

Understanding implementation of direct variable charging

Phase 2: The Scottish Context

Scottish Government

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Executive summary

This research was commissioned by the Scottish Government as part of their commitment to improving recycling in Scotland. They have identified that taking steps to disincentivise and reduce residual waste is key to achieving this. Direct variable charging (DVC; i.e. directly charging residents a variable amount in relation to the waste they produce) is one mechanism that could be used to achieve this. Under a DVC system, householders are incentivised to reduce residual waste in order to reduce the cost they are charged. The aim of the first phase of this research was to identify where DVC has been implemented across the world and learn from the successes and challenges. This is the second of two phases, which aims to assess the applicability of the models identified in phase 1 to Scotland.

Desk-based research was carried out on the existing waste management services, recycling rates and policy landscape across local authorities in Scotland to understand the potential benefits and challenges that could be faced if DVC were to be implemented in Scotland. Interviews were conducted with representatives from the Scottish Local Authority Waste Managers Network and Convention of Scottish Local Authorities to build on the interviews that were conducted in the case studies developed in phase 1 of the project.

Phase 1 identified three main types of variable charging systems:

- **Weight-based**, where residents are charged per kilo (or pound) of waste they produce. This typically involves fitting waste collection vehicles with scales which weigh a householder's waste upon collection. In some DVC schemes, householders are given a free allowance and are only charged if they exceed this.
- **Volume-based**, where residents pre-purchase bin bags or stickers/tags that can be placed on bin bags. These are charged depending on the size of the bag, with larger bags costing more.
- **Frequency-based**, where residents are charged per bin collection. In some DVC schemes, residents are given a certain number of free collections and must pay if this is exceeded.

There is evidence that DVC has the potential to be an effective behaviour change mechanism when implemented with sufficient infrastructure and education to support householders. DVC adoption will impact waste streams differently given the handling requirements of each and understanding this can allow for the tailoring of systems to match the needs of specific regions. Although separate food waste collections are in place in most Scottish local authorities, diverting food waste from residual waste still poses a significant challenge. With the right messaging, DVC could help target behaviour change around specific materials. For example, as organic waste is the densest recyclable, a weight-based system could help to drive recycling rates. Similarly, a weight-based system could also drive recycling of glass, whereas a volume-based system is more likely to drive separation of plastics, metal, and drink cartons due to their high volume to low weight ratio (density).

Whilst case studies in phase 1 suggest a weight-based system may have a greater potential to increase performance, it comes with significant challenges. In particular, it requires significant investment in infrastructure, such as retrofitting waste collection vehicles with scales, and administrative costs. It will also potentially cause significant challenges in Scotland where many residents, particularly in urban areas, use communal bins. The shortlisted case studies in phase 1, highlight the challenges of communal bins as it is difficult to link waste with a household.

Volume and frequency-based systems provide more of a one size fits all approach which can be used across different geographies and dwellings without presenting too many challenges. In particular, a volume-based system is simple to implement as it allows for lowest initial investment.

It is recommended that a phased approach may be most suitable for the Scottish context, beginning with a volume-based approach which can then later be combined with a frequency-based approach to drive behaviour change in a way that requires less upfront change and investment. This could then allow Scottish local authorities to further raise ambition and begin to assess opportunities for progressing to a weight-based system. Some of the longstanding DVC case studies that were identified in phase 1 began with a volume-based system and then switched to a weight based one to further drive performance. In these cases, a phased approach was not the intention when DVC was first implemented, but was required to achieve environmental objectives.

Whilst DVC is an overall fairer approach to waste management as the amounts residents are charged is proportional to the waste that they generate, it is important to consider groups, such as low income households, large families and individuals with certain medical needs, and how they may be disproportionately affected. There also needs to be sufficient infrastructure and communication to help householders transition to DVC.

Scotland is currently undergoing significant changes in waste management, with various policy measures such as extended producer responsibility, and a deposit return scheme planned. Measures such as these have the potential to support the objectives of DVC, however, coordination and communication must be considered. It is also important to make the public aware of the interaction between these policies to ensure public trust isn't impacted, and that DVC is a behaviour change tool and not a cost recovery tool.

Further consideration must be given to measures to maximise the success of DVC, including expansion of separate collections, and focus on food waste collection to make it easier for householders to change their behaviour and divert as much waste as possible from the residual waste bin. A comprehensive and ongoing communications strategy should also be provided to educate residents about the changes, benefits, and guidelines of a new system. There is also a need to implement strong supporting measures, with a focus on strengthening enforcement, to mitigate any illegal activity that can lead to unintended environmental consequences.

Overall, DVC, when implemented alongside supporting measures and effective communication, has the potential to drive significant progress in achieving the Scottish Government's waste and recycling targets. By incentivising recycling, promoting separate collection of food waste, driving waste reduction, and reducing landfill reliance, DVC can play a pivotal role in shaping a more sustainable and circular waste management system.

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Abbreviations

CoSLA	-	Convention of Scottish Local Authorities
DVC	-	Direct variable charging
EPR	-	Extended producer responsibility
HRC	-	Household waste recycling centre
PMD	-	Plastics, metal packaging, and drink cartons
RFID	-	Radio frequency identification

Definitions

Bulky Waste	Waste which exceeds 25 kg or cannot fit into an appropriate domestic waste receptacle.
Direct Variable Charging	Directly charging residents a variable amount in relation to the waste they produce. For the purposes of this report, this relates to the charging of residual waste, unless otherwise stated.

1 Introduction

1.1 Aims and objectives

This research was commissioned by the Scottish Government as part of their commitment to improving recycling in Scotland. In 2023, the Scottish Government introduced the *Circular Economy Bill* which sets out measures to strengthen household recycling collection services and incentivise household waste reduction.¹ The consultation on *Delivering Scotland's Circular Economy – Route Map to 2025 and beyond*, which was published in 2022, sets out the strategic plan to meet the following targets by 2025:²

- 15% reduction of all waste by 2025, against 2011 levels;
- 33% reduction of food waste by 2025, based on 2013;
- Minimum of 70% recycling of household waste by 2025 and;
- Maximum 5% of all waste to landfill by 2025, and a ban on all biodegradable waste.

The Scottish Government has identified that taking steps to disincentivise and reduce residual waste is key to boosting recycling. Direct variable charging (DVC; i.e. directly charging households a variable amount in relation to the waste they produce) is one mechanism that could be used to achieve this. In Scotland, current regulations only allow charging for bulky waste, garden waste, clinical waste, and hazardous waste from domestic properties.³ The aim of this research was to identify where DVC has been implemented globally, learn from the successes and challenges, and assess the applicability of these models to Scotland. This is the second of two reports which will seek to use the learnings from phase 1 to assess the applicability of a DVC model to Scotland.

1.2 Summary of findings from phase 1

DVC has been implemented in many countries globally, many of which have been in place since the early 1990s. The first phase of this research sought to learn from DVC implemented elsewhere by:

1. Identifying case studies where DVC has been implemented;
2. Shortlisting case studies to conduct further detailed research on DVC.

A total of nine case studies in Ireland, Italy, Flanders (Belgium), Guernsey (UK), Dordogne (France), Massachusetts (USA), Maine (USA), Aschaffenburg County (Germany), and Orillia (Canada) were shortlisted to explore in more detail through desk-based research and stakeholder engagement to better understand implementation (Table 1). In some of these cases studies, charging householders for waste was mandated at a national level and in others DVC was a voluntary policy adopted by local authorities.

All the case studies saw an increase in recycling rates and reduction in residual waste rates following the implementation of DVC. However, this improvement typically plateaued following implementation. DVC was not introduced in isolation and it's difficult to separate the impact of DVC and other policy measures on performance. Regardless of the system design, DVC alone is not sufficient to significantly improve performance and should be introduced in tandem with supporting infrastructure to ensure accessibility, other measures to support reduction and reuse of materials, and social instruments to support citizens change

¹ The Scottish Parliament (2023) *Circular Economy (Scotland) Bill* [Link](#)

² Scottish Government (2022) *Delivering Scotland's circular economy – route map to 2025 and beyond: consultation*. [Link](#)

³ The National Archives (1992) *The controlled waste regulations* (1992) [Link](#)

their behaviour. However, DVC is a fundamental policy that changes behaviour and motivates individuals to take responsibility for the waste they produce.

The findings from this research show that the extent of this impact will depend on:

- **System design** – the charging and operating structure of the DVC system should allow flexibility to be tailored to the local context;
- **Collaboration** – design and implementation requires support and collaboration between local and national government;
- **Communication** – implementation needs to be accompanied by a strong communications campaign which begins early and is ongoing to support householders;
- **Fairness** – whilst many thought DVC was a fair system, vulnerable groups may require additional support; and
- **Addressing challenges** – particularly within communal properties and mitigating non-compliance.

