cost	**568.86**	**0.0422**
Funded by Producer Admin Fee	**-568.86**	**-0.0422**

The net annual operating cost of the system is ₺568,860,000, meaning a net cost to producers of just over ₺0.042 per container. As can be seen in Figure 7-2, the majority of costs are to compensate retailers for the service they provide to consumers. As detailed in Section 7.4, these handling fees, like the transport costs, counting centre costs and central admin system costs, include both the annual operating costs and the annualised costs of the capital expenditure needed to establish the DRS.

In the current modelling, the average producer fee is just over ₺0.042 per container sold. It is not possible within this hypothetical modelling to determine the exact allocation of costs between plastic, metal and glass. The eventual system operator will, however, have the information needed to split the costs, which should then be directly offset by the material revenues for each fraction, so the fee for a metal can would be lower than for a glass bottle.

Figure 7-2: Breakdown of DRS Costs



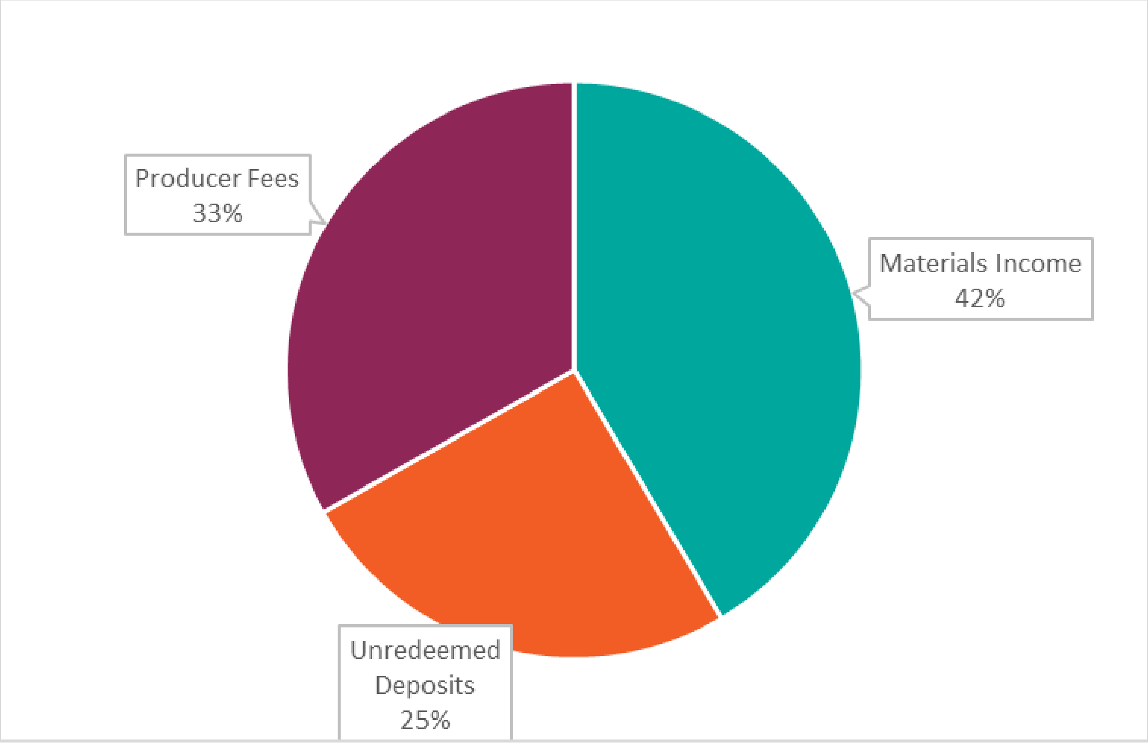
The system costs are based on Turkey having 10 counting centres. 15 counting centres reduces the net costs slightly to ₺564,720,000, or ₺0.0419 per container due to the reduced distances the uncompacted containers would need to be transported. However, it may not be possible, or desirable, to establish these all before the DRS is launched due to the time and capital investment required. Moreover, the return rate will be lower in the first year, so fewer counting centres may initially be needed and, as the system becomes more embedded, it is likely – based on experience elsewhere – that the percentage of containers returned to RVMs, rather than manually, will increase. This will reduce the through-put at counting centres and may mean that fewer centres are needed in the future. Given the marginal difference in price and environmental outcomes (when only transport is considered – not the emissions associated with the counting centres themselves), 10 counting centres appears to be sufficient. The impact of the number of counting centres on transport and total costs is outlined in Appendix A.3.5.[49]

Figure 7-3 illustrates how the annual costs are funded, with 42% of costs covered by material revenues, unredeemed deposits providing 25% of the funding and producers responsible for 33%. The material revenues as modelled cover a slightly higher percentage of costs than in some other systems as the prices in Turkey, particularly for secondary glass, are higher than in some countries. If the material prices fall by the time

[49] Counting centres could also serve a dual purpose by providing a facility at which containers returned to RVMs can be consolidated and sorted before onward transport.

the DRS is introduced, it should be noted that the producer fees will consequently be higher.

Figure 7-3: DRS Annual Revenues



As an illustrative example of the sensitivity of costs, if material prices were to follow patterns seen in some other markets (where the glass price in particular can be considerably lower) and material revenues are assumed to fall by 26% on average below those used in the modelling, the material would only cover 31% of total costs.[50] This would increase the net costs covered by producer fees to ₺756.7 million and the producer fee would be approximately ₺0.056.

7.3 Retailer Handling Fees

As indicated in Table 7-3, retailers with an RVM would be paid approximately ₺0.155 per container returned to their shop (to include the annualised cost, per container, of purchasing the RVMs), while the handling fee for retailers without an RVM would be approximately ₺0.040. The difference between the two rates is larger than in some existing DRSs, however this is to some extent to be expected, given the relative costs of labour in Turkey and the costs of imported machinery (which have been converted from Euros, so are affected by the exchange rate). The eventual system operator will have access to more detailed information on staff costs and rental space to use in the handling fee calculations.

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[50] This is based on a 25% reduction for steel, 10% for aluminium, 30% for plastics and 66% for glass.

Given the rate of inflation in Turkey, wages and rental costs are likely to change relatively rapidly. This means that handling fees should be reviewed on a relatively frequent basis to avoid retailers making a large profit at the expense of the system operator, or retailers incurring significant losses. The handling fees are, by necessity, an average so some retailers will inevitably gain slightly while some will find that their costs are not completely covered, possibly particularly in areas with high rents. Retailers in areas with high rents are, however, likely to benefit from a higher footfall, so will on average receive more containers. This increases the likelihood that their DRS-related costs are covered, as, for instance, it is more likely that the through-put capacity of their RVMs is optimised.

Table 7-3: Breakdown of Handling Fees by Redemption Method

	Total Cost, ₺million	Cost/Unit Redeemed, ₺
Handling Fees - Reimbursing Retailers (RVMs, Labour and Space)	966.36	0.1550
Handling Fees - Reimbursing Retailers (Manual collection, Labour and Space)	225.47	0.0404

7.4 Set-Up Costs

The operating costs in Table 7-2 include the annualised initial investment costs needed to establish the DRS. The set-up costs included in each of the rows in Table 7-2 are listed in Table 7-4.

Table 7-4: Set-Up Costs Included in Annual Operating Costs

Annual Operating Cost	Capital Costs Included
Central Admin System	Capital investment in IT Office furniture and equipment Project management to set-up the system Communication campaigns
Handling Fees	Purchase and installation of RVMs
Transport Costs	Purchase of collection vehicles
Counting Centre Costs	Purchase of counting machines Purchase of compactors and balers Installation

To cover the initial investment costs, it is likely that the system operator would take out a low-interest loan, which would be supported by the positive cash-flow created by the time-lag between the deposits being initiated and refunded to consumers. In the first few years, when the system is not expected to reach its 90% target, the higher value of unredeemed deposits will help to pay-off the loan. This means that – as only one year has been modelled in this study – the amount to be repaid may actually be lower than modelled here by the time the return rate reaches 90%.

While the set-up costs are not paid in one lump sum, the costs are listed for clarity in Table 7-5. 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 most significant cost is the ₺2,506 million 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 ₺691 million 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 vehicles 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 7-5: Initial Capital Requirements

	No. Units	Capital Cost/Unit	Total Capital Cost	Number of Years to Repay
RVMs				
RVMs - Smaller shops	9,917	₺147,600	₺1,463.8m	
RVMS – Supermarkets	3,921	₺265,680	₺1,041.9m	7
RVMs - Total			***₺2,505.6m***	
Collections				
Collection Vehicles – large	124	₺533,000	₺66.16m	9
Collection Vehicles – small	696	₺435,230	₺302.89m	
Collections - Total			***₺369.05m***	

	No. Units	Capital Cost/Unit	Total Capital Cost	Number of Years to Repay
Counting Centres				
Counting Machines	78	₺1.37m	₺106.49m	5
Compactor & Baler	20	₺1.70m	₺33.95m	
Installation in Counting Centre	78	₺0.15m	₺11.51m	
Counting Centre - Total			***₺151.95m***	
Central System Operator Setup Costs				
IT - capital investment			₺83.1m	7
Office - furniture and Equipment			₺4.2m	
Project (setup) management			₺20.8m	
Communication			₺62.3m	
Central Set Up Costs - Total			***₺170.29m***	
Total Initial Capital Requirement			***₺3,196.89m***	

7.5 Environmental Impacts

As Figure 7-4 illustrates, the DRS increases the proportion of beverage containers that are recycled by 253%, and reduces landfilling by 88%. These changes will reduce the greenhouse gas emissions and other air pollutants associated with the disposal of beverage containers. It also, however, should be recognised that there is an environmental cost to the DRS, mainly associated with transporting the containers from the retailers to the counting centres and for processing.

The changes in greenhouse gas emissions and other air pollutants are given monetised values to estimate the change in damage costs to society as a result of the DRS.

Figure 7-4: Final Destination of Beverage Containers

As shown in Table 7-6, the net additional emissions resulting from the transport of containers in the DRS are valued at ₺27 million, including the reduction in emissions resulting from the reduced frequency of the bring-site collections. These increased emissions are, however, offset by the reduction in emissions as a result of the increased recycling and reduced landfilling rate. The DRS reduces such damage costs by ₺84.3 million for greenhouse gas emissions and the improvements to air quality are valued at ₺62.7 million. The DRS reduces greenhouse gas emissions by 263,000 tonnes in one year and, overall, produces an associated monetised environmental benefit of ₺120 million.

Table 7-6: Monetised Environmental Impacts of the DRS

	Greenhouse Gases (₺)	Air Pollutants (₺)	Total (₺)
Recycling	-83,500,000	-58,000,000	-142,000,000
Disposal	-800,000	-4,700,000	-5,600,000
Transport - Collections	22,000,000	5,100,000	27,000,000
Total	-62,300,000	-57,700,000	**-120,000,000**

In addition to the improved air quality, the DRS is conservatively assumed to reduce littering by 85%, or 33,000 tonnes in a year (see appendix A.1.3.2). 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. The current estimated litter disamenity impact associated with beverage containers, and the litter disamenity under a DRS, are shown in Table 7-7. This analysis indicates that the DRS could be associated with a reduction in litter disamenity of ₺585 million.