Table 1: Summary of shortlisted case studies from phase 1.

Case study	Date of Implementation	System Structure	Charging Structure	Waste Stream	In-house/Contracted Collections
Ireland	From 2003	Mandatory	Depends on local authority	Residual, Recycling, Organic	Both
Italy	From 2000			Residual	Both
Flanders	From 1995			Residual, Recycling, Organic	Both
Guernsey	2019		Volume	Residual	In-house
Dordogne, France	2022	Voluntary	Frequency	Residual	Contracted
Ashland, Massachusetts, USA	2006		Volume	Residual	Contracted
Maine, USA	2012		Volume	Residual	Both
Aschaffenburg County, Germany	1997		Weight	Residual, Organic	In-house
Orillia, Canada	1997		Volume	Residual	Contracted

2 Methodology

2.1 Desk-based research

Findings from phase 1 identified factors which are critical in evaluating the potential impact and risks of DVC. Desk-based research was carried out on these factors in Scotland to allow for the analysis and evaluation of the DVC models in phase 1 and to understand potential challenges and/or benefits for local authorities in Scotland if DVC were to be implemented. These factors included:

- Geography – urban/rural location;
- Population and population density;
- Socio-economic factors, including percentage of low-income households;
- Current policy landscape;
- Household recycling rates in each local authority and;
- Existing waste services in each local authority, including frequency and waste streams.

2.2 Stakeholder engagement

A total of six interviews took place during phase 1 to understand the design and implementation DVC in other regions. This included interviews with representatives from Guernsey Waste, State of Guernsey, Irish Environment Protection Agency, OVAM in Flanders, Consiglio di Bacino Priula, Contarina and US Environment Protection Agency, and Enzo Favoino, Scuola Agraria del Parco di Monza. Some of the information gathered during these interviews was also used in this report. A further interview was carried out with representatives from the Convention of Scottish Local Authorities (CoSLA) and the Scottish Local Authority Waste Managers Network (referred to as the Waste Managers Network for the purpose of this report) to understand Local Authority perception of DVC and where they see the biggest challenges for implementation in Scotland.

3 Evaluation for the Scottish context

3.1 Which type of variable rate structure is best suited for the Scottish Context?

3.1.1 Overview

There were three main types of variable charging that were identified in phase 1:

- Weight-based, where residents are charged per kilo (or pound) of waste they produce. This typically involves fitting waste collection vehicles with scales which weigh a household's waste at the point of collection. In some DVC schemes, householders are given a free allowance and are only charged for exceeding this.
- Volume-based, where residents pre-purchase bin bags or stickers/tags that can be placed on bin bags. These are charged depending on size of the bag, with larger bags costing more.
- Frequency-based, where residents are charged per bin collection. In some DVC schemes, residents are given a certain number of free collections and must pay if this is exceeded.

A summary of the benefits and risks identified for each of these systems in phase 1 can be found in Table 2 below.

Table 2: Summary of benefits and challenges for each type of variable charging system faced by the case studies identified in phase 1 of this project.

System Type	Benefits	Challenges
Weight-based	<ul style="list-style-type: none"> - Most effecting at improving performance; - Less dependent on other measures (ie frequency-based) to drive recycling. 	<ul style="list-style-type: none"> - Implementation in communal bins is challenging; - Requires investment in infrastructure such as vehicles fitted with scales and microchipped bins; - Heavily relies on technology and; - Requires more administration.
Volume-based	<ul style="list-style-type: none"> - Effective at improving recycling; - Easier to apply to all dwelling types; - Requires less investment in infrastructure and; - Easier for householders to understand and budget for - Can be used effectively in tandem with frequency modulation 	<ul style="list-style-type: none"> - Challenges may arise if pricing isn't consistent across local authorities; - Waste collectors will need to spend more time inspecting bags and stickers and; - Greater revenue uncertainty.
Frequency-based	<ul style="list-style-type: none"> - Easier to tailor to different types of geographies; - Effective at improving recycling. 	<ul style="list-style-type: none"> - Urban and rural areas likely to have different needs and; - Requires investment in infrastructure such as bins with radio frequency identification (RFID).⁴

3.1.2 Potential impacts of DVC

There is evidence that DVC has the potential to be an effective behaviour change mechanism when implemented with sufficient infrastructure and education to support householders (see section 3.5 for more detail). Case studies show that all charging methods can be effective in increasing recycling rates and reducing residual waste, and the evidence suggests that weight-based charging can produce the greatest increase in performance.⁵

As DVC was not implemented in isolation in the other case studies, it's impossible to quantify the potential impact of DVC without significant modelling. Nonetheless, DVC has been shown to be an effective behaviour change mechanism and the experience of the local authorities studied in phase 1

⁴ RFID tags allows waste collectors to identify the owner of a bin, so they can be charged for each collection

⁵ Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

points to good opportunities for performance improvements in Scotland. Learning in phase 1 highlights the potential complexities that should be considered when identifying the type of DVC scheme that will be most effective in Scotland.

DVC adoption will impact waste streams differently given the characteristics and handling requirements of each. Understanding the potential impact of DVC on household waste disposal decisions can help in the tailoring of systems that match the waste of specific regions or communities while also supporting the objectives of the institutions implementing them. For example, plastic, metal packaging, and drink cartons (PMD) are light, but bulky, so a volume-based system may be more effective in increasing the recycling of these items. Paper and card are also light and bulky in comparison to other waste streams, however, they only account for 0.5% of waste sent to landfill in Scotland in 2021.⁶

Food waste is a significant challenge for Scotland, with total food waste (municipal and commercial), accounting for approximately 4% of Scotland's total carbon footprint.⁷ Although separate food waste collections are in place in many Scottish Local Authorities, this waste stream remains a challenge as many householders are not effectively using this service.⁸ As organic waste is the heaviest recyclable waste stream per unit, a weight-based system that pushes organics toward separate collection at no cost to the householder would be more effective than a volume-based one at reducing food in residual waste.

A frequency-based system would also be effective, if free and separate food waste collections are provided on a more frequent basis (see section 3.4.2 for more detail). Currently, 47% of local authorities (15 out of 32) offer weekly food waste collection, 38% (12 out of 32) offer fortnightly collections, and the remainder are either exempt or do not provide this information on their website.⁹ Phase 1 highlighted the importance of separate and frequent food waste collections to support the implementation of DVC.

In Scotland, glass recycling has increased by 26% since 2011 with 2021 recording over 120,000 tonnes recycled.¹⁰ As the second heaviest recyclable waste stream per unit measure, rates of recycling of glass could also benefit from a weight-based approach.¹¹ However, a focus on expanding kerbside glass collection and/or a reassessment of glass bring bank density and accessibility would be required to ensure the full realisation of any DVC benefit. Based on research conducted as part of this study, findings indicate that seven local authorities collect glass via recycling points whereas at least 15 have kerbside collections, either comingled or separate. Information on how the remaining local authorities handle glass collections was not available in the public domain.¹²

Frequency-based collections are less likely to have an impact on a specific waste stream and may provide a one-size fits all solution, however a strategy that integrates both a frequency and volume -

⁶ SEPA (2021) *Household waste data* [Link](#)

⁷ Scottish Government (2018) *Scotland's carbon footprint* [Link](#)

⁸ Interview with representatives from the Waste Managers Network and COSLA, June 2023

⁹ Resource Futures' research based on reported system operations obtained by Scottish Local Authority websites.

¹⁰ SEPA (2021) *Household waste data* [Link](#)

¹¹ 'Volume-to-Weight conversion factors' U.S. Environmental Protection Agency, Office of Resource Conservation and Recovery, April 2016. [Link](#).

¹² Resource Futures' research based on reported system operations obtained by Scottish Local Authority websites.

based approach should produce better results. For example, charging by volume and then implementing frequency of collections for residual waste can further drive recycling performance.

The potential impacts of these waste streams need to be considered in the broader policy landscape in Scotland as impending measures such as deposit return scheme (DRS), extended producer responsibility (EPR) and landfill ban on biodegradable waste are being introduced to improve recycling performance. Section 3.5.1 discusses this in more detail.

3.1.3 Considerations for the Scottish context

This section explores the factors in Scotland which pose the greatest challenge to the successful implementation of DVC and takes learnings from the phase 1 report to understand how these can be mitigated. Further detail of the challenges the shortlisted case studies have experienced in regards to DVC implementation can be found in the phase 1 report.