Table 7-7: Change in Litter Disamenity as a Result of the DRS

	Litter Disamenity (₺)
Baseline	688,136,068
DRS	103,220,410
Reduction	- 584,915,658

8.0 Conclusions

The Turkish Government has already confirmed that a DRS will be introduced in Turkey and, to a certain extent, the existing refillable system for glass bottles has already demonstrated that a deposit system – albeit a different type to a system for one-way beverage containers – can be implemented.

Table 8-1 summarises the key findings from the modelling, which indicates that the costs of the system are outweighed by the environmental benefits and the savings for existing waste services.

Table 8-1: Summary of DRS Impacts

	Impact (₺)
Net Cost of DRS	568,860,000
Cost to Producers per Container	0.042
Retailer Handling Fee	0.040 – 0.155
Litter Disamenity	584,915,658
Environmental Benefits	120,000,000
Recycling Services Losses	125,800,000
Residual Waste Savings	160,100,000
Savings and benefits in green, costs and losses in red.	

Figure 8-1: Comparison of DRS Costs and Environmental Benefits

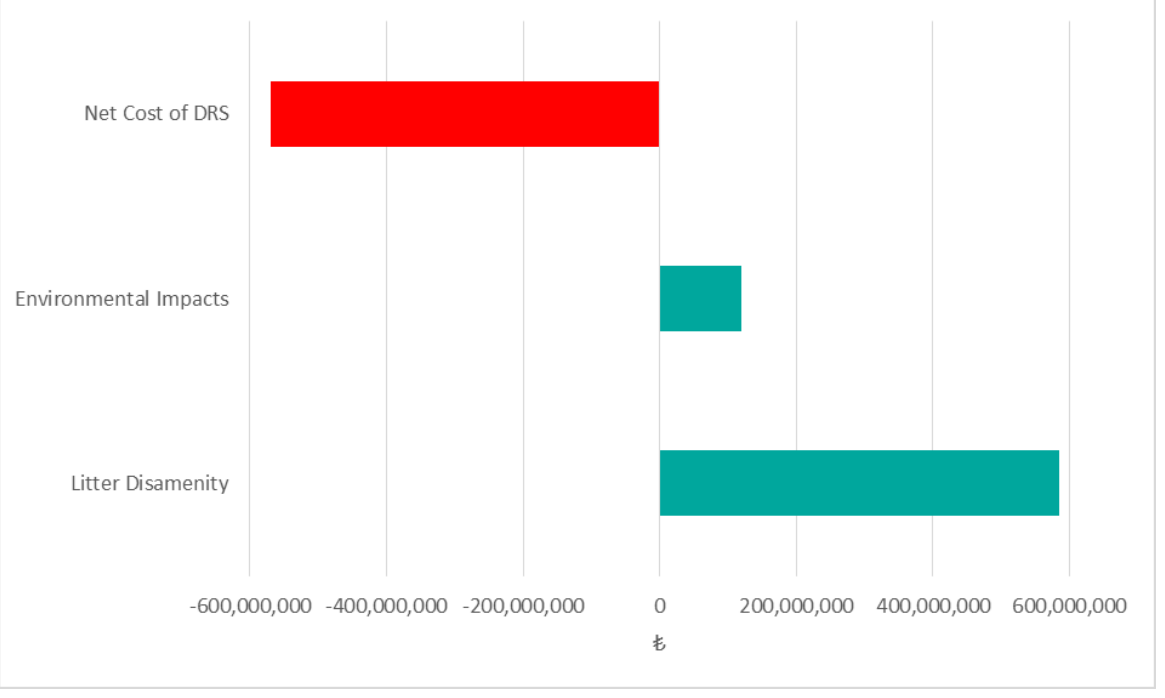
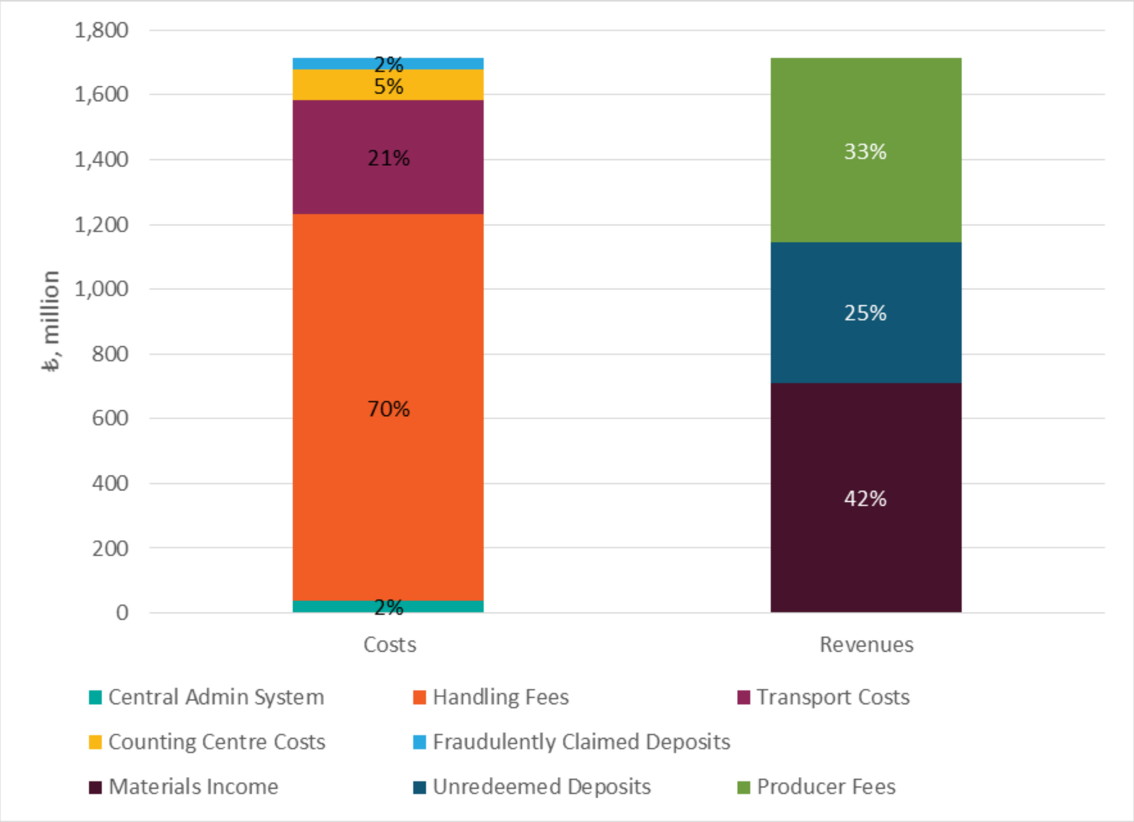


Figure 8-2 compares the different costs of the DRS and the sources of funding. This study has proposed a design for Turkey based on design features that have proved to be effective in other countries. Turkey's size – both in terms of population and geographically – raises particular questions for the eventual system operator, but it also presents opportunities: to have an even more significant environmental impact and for greater efficiencies due to the potential for economies of scale.

Figure 8-2: Modelled DRS Costs and Revenue Sources



It should be acknowledged that the costs of the DRS are higher than the savings generated for residual waste collections. However, this is arguably not a fair comparison, given that Turkey will need to change its waste management practices and invest in recycling services now that the Government has outlawed the disposal of packaging waste in landfills and is seeking to phase out municipal dumping sites. The costs of a system that delivers a 90% recycling rate are not directly comparable with the costs of the current services, which are reported to achieve a 26% recycling rate.

The DRS comes at a cost to producers of ₺0.04 per container. However, producers will incur expense under any system that is introduced to meet their legal responsibility to cover the costs of collecting packaging waste. A DRS at least means they can recover the waste in a way that allows it to be used to manufacture new beverage containers. Additionally, if the design approach recommended in this study is taken forward, it means producers could be financially rewarded for fulfilling their new legal obligations to design packaging so that it is suitable for recycling, given that producer fees can be lower for containers that are easier to recycle and the revenue from the recycled material reduces the overall need for producer fees. By giving producers ownership of the system, it means they can ensure that the logistics operation is designed as efficiently as possible. It should also be noted that, if producers are currently paying PRO fees, they should no longer be required to pay these for their beverage containers.

Additionally, if the Government decides to introduce a beverage container tax, the tax will generate revenue.

The DRS will reduce municipalities' waste collection and disposal costs, and could well assist municipalities that are in the process of developing packaging waste plans, now that municipalities are responsible for the separate collection of packaging waste. Given that only 500 districts and towns were estimated to have separate collections for packaging waste in 2016, it is possible that the estimated losses for existing recycling services are over-estimates, at least for some areas of Turkey.[51]

For consumers, the costs are minimal if they choose to redeem their deposit. Consumers are already used to taking their waste to bring-banks, but the DRS means they are financially rewarded for taking back their containers.

This analysis has not considered the potential for the DRS to create jobs, but it is worth noting that Turkey already has a substantial recycling industry; the DRS should mean that more recycled materials can be sourced locally (from within the country) and will be less susceptible to contamination – expanding the use options for the recycled material and boosting Turkey's recycling industry.

While retailers are an integral part of a DRS, they should not be incurring additional costs, providing the handling fee is calculated appropriately. Given that retailers provide an important service, and to some extent bear some responsibility for placing packaging on the market, they should be involved in setting up the DRS and taking this forward in partnership with producers.

The next steps should, therefore, be for retailer and producer associations to begin discussions on establishing a DRS and to analyse the costs and benefits in more detail. As glass bottles currently accounts for 85% of the weight of single-use beverage containers placed on the market, and that the costs of transporting and processing glass are relatively high, it may also be worth considering expanding the use of refillables and rolling out a DRS for refillable glass bottles alongside the DRS for single-use beverage containers.

[51] Ministry of the Environment and Urbanisation (2016) *Ulusal Atik Yönetimi Ve Eyelem Plani 2023*.

TECHNICAL APPENDIX

A.1.0 Material Mass Flows

A.1.1 Overview

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

One important factor to consider when looking at the potential impacts of a DRS is the assumption about when the analysis takes place. It is very difficult to predict future changes in parameters such as beverage consumption, material values, labour costs etc., and therefore it was appropriate to focus on illustrative costs for one year.

Before conducting the modelling, TÜÇEM and other 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. The reader should note that detailed statistical reporting of waste data in Turkey is still relatively undeveloped compared to, for example, some European countries. This has necessitated the use of carefully considered estimates and assumptions for some data inputs and modelling parameters, often based on knowledge from previous DRS work. These are noted throughout this report, and wherever possible have been evidenced with reference to known data points.

A.1.2 Beverage Container Sales / Waste Arisings

The scope of this analysis focussed on most drinks (except milk and dairy) and included plastic bottles, cans and glass bottles. 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 plastic bottle, metal can or glass bottle containing the following beverage categories:

- Soft drinks – carbonates, energy drinks, flavoured water, juice, nectars, packaged water, sports drinks and still drinks.
- Spirits
- Beer
- Cider
- Still & sparkling wine

The figures for total beverage container sales were taken from 2018 market data published by GlobalData. The following categories were used in the analysis:

- Plastic beverage packaging – PET and HDPE bottles;
- Metal beverage packaging – cans; and

- Glass beverage packaging – bottles.

It was assumed that 2% of metal cans are made from steel rather than aluminium.