3.1.3.1 Communal properties

Communal properties pose a challenge across each of the three types of DVC systems that are outlined in Table 2 as it is difficult to attribute waste to a particular household. This was an issue that was highlighted in all the case studies that were examined in phase 1 of this project. With 37% of Scottish households living in flatted properties, this challenge requires careful consideration.¹³ The proportion of people living in flats is highest in Glasgow and Edinburgh, where 72% and 68% of households respectively live in flats, according to latest statistics.¹⁴ Representatives from the Scottish Local Authority Waste Managers Network highlighted that flatted properties already pose waste management challenges under the current system and there was concern that this could become more complex under DVC.¹⁵ This was also highlighted as a significant barrier to DVC in consultation responses to the consultation, *Delivering Scotland's circular economy: A Route Map to 2025 and beyond*.¹⁶

Scotland poses a unique challenge compared to some of the case studies examined because few properties have bin stores and residents in both flats and houses use on-street bins to dispose of their waste. Therefore, many of the solutions that have been used in other DVC schemes, such as treating waste from householders in communal properties as commercial waste (as seen in the USA)¹⁷ or splitting the charge proportionally across flats (as seen in Limburg, Flanders)¹⁸ are just not feasible in Scotland.

A volume-based system poses the smallest challenge as it removes the need to link a bin to a specific household or property, giving the most flexibility within the system. The greatest challenge arises with enforcement of individuals not complying with the system, because communal bins will be open for everyone to use. This was a rationale for Guernsey removing communal bins as much as possible when implementing their sticker-based DVC system.

¹³ Scottish Government (2017) *Dwellings by type* [Link](#)

¹⁴ Scottish Government (2017) *Dwellings by type* [Link](#)

¹⁵ Interview with representatives from the Waste Managers Network and COSLA, June 2023

¹⁶ Scottish Government (2022) *Delivering Scotland's circular economy: A route map to 2025 and beyond*. [Link](#)

¹⁷ US EPA (undated) *Apartments and multi-family housing* [accessed 12 June 2023] [Link](#)

¹⁸ Limburg.net, (accessed April 2023) *Waste Collection* [Link](#)

There also appears to be more flexibility within the frequency-based systems that were explored in phase 1. Dordogne has taken a very different approach to the other case studies by utilising communal bins as much as possible. Bins are equipped with swipe card access, which records how often an individual visits a bin. Single-family homes also have access to and use these bins, reducing the number of collections each vehicle must make. This could provide a solution for the communal property challenge in either a volume or frequency-based system.

The biggest challenges regarding communal bins appear to be within the weight-based systems due to the difficulty in being able to link the waste to a household. This is an issue that municipalities in Flanders have been struggling with as they have transitioned from a volume-based to weight-based system. It appears no effective solution has been identified yet.¹⁹ The most viable approach is to equip communal bins with scales and limit access via RFID or swipe card access. However, Flemish municipalities have found challenges due to increasing non-compliance from householders, such as burning of waste, waste tourism (disposing of waste in local authorities where cost is lower), and disposing of residual waste in bins/bags allocated for recyclables. These challenges lead to escalating costs, and increased management complexity. Solutions focus on the provision of increased enforcement, awareness raising and recycling convenience, and refusal to accept incorrectly sorted waste.²⁰ Due to the prevalence of flatted properties in Scotland, it is likely that a weight-based system would come with significant challenges.

3.1.3.2 Household recycling centres

Household recycling centres (HRCs) can be used to fit within the DVC systems; however, consideration of the charges and services in place need to be in line with those for kerbside collection to ensure households without cars are not unfairly penalised. In phase 1, the shortlisted case studies used HRCs as a secondary method of waste management to support the principles of DVC by implementing variable charging for other non-recyclable waste streams. HRCs can be used to support management of waste not included in kerbside collection (such as WEEE and cooking oil).

A weight-based charging system can be implemented in an HRC, although this will increase time and administration and requires additional staffing to oversee. A frequency-based system can also easily be implemented in HRCs, where residents are charged per visit. In Scotland, many local authorities use a booking system at their HRCs, and this could be paid upon booking. To support appropriate waste management of items not collected at kerbside, a set number of free bulky uplifts and/or visits to the HRC could be allowed. However, limits on the amount of waste that could be disposed at each visit would need to be in place to prevent those with cars being able to take advantage of the system.

A volume-based system is perhaps more challenging to implement at HRCs. This could be an opportunity where a hybrid system may be suitable, where a volume-based system is in place for kerbside collections and households are charged by weight or frequency at an HRC.

¹⁹ Interview with representative from OVAM, April 2023

²⁰ ACR+ (2014) *R4R Regions for Recycling, Good Practices Flanders: PAYT*. [Link](#).

3.1.3.3 Urban-Rural context

There weren't any examples given in the phase 1 report where a weight-based system had to be tailored to the rurality of a location. Volume-based charging systems also appear to work well in urban and rural areas. However, some challenges could arise with a volume-based system in urban areas due to the prevalence of smaller bins in flats. There needs to be a range in bag sizes to accommodate different householder needs. Most of the volume-based systems had a variety of bag sizes for sale which provide flexibility for these households. After consultation with householders, Guernsey waste, opted for a sticker-based approach because it allowed for more flexibility on the type of bags that were used, which was important to householders.²¹

The frequency-based systems in place in Dordogne and Priula were tailored to the rurality of the areas they served. In Priula, householders living in urban areas were allocated more frequent collections at no additional charge as those living in rural areas had larger bins and storage areas, and therefore didn't need their waste to be collected as often. In Dordogne, residents in urban areas were allocated a certain number of trips to communal bins, whereas in rural areas door-to-door collections were implemented when people weren't near a communal bin. A frequency-based DVC in Scotland would need to be tailored to the rurality in a similar way, whether this is considering the smaller households in urban areas, or the unsuitability of communal bins in rural area.

3.1.3.4 Balancing performance and feasibility

Whilst a weight-based system may have a bigger impact on performance than the other systems, it requires more investment in infrastructure and administration by local authorities (see section 3.6 for more detail). This includes retrofitting waste collection vehicles with scales and providing residents with microchipped bins. Local authorities have indicated that these one-off costs could not be met through existing local waste management budgets.^{22,23} Whilst administrative costs of managing a weight-based system are higher, there is potential for these costs to be covered by savings from the treatment of residual waste. For example, the State of Massachusetts experienced a 29% reduction in disposed waste in local authorities with DVC versus those without. While not quantified in the literature the 517 pound (234kg) difference between DVC and non-DVC LAs represents certain reductions in the cost to collect, transport and dispose of waste.²⁴

Some of the short-listed regions in phase 1 with longstanding DVC systems, such as municipalities in Flanders, have experienced an evolution of DVC over time. A volume-based system was initially implemented in most municipalities in Flanders and now many of these are moving to a weight-based system to further drive performance improvement.²⁵ Whilst there have been challenges in the migration to a weight-based system, this is mostly related to infrastructure challenges, such as communal properties as outlined above. In these instances, a phased approach was not planned and transitioning to a different charging system has been driven by the need to further improve performance.

²¹ Interview with Guernsey Waste, April 2023

²² Scottish Government (2022) *Delivering Scotland's circular economy: A route map to 2025 and beyond: Response*. [Link](#)

²³ Interview with representatives from Waste Managers Network and CoSLA

²⁴ Smith R. (2022) *Spring into PAYT: How to make it work for you*. [Link](#)

²⁵ Interview with representative from OVAM, April 2023

A phased approach, with initial implementation of a volume-based system, may be an approach which could be taken in Scotland. Beginning with a volume-based approach would allow the lowest initial investment in infrastructure and administrative charges and could allow more resources to be directed towards communication and support to maximise household behaviour change. Phasing-in of a frequency-based system to be used in combination with a volume-based system would drive behaviour change in a way that is more feasible. Furthermore, these two systems pose less challenges to implementation than a weight-based system and therefore could be implemented more quickly. If further performance improvement is required, a weight-based system could be considered, however, this phased approach would enable earlier progress.

3.2 Fixed charges for waste management

The purpose of the variable charge is to change the householder's behaviours by encouraging a household to take personal responsibility for the waste they produce and use pricing as an incentive for reducing residual waste generation while increasing recycling. In all the case studies identified in phase 1 of the report, the variable charge was accompanied by a fixed charge. It was not seen as feasible to use the variable charge alone for waste management cost recovery as this would be too high for householders leading to non-compliance.

Currently, waste management in Scotland is funded through council tax, which could continue to be the method by which the fixed charge is applied to households. A representative from the waste managers network said that the use of council tax by local authorities is not always well understood by householders and there is sometimes a perception that it is used exclusively for waste collection, as disposal is often not a consideration. A report conducted by Eunomia suggested that a reduction in council tax may make DVC more palatable to householders.²⁶ However, it may be that greater transparency as to the purpose and final use of these charges may help to mitigate resistance to this means of supporting waste operations. This could be accomplished through communications describing a household's opportunity to avoid DVC charging by diverting waste away from the general waste bin, to recycling bins, and the associated landfill disposal and environmental costs linked to general waste disposal. Parallel messaging could focus on the services covered by the fixed charge council tax.