The dataset was provided in units of number of containers. Unit weight assumptions (specified by packaging material and container size) were applied to convert these to packaging weights. These were based on a comprehensive review of unit weights available in the literature and from previous DRS work. A summary of average weights based on these assumptions is shown in Table A 1.

Table A 1: Average Weight per Container Type

Material	Average weight (g)
Plastic bottle (PET & HDPE)	26.5g
Steel can	25.5g
Aluminium can	14.3g
Glass bottle	210.6g

Source: Previous DRS studies (Spain, the Czech Republic, Germany, Kosovo) and other industry data

Based on these unit weights, the total number and estimated weight of beverage containers sold in Turkey are presented in Table A 2.

Table A 2: Total Beverage Container Sales in Turkey on which a Deposit Would be Applied (2018)

	Number of units, million	Total weight, thousand tonnes
Plastic bottles (PET & HDPE)	5,901	156
Steel cans	47	1.2
Aluminium cans	2,286	33
Glass bottles	5,246	1,105
Total	**13,479**	**1,295**

A.1.3 Material Flows

The process for estimating firstly the current (baseline) mass flows and then secondly the assumptions made for material flows after the implementation of a DRS system are explained below.

A.1.3.1 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 were based on the most recent (2017) Packaging and Packaging Waste Bulletin published by the Department of Waste Management.[52] It was assumed that the material specific recycling rates for all packaging waste (as published in this bulletin) are equal to the recycling rates for DRS material only.

A **littering rate** of 4.61kg per person per year was assumed; this is based on average littering rates in the EU28 and excludes waste that is collected in litter bins (i.e. it relates to litter left in the environment only). This is equivalent to a total of 373,000 tonnes of litter per year. This tonnage includes all material types, whereas this study is only concerned with the proportion of litter that is beverage containers. This proportion was derived from a recent litter composition study and used to calculate the tonnage of beverage containers littered.[53] In the absence of detailed data on litter composition in Turkey to indicate the varying litter rates of different container types, it was assumed that the litter rate for all containers is the same.

Municipal waste data records a small proportion of waste (0.19%) sent to 'other disposal' (burning in an open area, lake and river disposal, burial, other disposal methods). These unconventional disposal methods are associated with a high environmental disamenity, and were therefore grouped with litter in the modelling.

In summary, a total of 39 thousand tonnes of beverage container litter was assumed, equivalent to an average litter rate of 3% (of total beverage container consumption).

The remaining waste was assumed to be sent to **residual waste disposal**. Official municipal waste data states that nearly all residual waste disposal is via landfill, either at the municipal dumping site, or delivered to controlled landfill sites.[54]

Based on these inputs and assumptions, the final material flows used in the analysis are presented in Section A.1.3.3.

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[52] T.C. Çevre ve Şehircilik Bakanlığı (2017) *Ambalaj ve Ambalaj Atıkları Bülteni 2017*, Accessed 14th April 2019, https://cygm.csb.gov.tr/atik-yonetimi-dairesi-baskanligi-i-85475
[53] WRAP Cymru (2018) *Waste Composition Analysis of Litter in Wales*, February 2018, http://www.wrapcymru.org.uk/sites/files/wrap/Litter%20composition%20FINAL%20technical%20report%20WRAP%20Cymru%2020180607.pdf
[54] TÜIK: *Bertaraf/geri kazanım yöntemleri ve belediye atık miktarı, 1994-2016*

A.1.3.2 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 ₺0.30, 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 Turkey (Table A 3Table A 3).[55]

Table A 3: Scenario Assumptions for DRS Return Rate

	Plastic (PET, HDPE)	Aluminium	Steel	Glass
Return Rate	90.8%	89.1%	89.1%	89.9%

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 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.[56]

A.1.3.3 Summary of Material Flows

The overall baseline and DRS material flows used in modelling are presented in Table A 4 and Table A 5.

Table A 4: Baseline Material Flows, Thousand Tonnes

	Plastic	Steel	Aluminium	Glass	Total
Total Waste Generated	156	1.2	33	1,105	1,295
Collected through DRS	-	-	-	-	-
Landfill	72	0.5	14	835	922
Recycling	79	0.6	17	237	334
Litter	4.7	0.04	1.0	33	39

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

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

	Plastic	Steel	Aluminium	Glass	Total
Recycling Rate, %	50.8%	53.3%	53.3%	21.4%	25.8%
Litter Rate, %	3.0%	3.0%	3.0%	3.0%	3.0%

Table A 5: DRS Material Flows, Thousand Tonnes

	Plastic	Steel	Aluminium	Glass	Total
Total Waste Generated	156	1.2	33	1,105	1,295
Collected through DRS	142	1.1	29	993	1,165
Landfill	7.0	0.06	1.7	102	111
Recycling	148	1.1	31	997	1,178
Litter	0.7	0.005	0.1	5.0	5.9
Recycling Rate, %	95.0%	94.5%	94.5%	90.3%	91.0%
Litter Rate, %	0.5%	0.5%	0.5%	0.5%	0.5%

A.2.0 Bring Site Collection Modelling

Container collection modelling was undertaken to assess the impact on the current waste services. A simplified version of the European Reference Model on Municipal Waste Management was used to calculate the effects on the recycling and mixed waste schemes associated with the change in waste flows under a DRS.

A 'baseline' model was created to represents the current service for areas with urban, semi-urban and rural housing densities. Inputs were based on values provided by TÜÇEM where known, and are otherwise Eunomia assumptions. Key variables were then adjusted to calculate the changes in waste flows, collection frequency, and associated costs.

The introduction of a DRS entails a reduction in beverage containers collected within the recycling containers and in residual waste. It was assumed that, with a DRS, the bring site distribution remains the same, each collection container fills more slowly, and the collection containers were assumed to be collected at the same level of fill, but less frequently.

A.2.1 Assumptions

Where possible, assumptions used in the modelling were based on data provided by TÜÇEM. Where specific data were not available, Eunomia assumptions based on standard industry assumptions or from the European Reference Model on Municipal Waste Management were used.

The bring site model included costs for:

- Resources;
- Sorting costs;
- Bulking and haulage costs; and
- Estimation of change in material revenues obtained from sold recyclate or in disposal costs of mixed waste.

The model first calculated the frequency of collections required. It then modelled the resources required to collect at this frequency. The frequency of collections depends on:

- The number of collection containers per site (1 for recyclate, 3-5 for mixed waste);
- The number of households served per site (Table A 7);
- The yield of material per household (change modelled shown in Table A 8); and
- The fill-rate before the collection container is emptied (80%).

The number of vehicles required then depends on the above and:

- Time taken to travel between sites and to tip;
- The capacity of the vehicle.

The resource costs comprise then of:

- Vehicle capital, insurance and maintenance costs (see below);
- Fuel costs (based on average calculated distances travelled on the rounds, assumed vehicle fuel efficiencies and a cost of diesel of ₺6.44); and
- Labour costs (based on an hourly rate for drivers of ₺21/hr and for loaders of ₺17/hr).

All vehicles were assumed to be 26 tonne RCVs, with the following specifications:

- Capacity (weight) – 11 tonne
- Capacity (volume) – 23m^3
- Capital cost – ₺900,000
- Maintenance – ₺90,000 per annum
- Insurance – ₺45,000 per annum

Vehicle costs were annualised over 9 years at 5% interest.

For material revenues/disposal costs, gate fees, bulking and haulage, and sorting costs, it was assumed that:

- Mixed waste gate fee – ₺93 per tonne;
- Incomes for different recycling materials are as per Table A 6;
- Bulking and haulage – ₺47 per tonne; and
- Sorting cost (recycling only) – ₺258 per tonne.

Table A 6: Material Incomes

Material	Income (₺)
PET	2,250
Aluminium	5,000
Steel	875
Glass	243

Source: TÜÇEM

TÜÇEM provided information on the numbers of collection containers required and the distance between sites depending on the population of different municipalities. These inputs were used to tune the baseline model and were kept constant in the future model. Table A 7 lists the assumptions that change by rurality. Municipalities were classified as urban, semi-urban and rural depending on their population. This was used to calculate the number of households within each rurality classification.

Table A 7: Container Collection Assumptions that Change by Rurality

	Urban	Semi-Urban	Rural
Bring Site Density (Households/Site)	120	180	240
Residual Containers per Site	3	4	5
Fuel Efficiency (km/l)	1.4	1.4	1.8

Table A 8: Reduction in Yield of Material Collected (kg per household per year)

	Change in Collected Waste (kg/hh/yr)
Recycling	14
Mixed Waste	35

A.3.0 DRS System Return Network

A.3.1 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 A 9. 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 A 9: 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.	257,988	49.0%	Smaller grocery stores, express stores and bakkals that are assumed to not receive a high enough volume or have enough space for an RVM.
Retail stores, RVMs	Most larger retail stores have installed RVMs to automate the process of redeeming containers.	12,394	51.0%	Most supermarkets and 5% - 50% of groceries and express shops are assumed to have enough throughput to install RVMs.

A.3.2 Retail Landscape and System Design

Turkey's retail landscape, in respect of companies selling beverage containers, is moving away from the traditional "bakkal" style shops, towards discount retailers and large chains. There are 90,000 bakkals[57] but this number is rapidly decreasing, in conjunction with the rapid increase of "organised retail". However, the latest available numbers were used in the modelling to avoid making assumptions about future trends.

The types and total number of retail outlets in Turkey participating in the DRS system were based on data relating to chain stores and their respective size bandings.[58] This data was extrapolated to give an estimated split by size of the 26,334 chain stores within Turkey, as shown in Table A 10. [59]

Table A 10: Number of Retailers

Type of Retailer	Number of Retailers
Hypermarket	730
Large Supermarket	1,747
Medium Supermarket	4,771
Small Supermarket	678
Medium Grocery	8,461
Small Grocery	248
Medium Express Shop	8,291
Small Express Shop	1,656
Bakkals	90,000
HORECA	153,800

The next assumption to consider was which retailers would be participating in the scheme, which 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 A 11.

[57] http://www.transport-exhibitions.com/Market-Insights/Cold-Chain/Turkey-s-top-5-supermarkets-profiled
[58] Data provided on Migros stores.
[59] USDA Foreign Agricultural Services (2018) GAIN Report, Turkey, Retail Foods, Turkish Retail Food Industry

Table A 11: RVM Assumptions

Type of Retailer	% in the DRS Scheme	% Using RVM vs Manual	Number of RVMs per Redemption Point	% Compacting
Hypermarket	100%	100%	2.5	100%
Large Supermarket	100%	100%	1.2	100%
Medium Supermarket	100%	95%	1.0	100%
Small Supermarket	100%	95%	1.0	100%
Medium Grocery	100%	50%	1.0	100%
Small Grocery	100%	5%	1.0	100%
Medium Express Shop	100%	5%	1.0	100%
Small Express Shop	100%	5%	1.0	100%
Bakkals	100%	0%	N/A	N/A
HORECA	100%	0%	N/A	N/A

A.3.3 Retailer Costs and Handling Fee

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 'bottom-up' based on some rational considerations of the costs incurred. This enabled an estimate of the 'correct' handling fee, which assumes that retailers are 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.3.2, 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 A 12. The assumptions behind these costs are detailed in sections A.3.3.1 to A.3.3.4. 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, including 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 A 12: Retailer Cost Overview per Container

Retailer	RVM, ₺	Manual, ₺
Space Costs	0.0028	0.0054
Labour Costs	0.0048	0.0254
RVM and Maintenance Costs	0.1378	0.00
Containment Costs	0.0096	0.0096
Total	**0.1550**	**0.0404**

A.3.3.1 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 ₺9.63 per square metre per annum was used for retail cost calculations.[60]

Table A 13: Space Requirement and Costs

	RVM Redemption	Manual Redemption
RVM floor space, m^2	10.0	-
Storage floor space, m^2	1.0	1.0

[60] This cost is an average taken from retail prices across the majority of regions in Turkey, weighted by population. Costs are taken from https://www.zingat.com/.