3.3 Mandating implementation of DVC

The shortlisted cases which were identified in phase 1 of this project represented examples of mandatory and voluntary DVC systems. These took three different forms:

- **Nationally designed mandatory system**, where government mandated that local authorities had to implement DVC, including the system type and charges;
- **Locally designed mandatory system**, where government mandated that local authorities have to implement variable charging, but local authorities are given the autonomy to design their own DVC system;
- **Voluntary**, where municipalities voluntarily implement DVC, this may be with or without the support of national government.

²⁶ Eunomia (2021) *Review of high performing recycling systems* [Link](#)

In Scotland, local authorities have autonomy to design and implement their own waste and recycling services, within a framework set out through national waste regulations, and a voluntary household recycling charter and associated Code of Practice.²⁷ The Circular Economy Bill, which was introduced to Parliament in June 2023, sets out measures to maximise recycling performance and achieve more consistent local services in Scotland.²⁸ This includes placing a revised household recycling Code of Practice on a statutory basis to 'provide a clear strategic direction for recycling in Scotland and accelerate improvements to both the quality and quantity of recycling collected to help meet the Scottish Government's targets'. Responses to the Route Map consultation highlight the importance of being able to tailor waste management to the local context.^{29,30} Most of the shortlisted case studies which took a mandated approach, allowed for local authorities to design their own system to allow this tailored approach, which was viewed as important among local authorities, particularly in countries which had to accommodate a range of different geographies and demographics. Guernsey was the only shortlisted case study where DVC was designed by national government. However, Guernsey is a very small island with only 63,000 people.³¹

A mandated system where local authorities are given the autonomy to design their own type of system can result in an inconsistent approach which may be confusing to residents, leading to reduced compliance. It also has the potential to create competition for lower prices, which goes against the principles of the system. In Flanders, differences in tariffs between local authorities has led to waste tourism, with people trying to get rid of their waste in neighbouring local authorities where waste is less expensive. Differences in pricing may also limit the success of DVC if it becomes politically favourable for local authorities to implement pricing lower than other areas. To mitigate this, there would need to be a national minimum pricing in place that could be reviewed regularly and changed over time to meet the needs of the DVC scheme.

Representatives from the Waste Managers Network said that if DVC was mandated, a nationally designed approach, in consultation with local authorities, would be preferred. They felt it could be unpopular to implement DVC locally without national government design and would cause local authorities to lose support from the public.³² Additionally, they thought requiring local authorities to design and implement their own system would be too much of a burden on resources. If this was required, they would want substantial support from Scottish Government.

In interviews, representatives from the Waste Managers Network and CoSLA were asked if there would be an appetite among local authorities to implement DVC on a voluntary basis, if powers were given to them. They said with the information that they currently have, this is unlikely. To get local authorities on board there would need to be evidence that implementation of DVC would be the most cost-effective way of increasing performance compared to other strategies (outreach, awareness, etc). Voluntary approaches seen in other countries are most often found in local authorities where a driver, such as

²⁷ Scottish Government (2016) *Code of Practice Household Recycling Charter in Scotland* [Link](#)

²⁸ Scottish Parliament (2023) *Circular Economy (Scotland) Bill* [Link](#)

²⁹ Scottish Government (2022) *Delivering Scotland's circular economy: A route map to 2025 and beyond: Response*. [Link](#)

³⁰ Scottish Government (2022) *Delivering Scotland's circular economy: A route map to 2025 and beyond: Response*. [Link](#)

³¹ States of Guernsey (2023) *Electronic census: Latest population, employment, and earnings* [Link](#)

³² Interview with representatives from Waste

reaching landfill capacity, has encouraged local decision makers to take up DVC. While voluntary approaches can offer good examples of DVC implementation, they often do not provide examples as to how different levels of government should interact to support implementation as well as to monitor operations and finances.

3.4 Operating structure

This section focuses on operation of the above DVC models and the key considerations to implementation of these models within the Scottish context.

3.4.1 Waste streams

Key findings related to this section include:

- Material diverted from the residual waste bin will be the primary measure for gaging success of DVC implementation and;
- Many of the shortlisted case studies describe the assessment of a reduced fee for the collection of some recyclable waste streams, however this is not recommended for inclusion in a Scottish DVC strategy at this early stage.

Whilst most DVC systems implemented in other regions only charge for residual waste, some of those identified in phase 1 also charge for the collection of recyclable waste (Table 3). This section will look at the specific considerations for each waste stream as reflected in the focus case studies as well as how these fit within the Scottish context.

Table 3: Summary of waste streams included in the shortlisted DVC case studies in Phase 1

Case study	System type	Waste stream
Ireland	Depends on local authority	Residual, Recycling, Organic
Italy		Residual
Flanders		Residual, Recycling, Organic
Guernsey	Volume	Residual
Dordogne, France	Frequency	Residual
Ashland, Massachusetts, USA	Volume	Residual
Maine, USA	Volume	Residual
Aschaffenburg County, Germany	Weight	Residual, Organic
Orillia, Canada	Volume	Residual

In 2021, Scottish households produced nearly 2.5 million tonnes of waste, of which only around 43%, 1.1 million tonnes, was recycled waste.³³ With the pending introduction of additional supporting measures, such as DRS, EPR, and a ban on landfilling of biodegradable municipal waste, residual waste should

³³ SEPA (2021) *Household waste data* [Link](#)

remain the primary focus. The purpose of DVC in this context is to use it to focus attention on reducing residual waste while maximising the impact of simultaneous measures providing a boost to recycling services. Reductions in rates of residual waste disposed offer the most reliable metric for measuring progress.

In the case studies identified in phase 1, only municipalities in Flanders and Ireland charged for the collection of recycling. The motivation behind charging for these waste streams was to adhere to the waste hierarchy and that not charging would send the wrong message to householders.³⁴ However, these charges were less than those for residual waste. For instance, Flanders charges a nominal rate for the collection of PMD that only covers the cost of the collection blue sack itself, as the collection and treatment of material is funded through the existing EPR system. This small fee was designed to signal to householders that these services are not free. Whilst charging for recyclables may help meet waste prevention objections, there are a lack of services available in Scotland to promote reuse and repair when compared to the shortlisted case studies examined in phase 1. Additionally, there may be a perception among residents that this additional charge is unfair, particularly if there are no changes to council tax fees collected by the local authority.

While most case studies documented no cost for the collection of organic waste, this was not the case in Flanders or in Aschaffenburg where organics collection incurs a small collection fee. The motivation behind these decisions is slightly different in each case with the Flemish approach³⁵ designed to motivate home composting while the German one is based on a lack of composting capacity.³⁶ In both instances the fee for organics collection is lower than that at which residual waste is set. Given that there are drivers to increase organics collections in Scotland and challenges already seen by local authorities in separating organic waste³⁷, a charge may be counterproductive. As household behaviours in Scotland around food waste collection have yet to take hold, instead of a fee a better approach would be to provide a discount for those households that compost at home, and do not dispose of organic waste.

3.4.2 Frequency of waste collection

Key findings related to this section include:

- Most Scottish local authorities collect residual waste either fortnightly or once every three weeks;
- Several local authorities have already changed frequency of collections to encourage recycling, by reducing residual waste collections. This serves as an opportunity to implement a frequency-based DVC system and;
- Increased frequency of food waste collection is an essential component of effective DVC implementation, offering households the best strategy for reducing waste volumes and weight.

³⁴ Interviews with OVAM and Irish EPA representative, April 2023

³⁵ Regions for Recycling (2014), *Good practice Flanders: PAYT*

³⁶ J. Morlok, H. Schoenberger (2017), *The Impact of Pay-As-You-Throw Schemes on Municipal Solid Waste Management: The Exemplar Case of the County of Aschaffenburg, Germany* [Link](#)

³⁷ Interview with representatives from the Waste Managers Network and Cosla

The current Scottish collection system offers a good starting point for frequency-based DVC implementation given that many local authorities are already operating systems with a frequency element, while the standardization and downward trend of bin sizes offers opportunity for ready adaptation of volume-based DVC. In the selected case studies, modulation of collection frequency is commonly used to reduce residual waste volumes and promote better separation of recyclable materials. While a combination of volume and frequency-based DVC models can be used to drive heavier wastes away from residual waste collection, frequency modulation for residual waste collection is not unique to DVC and is already implemented in some Scottish local authorities to encourage higher recycling rates. Collection frequency varies among Scottish local authorities, ranging from once a week to every four weeks for residual waste (Figure 1). Most Scottish local authorities collect residual waste either fortnightly or once every three weeks.