Total number of RVMs	13,839	-
Total number of retailers	12,394	257,988
Total floor space required, m²	151,652	276,143
Total cost, ₺m	**17.52**	**31.91**

A.3.3.2 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:

- Each customer returns 20 containers in one go to RVMs at retailers;[61]
- RVMs have on average a storage capacity of 300 glass, 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

[61] Previous communication with an RVM supplier

estimated at 48 seconds.[62] Labour costs assume that staff are unskilled and paid an hourly rate of ₺13.08 per hour (plus 25% on costs).[63]

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 the largest retailers take 20 minutes, intermediate supermarkets take 10-15 minutes and small stores take 5 minutes. Estimates for the number of pickups required per week for each of the main retail categories were also made.

Table A 14: Labour Hours Required at Retail Stores

Labour	Total Time (hours per annum)
Emptying Bins	19,268
Cleaning Machines	866,293
Processing RVM Receipts	259,830
Manual Takeback	7,448,407
Total	**8,593,798**
Cost/Container Redeemed - RVM (₺)	0.0035
Cost/Container Redeemed – Manual Takeback (₺)	0.0241

A.3.3.3 Reverse Vending Machine (RVM) 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 ₺0.138 per container for the RVM based on average prices.[64]

Table A 15: RVM Summary Table

RVM Purchase Cost per Container	₺0.138
Containers Through Retail RVMs	6,236 million

[62] Previous communication with an RVM supplier
[63] https://www.salaryexpert.com/salary/job/cashier/turkey
[64] Previous communication with an RVM supplier

Average RVM throughput/Month	29,676
Total Cost per RVM per annum	₺62,074

A.3.3.4 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;
- All plastic and cans, compacted and uncompacted, are transported in plastic bags;
- All compacted glass is collected bins; and
- All manually collected glass is transported in 240 litre bins.

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.[65] 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 bag was modelled at ₺1.85.[66] This cost could go down if bags are reused more. 44.6 million bags per annum are needed. Glass bottle bins are assumed to have a 240L capacity, cost ₺95.94 and last three years, being used once per week.

A.3.4 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. Cans and plastic bottles are assumed to be transported in bags and glass bottles in 240L bins. 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.

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[65] TOMRA (2001), Zentrale Organization Einweg Pfand Deutschland: Business Model Development Guide
[66] This is based on doubling the price of bags bought by waste operators for recycling collections.

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:[67]
  - Glass bottles – 557 kg/m^3 compacted and 186 kg/m^3 un-compacted;
  - 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);[68]
- Drivers work a 9-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:
  - ₺533,000 capital costs for large shop round vehicles and ₺435,000 capital costs for small shop round vehicles, with a 9-year depreciation period;
  - Drivers earn ₺21.00 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 ₺6.44 per litre of diesel.

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 8 retail stores during a 9-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 A 16.

Table A 16: Pickups per Week for Participating Retailers

Type of Retailer	Number of Pickups per Week
Hypermarkets	1.59
Large Supermarkets	1.21
Medium Supermarkets	1.14

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

Small Supermarkets	1.93
Medium Grocery	1.67
Small Grocery	3.00
Medium Express Shop	1.82
Small Express Shop	2.10
Bakkals	1.11
HORECA	0.25

A.3.5 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 5.9 billion containers is estimated to be collected manually, which would require 78 machines.

The model shows 15 counting centres as optimal for Turkey. Whilst the capital costs increase, the transport costs decrease and provide a net benefit, compared to fewer counting centres. However, it is assumed in the modelling that there are only 10 counting centres, as the difference in total costs is relatively marginal. Table A 17 shows the differences between 5, 10 and 15 counting centres.

Table A 17: Counting Centre Net Costs

	Machines per centre	Counting centres total cost, ₺m	Transport total cost (whole system), ₺m	Net DRS cost, ₺m	Net cost per unit placed on the market, ₺
5 centres	15.6	82.38	473.23	677.58	0.0503
10 centres	7.8	93.71	353.19	568.86	0.0422
15 centres	5.2	105.03	337.72	564.72	0.0419

A.3.6 Material Revenue

Factors affecting the material revenues, including sorting costs, are:[69]

- The cost of unloading and preparation for offtake of collected material is estimated at ₺517 per tonne, which will affect the overall revenues received.
- A mix of amber, green and clear glass is assumed, so a sorting cost of approximately ₺111 per tonne is applied.

The costs of the system operations are offset by material revenues. Revenues are shown in Table A 18 (net of sorting costs).

Table A 18: Material Revenues

Material	Revenue per tonne (₺)[70]	Total Revenue per annum, ₺M
Glass Bottles	110	109.27
Plastic Bottles	3,000	425.30
Steel Cans	1,050	1.11
Aluminium Cans	6,000	175.08

A.3.7 Unredeemed Deposits

With a 90% return rate, a total of 1,448 million beverage containers will not be redeemed, which will generate ₺434.40 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 ₺36.5 million.

A.3.8 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, and estimates from industry operators. Assumed annual costs are shown below in Table A 19.