Shifting to three-week collection allows for more extensive coverage without additional equipment. However, reducing the frequency of residual waste collection will require consideration of more frequent collection of recyclables. Increasing the frequency of recyclable collection offers greater convenience to households for bulky waste and is a crucial aspect of a frequency-based system designed to encourage households to separate waste.

A limitation of a frequency-based system is the capacity of households to store waste until the next collection. This depends on the size of waste bins and available storage space. In Scotland, single-family bins for residual waste typically range from 140 to 180 litres, with a trend towards smaller bins (previously 240 litres). This downward trend in bin size supports future implementation of a volume-based subscription model of DVC, utilizing existing bins in single-family residential services. Frequent kerbside collection of recyclables will be essential to support any form of DVC.

Higher collection frequency is also used to enhance collection of organic waste. Italian local authorities collect food waste as often as twice weekly, which is more often than in any of the local authorities in Scotland. Five of the six local authorities with the lowest recycling rates either do not offer or offer fortnightly collection of food waste³⁸. As separate collection of food waste was seen as an instrumental supporting mechanism to the success of DVC in phase one and just over one-third of Scottish Local authorities collect food waste once every fortnight, increasing separation of food waste is essential. Further research would be needed to understand the optimal frequency of collections as there is a different climate in Scotland than in some of the case studies (i.e. food waste will spoil more quickly in a warmer climate). A frequency-based system for residual waste may help to support take up of food waste services.

³⁸ SEPA (2021) *Household waste data* [Link](#)

Waste collection frequency in Scottish LAs						
Local Authority	General	PMD	Paper / card	Food waste	Green waste	Glass
Aberdeen City						n/a
Aberdeenshire					n/a	n/a
Angus					n/a	n/a
Argyll and Bute				No collection	n/a	n/a
City of Edinburgh						
Clackmannanshire						
Dumfries and Galloway					n/a	Recycling point
Dundee City						Recycling point
East Ayrshire						
East Dunbartonshire					n/a	
East Lothian						
East Renfrewshire						
Falkirk						
Fife						n/a
Glasgow City						
Highland						Recycling point
Inverclyde						Recycling point
Midlothian						
Moray						
Na h-Eileanan Siar						
North Ayrshire						
North Lanarkshire						
Orkney Islands				Exempt	Exempt	
Perth and Kinross						n/a
Renfrewshire						
Scottish Borders					n/a	Recycling point
Shetland Islands				No collection	Recycling point	Recycling point
South Ayrshire	N/a					
South Lanarkshire						
Stirling				N/a	N/a	Recycling point
West Dunbartonshire						Recycling point
West Lothian						Recycling point

Figure 1: Waste collection frequency by local authority in Scotland

	1 collection / week
	1 collection every 2 weeks
	1 collection every 3 weeks
	1 collection every 4 weeks
	1 collection every 6-8 weeks
n/a	No information available

3.4.3 Enforcement and legal framework

Key findings related to this section include:

- In the case of development of a national framework for DVC implementation, local authorities need to have autonomy in a number of areas that include: determination of variable rates, mandate for use of waste services, and enhanced enforcement oversight;
- It is important to develop strategies to prevent waste stream contamination, use of clear plastic bags can ensure that only recyclables are being placed in recycling containers and;
- Local authorities should aim to achieve a balance between enforcement and a focus on outreach and communications, achieving this through a focus on improved communications and resorting to fines as a last resort.

Considerations related to the legal framework and system governance include the need for coordinated oversight and enforcement roles at all levels of authority, from the national level to the local one. This includes providing for national framework legislation to guide local authorities as to the elements necessary to be included in DVC system design, implementation, and operation. A final but key element related to system design is the enforcement provisions governing behaviour and participation of residents. Ideally, a balance between measures focused on reaching compliance via enforcement and those promoting compliance through communications and outreach strategies will be achieved. It is important to note that enforcement should be the last resort, with other approaches prioritised.

If a national framework for DVC was to be implemented, local authorities would need to have autonomy in a number of areas when designing their specific systems, these areas include: .,

- Set variable waste collection rates and charge residents accordingly;
- Establish an ordinance mandating that residents use the waste collection service;
- Enforce size or weight limits on waste containers;
- Enforce bans on illegal diversion, including fly-tipping, and burning of waste. and
- Implement powers to allow local authorities to bring enforcement measures against adding non-recyclable materials to recycling bins and;
- Spend funds for activities beyond those associated with traditional solid waste management services, such as public education.³⁹

In Scotland, compliance with environmental regulations is anchored around five principles related to improved regulation: proportionality, accountability, consistency, transparency, and targeting, with the integration of a timely approach.⁴⁰ These principles are present in the current approach to regulating waste management systems and can also be readily applied within the context of any future DVC system implementation.

There needs to be enforcement of the size or weight limits that are in place. This will require local authorities to examine each of the collection receptacles to ensure compliance. In the shortlisted case studies, non-compliance leads to waste not being collected. This requires time to inspect each collection, but is necessary to drive compliance, particularly in the early stages of DVC. A 'tag

³⁹ EPA (2018) *Pay-as-you-throw workbook: A supplement to EPA's pay-as-you throw guidebook* [Link](#)

⁴⁰ SEPA (undated) *The Scottish Environment Protection Agency's Enforcement Policy* [Link](#)

enforcement' blitz in Orillia in 2017 resulted in increased sales of tags, suggesting that historically not all residents were abiding by the system.

To prevent waste stream contamination, many of the shortlisted case studies utilise clear plastic bags to ensure that only recyclables are being placed in recycling containers to prevent householders from avoiding charges.⁴¹ Clear bags have also been used in Orillia, providing a means for collection crews to verify the content of waste bags. If the crew determines that more than 10% of the bags' contents are not recyclable, they can elect not to collect the bag. This could compliment a volume-based system where bags must be purchased.

Enforcement of this type will prove a challenge in on-street communal bins in Scotland where it becomes difficult to associate the waste deposited with a household. In Guernsey, collection crews log any bags that have been left without a sticker and hand sort to determine if an individual can be identified. Upon successful identification, the resident is sent a notice warning of their action or fine. In the case of a second offense, an official warning is sent. Fines of £60 are issued for a third offense, and if paid in a timely manner, the fine is reduced to £40. For every offense thereafter, additional fines are issued.⁴² Swipe card access to bins and smaller receptacles on litter bins are other methods that can be used to increase compliance.

In Scotland, a duty of care code of practice exists at the household level, which describes the responsibilities of householders in managing waste and assesses partial responsibility for improperly managed waste by third parties. Behaviours that violate the code can be penalised through fines or other civil mechanisms. This focus on waste generator responsibilities, particularly those of business and householders, is reinforced in the recently introduced Circular Economy Bill.⁴³

Tagging enforcement measures are already in operation in Dumfries and Galloway where they utilise include a tagging system used to identify problems with residential waste separation or presentation for collection. Tags are color-coded and indicate specific issues such as recycling bin contamination (green tag), bins too heavy to lift (white tag), overfilled or jammed bins (red tag), presenting two bins instead of one (orange tag), presenting the wrong waste bin (purple tag), contaminated food bin (yellow tag), farm waste in bins (blue tag), and improper securing of commercial waste bins (pink tag).⁴⁴ A system such as this could be used within a DVC systems and provides the opportunity for education first, followed by enforcement.

Priula (IT) provides an example of the balance required between enforcement with a focus on outreach and communications. Here, local managers point out how, through a focus on improved communications related to the functioning and benefits of the DVC system, compliance with system operations improved. At the same time, system operators noted that enforcement is the last resort, and that most residents remain supportive and compliant with system parameters. This finding indicates the power of effective communication in ensuring compliance.

⁴¹ Interview with representative from OVAM, April 2023

⁴² Interview with representative from Guernsey Waste

⁴³ Scottish Parliament (2023) *Circular Economy (Scotland) Bill* [Link](#)

⁴⁴ Dumfries & Galloway Council, FAQ's Your Waste and Recycling Service, [Link](#)

Direct variable charging must be accompanied by strong supporting measures to prevent fly-tipping. This has been addressed in the shortlisted case studies through a variety of mechanisms such as effective communications, increasing infrastructure and surveillance. The Scottish Government has recently published an updated National Litter and Fly-tipping Strategy which focuses on three key themes: behaviour change, services and infrastructure and enforcement.⁴⁵ Consideration of these measures should be considered in the context of DVC if implemented.

3.5 Supporting measures

To ensure successful DVC outcomes it is important that the existing policy, system and operational elements are considered and that they are supportive of DVC objectives. This section provides an overview of the status of these key factors.

3.5.1 Waste policy coordination

Scotland is currently undergoing significant changes in waste management, with various policy measures planned, implemented, or in progress. Some of these measures directly relate to DVC implementation. These include:

- Bans on single-use plastics (2022)⁴⁶
- Planned implementation of a Deposit Return Scheme (DRS) (October 2025)⁴⁷
- Major investments in a five-year local authority recycling infrastructure initiative (2021-2026)⁴⁸
- Planned consultations on separate collection of garden waste, textiles and hazardous household waste (2023-2025)⁴⁹
- Boosting recycling and increase focus on food waste reductions as component of plan to comply with targets in 'Climate Change (Scotland) Act (2019)'⁵⁰
- Introduction of extended producer responsibility (EPR) schemes for packaging, waste electrical and electronic equipment (WEEE), and batteries (part of UK-wide reform) (2021 ongoing)⁵¹
- Landfill ban on biodegradable municipal waste (2025).⁵²

Since the objective of DVC is to divert materials from linear disposal towards recovery and reuse, it is crucial to assess the impact of other supportive policies. This ensures coordinated and mutually supportive reforms. Whilst there is a potential for the above to have a high impact on performance when combined with DVC, some considerations need to be taken in the design of these policies. With incoming policy measures on DRS and EPR, it is essential to make the public aware that by adhering to waste separation practices they can avoid being charged twice for materials collected for recycling and disposal. The alternative in the case of non-separation of waste would be a double charge for disposal of materials or packaging that already include a handling fee or deposit, e.g. EPR or DRS.

⁴⁵ Scottish Government (2022) *National Litter and Fly-tipping strategy* [Link](#)

⁴⁶ Zero Waste Scotland (2023) *Single-use plastic products (Scotland) regulations 2021* [Link](#)

⁴⁷ Zero Waste Scotland (2023) *Deposit Return Scheme to Go Live October 2025* [Link](#)

⁴⁸ Scottish Government (2021) *Landmark investment in recycling* [Link](#)

⁴⁹ Scottish Government (2022) *Delivering Scotland's circular economy – route map to 2025 and beyond: consultation* [Link](#)

⁵⁰ Scottish Government (2022) *Climate Change (Emissions Reduction Targets) (Scotland) Act 2019* [Link](#)

⁵¹ Defra (2021) *Extended producer responsibility for packaging: consultation document* [Link](#)

⁵² Scottish Government (2022) *Delivering Scotland's circular economy – route map to 2025 and beyond: consultation* [Link](#)

I.e. householders have contributed towards waste collection and recycling costs for packaging items where these policies result in an additional cost or deposit being added to the price of products sold. By not effectively separating waste they would then be charged again under a DVC.

It is critical that the public understand how these charges are assessed, and that DVC is a tool for behaviour change and not cost recovery, unlike EPR which is designed as full net cost recovery. A lack of understanding of any of these elements can result in a negative impact on public trust and disincentive to participation.

In Flanders, efforts are being made to harmonise fee assessment across DVC and EPR systems. The focus is on avoiding duplicate fees within the DVC system for materials already covered by EPR⁵³. Only additional costs that are not provided for under EPR would be applied, such as the cost of a bag or bin. The same precaution applies to a DRS system where system design relies on non-municipal actors handling logistics and financial management. In such cases, a DVC system could incorporate a fee on bottles and flasks covered by the DRS to encourage households to return these materials and recover the associated deposit.⁵⁴ UK consultations have analysed the potential impacts of DRS introduction on existing household recycling efforts. Key findings include a reduction in litter clean-up costs, anticipated reductions in kerbside collection of in-scope containers, and the need for revised investment planning in collection trucks and infrastructure. Coordinated implementation of DVC alongside DRS can further drive positive outcomes by imposing an alternative cost to the preferable deposit return incentive offered by DRS.

An example of this approach is seen in the Maine (US) example where the state's longstanding Returnable Beverage Container Law, synonymous with a DRS, has been in effect since 1978. This law includes deposit fee assessment and recovery on sealed containers made of glass, metal, or plastic. In 2014, Maine reported that glass accounted for 2.7% of residential waste disposed, while national calculations by USEPA estimated the glass contribution to MSW composition at five percent, demonstrating a probable consequence and link between DRS and DVC policies where over 31% of the population lives in a DVC system community.

3.5.2 Expansion of separate collections

Experience from international examples demonstrates that separate household collection of recyclables leads to better material recovery rates, while an increase in the number of waste streams being collected separately leads to more waste being diverted from landfill and incineration.⁵⁵ A transition to DVC provides an opportunity to build on this success but it is important to understand how past practices will need to be modified to realise gains.

The Scottish approach to separate household collection reflects current practice in many European and North American local authorities and includes provision for separate collection of waste streams that include paper and card; PMD, biodegradable wastes, residual waste and often glass and garden waste. Looking at specific results from DVC case studies analysed, Priula recorded recovery of 54kg of paper

⁵³ Interview with representative from OVAM, April 2023.

⁵⁴ 'Understanding the impacts of the Deposit Return Scheme (DRS) for Local Authorities' Insight, SLR Consulting. [Link](#)

⁵⁵ European Environmental Agency (2023) *Economic instruments and separate collection systems – key strategies to increase recycling*

and card per inhabitant annually, representing 13% of waste generated. Of the material collected 99% was compliant with 100% of the remaining material going to mills for recycling. All case study DVC systems provide separate kerbside pick-up of paper, while also providing this collection at no cost to households.

Examples of other UK and European local authorities (such as in Wales, Denmark and Norway) expanding their scope of separate collections include separate collections for smaller material waste streams such as textiles, waste electrical and electronic equipment (WEEE), batteries and household hazardous wastes.⁵⁶ While not all of these are DVC systems this push toward new waste stream recycling efforts offers insights for the design of a Scottish DVC system. While the opportunity for gains in recovery in Scotland are understood to exist around food waste and other dry recyclables, adding new waste streams to existing separate collection adds to ambition to drive down disposed waste overall. At the same time this push should be accompanied by a boost in offerings of separate collection within rural areas and strategies to facilitate these offerings in communal housing. The introduction of EPR schemes for a range of products and materials will provide local authorities with a significant source of funding to drive high-quality collection systems. When introduced, packaging EPR will see local authorities receive an estimated £1.2bn per annum to fund an efficient and effective kerbside collection system for packaging. The Scottish Government is also working with the other UK governments to introduce EPR across other products including waste electrical and electronic equipment and batteries. Ensuring delivery of recycling compliant dry recyclables will be further facilitated by increasing separate collection for food waste to rural and exempt areas, as food waste is often responsible for contamination of otherwise recoverable material streams.

3.5.3 Infrastructure

Based on the experience of several of the case studies shortlisted in phase 1, implementation of DVC systems often does not require significant new infrastructure. This is especially true in the case of the DVC systems based on volume and frequency, whereas weight-based systems do require additional weighing equipment and systems to track and bill for waste disposed. In Maine, where predominately volume-based DVC has been implemented, minimal new infrastructure requirements have been required. By incorporating existing separate collection and utilising existing waste containers, many Maine local authorities have successfully implemented DVC at reduced cost while achieving better waste management outcomes.⁵⁷

Implementation of volume-based DVC system infrastructure is not so different from traditional systems of waste collection and treatment as Scotland already has existing collection infrastructure, including separate collections at kerbside, to support DVC. Reduced waste and increased recycling generation rates will require adjustments to waste collection vehicle capacity to respond to changes in waste and material collection volumes. An assessment would need to be made on whether new waste containers, bins or bags, and the equipment needed to process or register volume-based measurements are needed. In some volume-based DVC schemes, local authorities have had to invest in new bins if they are

⁵⁶Eunomia (2021) *Review of High Performing Recycling Systems* [Link](#)

⁵⁷ Reason Foundation (2002) *Variable-Rate or 'Pay-as-you-throw' Waste Management: Answers to Frequently Asked Questions* [Link](#)

paying per size of container. In the US, there have been challenges with this system as householders try to fit as much waste as possible in the bins which make it difficult for collection crews to pick up.⁵⁸ The use of pre-paid bags and stickers used in some of the shortlisted case studies offer an alternative to new bins and thus reduced costs. An assessment on the feasibility of individually removing and checking bags from Scottish wheelie bins will need to be made.

Frequency-based and weight-based systems involve more investment in infrastructure. A frequency-based system involves implementation of technology to record collections or deposits from households. In Priula, this is through RFID tagged bins and in Dordogne through swipe card access bins. In phase 1, interviewees from Contarina, outlined that the cost of equipping bins with RFID tags has reduced significantly in recent years and that it is an easy to implement and use technology and can be used with existing bins. Swipe card access at HRCs or communal bins requires more infrastructure as bins will need to be replaced. A weight-based system requires the biggest change in infrastructure, as they require fitting bins with microchips and waste collection vehicles with scales. Both of these systems will also require a change in administrative systems to ensure that the waste generated can be associated with a household.