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[69] Previous communication with RVM supplier
[70] Provided by TÜÇEM

Table A 19: Central System Operator Annual Costs

	Cost, ₺M
Annualised Set Up Costs	29.43
Staff Costs	0.63
Office Space Costs	0.29
Administration & Marketing Costs	8.51
Total	**38.86**

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 total of 11 members of staff are employed by the central system operator for these central administrative purposes.

Table A 20: Breakdown of Producer Admin Fee by Net System Costs

	Total Cost, ₺million	Cost/Unit Redeemed, ₺	Cost/Unit Placed on the market, ₺
Central Admin System	38.86	0.0032	0.0029
Handling Fees	1,191.83	0.0981	0.0884
Transport Costs	353.19	0.0291	0.0262
Counting Centre Costs	93.71	0.0077	0.0070
Materials Income	-710.76	-0.0585	-0.0527

	Total Cost, ₺million	Cost/Unit Redeemed, ₺	Cost/Unit Placed on the market, ₺
Unredeemed Deposits	-434.43	-0.0357	-0.0322
Fraudulently Claimed Deposits	36.46	0.0030	0.0027
Net Cost	**568.86**	**0.468**	**0.0422**
Funded by Producer Admin Fee	**-568.86**	**-0.0468**	**-0.0422**

Table A 21 shows how the total system costs and costs per unit redeemed are split across redemption methods.

Table A 21: Breakdown of Handling Fees by Redemption Method

	Total Cost, ₺million	Cost/Unit Redeemed, ₺
Handling Fees - Reimbursing Retailers (RVMs, Labour and Space)	966.36	0.1550
Handling Fees - Reimbursing Retailers (Manual collection, Labour and Space)	225.47	0.0404

A.4.0 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 disamenity associated with less beverage container 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.4.1 and Section A.4.2. However, there is another environmental impact to be considered, which is the disamenity impact associated with litter. The approach to valuing the reduction in litter is set out in Section A.4.6.

A.4.1 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 rulemakings. The damage cost is a measure, in Turkish lira (₺), 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 used in the cost benefit analysis of landfill bans undertaken by Eunomia; full details of the calculations used can be found in the appendices of that report.[71]

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 correct value year-by-year, and calculating the net present value of the total benefits. Given that the study is forward looking, it seems sensible to choose a year, not too close, but not too far ahead. The value for 2020 have thus been used in the calculation of greenhouse gas associated damage costs. The official EEA value of €32 per tonne of CO_2e / ₺198 (converted to 2019 prices) was used.

A.4.2 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).

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[71] 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

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.[72] This report provides damage costs in 2005 prices, these are converted to Turkish Lira and then local currency GDP deflators applied to convert to 2019 prices.[73] 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 A 22: Air Damage Cost Assumptions

Compound	Damage costs (2019 Prices)	
	€ / tonne	₺ / tonne
NH_3	6,232	45,990
PM2.5	40,256	297,088
SO_2	6,305	46,529
NOx	3,352	24,736
VOCs	157	1,158

A.4.3 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

[72] 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
[73] 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

limited number of pollutants taken from some of the studies included within its review.[74] Otherwise, however, the main source of information in this respect is life cycle databases such as Ecoinvent, although some trades 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 A 23.

Table A 23: 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	
Plastic	-1,150	-0.11	0.005	-2.27	0.01	-3.51	-305
Glass	-169	-0.04	-0.03	-0.59	-0.15	-0.05	-63
Steel	-1,623	-0.78	-0.01	-2.70	-0.07	-0.25	-576
Aluminium	-10,721	-4.62	-0.01	-18.00	-0.15	-2.20	-3,662

Sources: WRATE2 / Prognos / Environmental Resources Management / Ecoinvent

A.4.4 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 A 24.

Table A 24: 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	
Plastic	4.3	0.004	0.008	0.17	5.0E-07	0.04	6.7
Glass	4.3	0.004	0.01	0.17	5.0E-07	0.04	6.7
Steel	4.3	0.004	0.01	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

[74] 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

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, glass and metals are all 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).

A.4.5 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 curtain-side trucks and passenger cars.

Air quality emissions factors (grams per kWh) for heavy-duty trucks were based on Euro Class 5 standards (2008).[75] 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) are based on Euro Class 4 standards (2005),[76] as the average age of cars is approximately 12 years.[77] Equal numbers of petrol and diesel vehicles were assumed, roughly equivalent to that observed in Turkey (although new registrations are predominantly diesel).

GHG emissions factors for diesel and gasoline fuel were sourced from the US EPA.[78] These were converted into emissions per mile travelled based on average fuel consumptions for each vehicle, these are: 37 litre per 100km (HGVs); 27 litres per 100 km (12 tonne curtain-side truck); 8 litres per 100km (passenger car).[79,80]

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

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

[77] The International Council of Clean Transportation (2016) *The Automotive Sector in Turkey*, March 2016, https://www.theicct.org/sites/default/files/publications/ICCT_Turkish-fleet-baseline_20160318.pdf

[78] 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

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

[80] 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

A.4.6 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.[81] 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 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.[82] 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.[83]

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.

In applying these valuations we, conservatively:

- Use the WTP for a 'one-level' improvement of £10.79 per month to account for total litter disamenity;

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

[82] 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

[83] 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

- Do not inflate to 2019 values; and
- Apply the monthly WTP figures, adjusted to Turkey on a PPP-adjusted per capita GDP basis, to each Turkish household, rather than each Turkish adult.[84]

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. 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 40% by volume. A conservative estimate of 85% litter reduction was then applied to this figure as assumption for the litter reduction that a DRS provides.

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.

Based on this approach, the total reduction in litter disamenity is ₺584.9 million.

[84] There are estimated to be 21 million households, based on Eurostat data on the average number of people per household in Turkey.