Support to Scottish local authorities will be required to assist them in developing realistic projections for changes in waste handling following DVC implementation, permitting them to then anticipate required changes in truck routing, staffing and needed frequency. It is expected that with the successful implementation of DVC focused on volume and frequency approach, Scottish local authorities could in a second phase raise ambition and begin to assess opportunities for progressing to a weight-based system which would require the additional infrastructure and equipment described above.

3.5.4 Communications and outreach

Effective communication and outreach are crucial for garnering support for a DVC system. Engaging with residents during the planning and implementation phases is essential. Establishing a citizens' advisory council can aid in goal setting, communication plans, and decision-making.⁵⁹ Additional communication approaches should be taken up, such as press releases, targeted social media campaigns, neighbourhood consultations, flyers, brochures, online messaging, information points, and dedicated phone lines.⁶⁰

A common concern during discussions about DVC adoption is the introduction of a new service fee. In the Scottish context, where waste management is currently funded through taxation, it is important to develop a clear messaging strategy to address that concern. As part of this process, it will be important to describe the reasoning leading to the establishment of DVC, including the need to reduce waste generation, plateauing recycling rates, rising costs, and a need to align with waste and carbon reduction goals. Explaining how the phased implementation of DVC works with existing council will provide a rationale for the continued need for funding.

⁵⁸ EPA (2020) *Volume- vs. Weight-Based Programs* [Link](#)

⁵⁹ EPA (2018) *Pay-as-you-throw workbook: A supplement to EPA's pay-as-you throw guidebook* [Link](#)

⁶⁰ EPA (2018) *Pay-as-you-throw workbook: A supplement to EPA's pay-as-you throw guidebook* [Link](#)

The case studies highlight the importance of well-planned and ongoing communications efforts before during and after DVC implementation. In Flanders, municipalities work within the context of EPR and DVC schemes to engage citizens, conduct surveys, and refine service provision.⁶¹ Communication is a continuous and on-going process for maintaining an effective DVC system and Scottish local authorities can build on existing waste and recycling communication strategies. The Scottish Government can provide guidance and tailored messaging based on local waste management plans. Consistent branding and messaging, leveraging past campaigns, and existing circular economy efforts can help convey the necessity and benefits of DVC to residents.

A final element of communications involves timing. As Scotland is in process or preparing for the introduction of several ambitious waste policy measures (EPR, DRS, BWM landfill ban); any introduction of DVC in addition will require consideration of the proper messaging strategy. Some of the key considerations to this effort include:

- **Explanation of Sequencing:** Clearly communicate the rationale behind the sequencing, emphasizing how EPR, DRS and BMW focus lay the foundation for DVC implementation;
- **Integrated Messaging:** Development of a cohesive message that emphasizes how EPR, DRS, and DVC work together to create a comprehensive waste management system;
- **Public Consultation:** Seek input from stakeholders through consultation to address concerns and gather feedback on the sequencing and communications plan and;
- **Stakeholder Collaboration:** Engage with environmental organizations, industry representatives, local authorities and civil society to foster collaboration and enhance public understanding.

3.6 Costs

The implementation of a DVC system for waste management involves various costs that depend on the system design selected. Additionally, the cost recovery mechanism of legacy systems and the acceptance of users to new charges will also play a role in introducing a new DVC system.

The costs associated with transitioning to a new system can be divided into start-up costs and on-going operational costs. Start-up costs include investments in additional carts or bins, equipment for weighing or tracking waste, and expenses related to education and outreach campaigns. Upgrading waste collection vehicles to read and record bin weights can cost around €30,000 (approximately £26,000) per vehicle, leading to an increase of approximately €3.00 (approximately £2.60) per tonne of waste collected over the vehicle's lifetime.⁶² Indirect costs linked to administration, management, customer service and education may see a slight increase in the early phase of implementation, but will level-off as the system settles into place and residents become familiar with system operations.⁶³ As DVC aims to change behaviour and encourage waste reduction over time, some costs will shift, resulting in an overall reduction in collection and disposal costs.

⁶¹ Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

⁶² Gallagher, L., Convery, F., and Dunne, L. (2008). *An investigation into waste charges in Ireland, with emphasis on public acceptability.* [Link](#).

⁶³ Gallagher, L., Convery, F., and Dunne, L. (2008). *An investigation into waste charges in Ireland, with emphasis on public acceptability.* [Link](#).

Changes in residents' waste disposal behaviour can impact overall system operations. During the initial stages of DVC implementation, both direct and indirect costs to local authorities will change as waste management patterns shift. Collection costs may decrease while revenue from recyclables increases. Direct costs related to the collection and treatment/disposal of recyclables, biowaste, and general waste will shift between activity categories as less waste is disposed, and more recyclable material is collected. Indirect costs associated with administration, management, customer service, and education may slightly increase initially but will level off as the system becomes established and residents become familiar with its operations. Considering these direct and indirect cost categories is crucial for decision makers to anticipate how system changes may lead to temporary or permanent cost fluctuations under the new DVC system.⁶⁴

Looking to the case studies, in the Contarina DVC system in Priula, management costs were estimated at €117 (approximately £100) per inhabitant in 2021, compared with management costs in other parts of Italy put at: €166 (approximately £143) per inhabitant in Northern Italy; €222 (approximately £190) per inhabitant in Central Italy; and €196 (approximately £168) per inhabitant in southern Italy.⁶⁵ In the case of Flanders, the system operator OVAM estimates that over €50 million (approximately £43 million) were provided as subsidies for municipal DVC implementation. Start-up costs for weight-based systems included purchasing micro-chipped bins and weighbridges at civic amenity sites. Per capita cost data from Flanders reveals additional insights, with the per capita costs of combined waste management calculated at €71 (approximately £60), with per capita costs of collecting residual waste in 2015 amounting to €22.40 (approximately £19), and disposal costs totalling €30 (approximately £25).⁶⁶

⁶⁴ Rate structure design, setting rates for a Pay-as-you-throw program' United States Environmental Protection Agency (USEPA), January 1999.

⁶⁵ Data provided in interview with Contarina, April 2023.

⁶⁶ Irish Waste Management Association (IWMA) (2018) Household Waste Collection Benchmarking Report [Link](#)

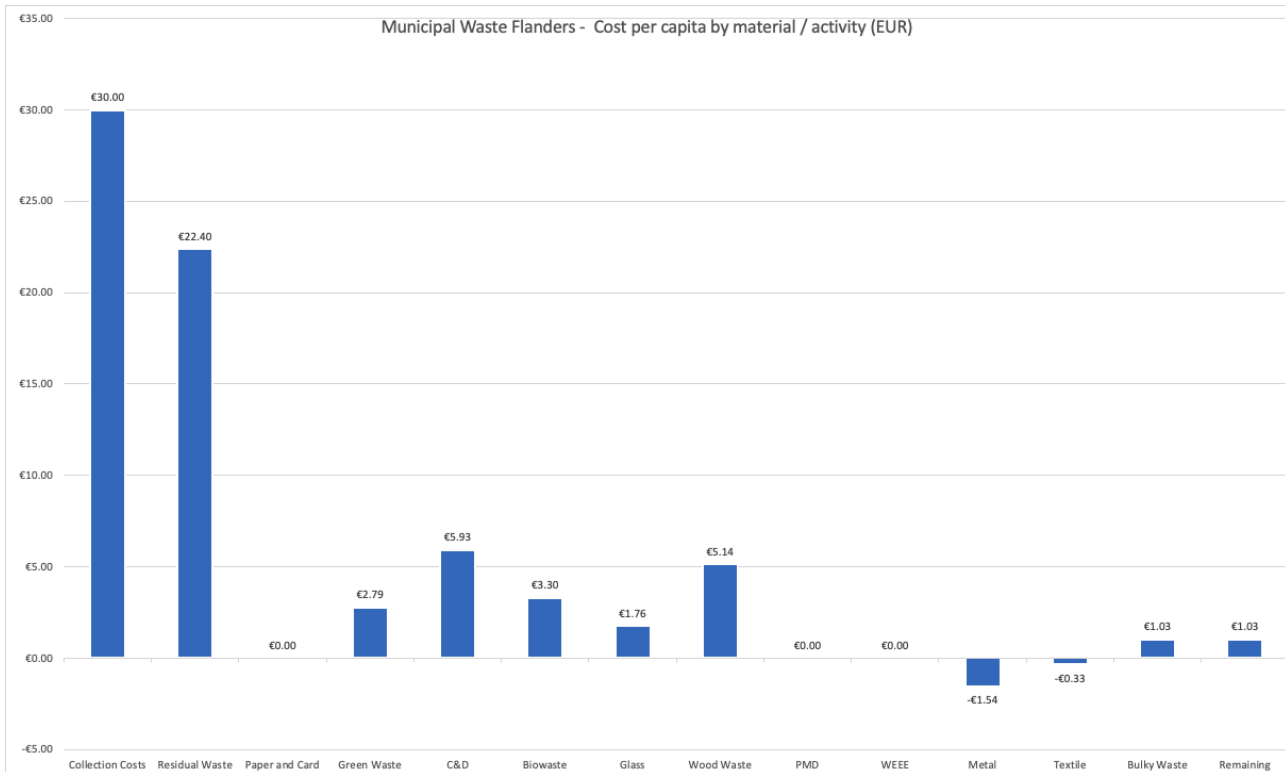


Figure 2: Cost per capita by material and/or activity in Euros for Flanders (BE). Source: Irish Waste Management Association (IWMA) (2018) Household Waste Collection Benchmarking Report [Link](#)

The costs described in Flanders for collection and residual waste disposal are primarily driven by fuel and staff expenses, as well as gate fees and taxation associated with landfilling and incineration. Based on this data focused approach, it appears logical for households responsible for generating general waste to contribute to the costs of its treatment, while costs related to recyclables are reasonably covered by the local authority through existing taxation or a base fee. During the transition phase to DVC, it would be appropriate for the national or regional government to facilitate the process with grants and subsidies as seen in the Flanders example.

Looking at costs of waste management in Scotland, a report on benchmarked costs of waste management indicates a gradual increase in the cost of waste collection and disposal over a ten-year period from 2012 to 2021. In that period the total per capita cost of waste management was put at £170.31 (€199.01).⁶⁷ Comparing these costs with other comparable countries analysed in phase 1 we find: Italy (€167), Germany (€295), Belgium (€62.85), and Ireland (€250 to €300) per capita in 2016.^{68 69} While there are many factors that may account for differences in costs associated with each country (for example, population density, proximity to disposal site, cost of labour, and policy framework) initial observations indicate that Scotland’s waste management costs are in line with many European nations,

⁶⁷ Local Government Benchmarking Framework (2022) National Benchmarking Overview Report 2021-22 [Link](#)

⁶⁸ Irish Waste Management Association (IWMA) (2018) Household Waste Collection Benchmarking Report [Link](#)

⁶⁹ It is important to note these are costs based on all waste system in a country and are not reflective of DVC systems specifically.

and based on insights from other case study examples, Scotland can expect to drive increased cost controls as DVC implementation comes into force.

3.7 Fairness / Equity

One important advantage of DVC is its inherent fairness. When costs of managing waste are hidden in taxes or charged at a flat rate, residents who recycle and prevent waste subsidise the wastefulness of others.⁷⁰ Under DVC, residents can realise savings through waste reduction and overall will be paying less than households that don't recycle. Whilst it is true that in the broadest sense DVC is a fairer approach to waste management overall, it is important to consider how the transition to a DVC system might impact specific groups in unexpected or disproportionate ways, and to anticipate measures to mitigate or eliminate these impacts.

In a UK wide survey that included Scottish respondents, most had not heard of DVC but of those that had 33% thought it was fairer than introducing a flat fee for residual waste while 60% thought it would be a way of incentivising waste reduction. However, there were concerns over fairness raised especially with respect to impacts on low-income residents, other concerns raised included illegal dumping and waste stream contamination.⁷¹

The need to address upfront any perception that DVC implementation will result in double charging for residents already paying for waste services via local taxes has been addressed above.⁷² Other equity issues to be addressed should focus on groups that will face challenges in complying with new DVC system implementation due to economic, health, demographic or cultural factors. These groups may include:

1. **Large families** – several family members living under a single roof leads to above average waste generation for that household;
2. **Elderly residents** – may have difficulty complying with system requirements due to cost or inability to access bins or bags required;
3. **Residents with medical conditions** – may generate waste in different quantities and based upon different materials due to long-term health conditions;
4. **Residents with mobility issues** – residents who don't easily move around may face challenges in management of waste in compliance with DVC requirements;
5. **Low-income residents** – can face challenges complying with bag and bin requirements due to costs that compete with other household needs.

To address these equity issues local and/or national government may decide to address them by developing exemptions or subsidies to mitigate impacts on these groups. As is seen in existing systems, exemptions can be implemented whilst maintaining the principles of DVC.

Exemptions could be made to the variable charge to support residents with young children or specific medical conditions to allow for increased waste generation for nappies and other absorbent hygiene products. Exemptions such as these are in place in Flanders, Italy, and Orillia. In a volume-based system

⁷⁰ EPA (2018) *Pay-as-you-throw workbook: A supplement to EPA's pay-as-you throw guidebook* [Link](#)

⁷¹ https://pelicancommunications.co.uk/wp-content/uploads/2018/03/PAYT_Report.pdf

⁷² EPA (2018) *Pay-as-you-throw workbook: A supplement to EPA's pay-as-you throw guidebook* [Link](#)

this could be accommodated through the provision of free bags, tags, or stickers to allow for disposal of medical consumables. In Orillia, residents with medical conditions can receive up to 15 additional tags, pro-rated throughout the year. In 2020, 11 applications were received, and 75 tags were issued in the city of 33,000 people.⁷³ This could be extended to those on low incomes who may benefit from reduced charges.

Exemptions for weight or frequency-based systems could be made to accommodate these groups by allowing a free allocation for waste, where payment is only required if this is exceeded. Most of the shortlisted case studies provided exemptions or subsidies through the fixed fee as this was easier to administer and was not seen to interfere with the behaviour change mechanism. This was typically related to income, however, some municipalities in Ireland also gave reductions to families proportional to the number of dependents they have.⁷⁴

To create a fair system, consideration needs to extend beyond financial support. Many local authorities in Scotland currently offer additional support to certain householders. For example, in Edinburgh, residents can request a larger bin for residual waste if they are a large family, have two or more children under three, or have a medical condition which generates additional waste.⁷⁵ Many local authorities also support collection of bins for those with mobility issues.⁷⁶ Depending on the type of system implemented, measures such as these can be built upon to support residents.

There may also need to be additional support to certain communities to ensure engagement with the system. This could include individuals who do not speak English as their first language, or individuals with learning disabilities. This could be through provision of translated communication materials or through other social services. Representatives from Guernsey Waste interviewed in phase 1 highlighted the importance of supporting residents in social housing to use the system.

Use of other infrastructure such as bring banks and HRCs must be integrated into the variable pricing system, regardless of the type of DVC system, to ensure that those without cars or mobility needs are not unfairly penalised. Consideration of how bulky uplifts are integrated should be considered for those who are not able to reach these other services.

DVC implementation in Dordogne, where a transition was made from kerbside pick-up to a bring system with swipe card access and a set allocation of access swipes per year, offers an example of how a system that has not integrated exemption provisions has faced serious resistance from residents to system implementation. In this instance resistance has sometimes taken the form of illegal dumping of waste in front of swipe bins.⁷⁷

⁷³ Orillia (2022) *2022 Solid Waste Management Operations Annual Report* [Link](#)

⁷⁴ O'Callaghan, A., Coakley, T. (2011). "Study of Pay-by-use Systems for Maximising Waste Reduction Behaviour in Ireland". [Link](#).

⁷⁵ Edinburgh City Council (2021) *Kerbside waste collection policies (household waste only)* [Link](#)

⁷⁶ Scottish Borders Council (2023) *Request assistance with collections* [Link](#)

⁷⁷ Association des Mecontents de la Collecte des Dechets en Dordogne (AMCDD) (2021) *Kit d'information: preoccupations touristiques* [Link](#)

4 Conclusion

DVC has the potential to drive behaviour change in Scotland and directly address the current recycling rate plateau. Achieving recycling rates of 70% requires new approaches while balancing financial and behavioural change impacts on local populations. To introduce a DVC system effectively, a phased approach is recommended, considering the existing and future waste policy environments. It is important to ensure that DVC complements these measures while not competing with them.

The cost to households as part of a DVC system adoption should encourage changes in behaviour without being punitive. The goal of DVC is to incentivize waste separation while driving households away from residual waste. Simplicity of implementation and administration is crucial for gaining household buy-in and rapid implementation and adoption by local authorities. Whenever possible, DVC should align with existing household separation practices and infrastructure, with clear and straightforward mechanisms introduced. Fairness and equity considerations should address the challenges of implementing DVC in communal residences while accommodating populations with mobility or financial limitations due to health or socio-economic factors.

Clear communications around the rationale behind a shift to DVC and the functioning of new systems is key to operational success. Support from the Scottish Government is necessary to assist local authorities in planning and launching new systems and to ensuring their long-term viability, both from a regulatory and technical/administrative standpoint.

4.1 What type of DVC system would be most effective for Scotland?

To maximize impact and create an effective waste management strategy in Scotland, a phased approach is recommended. The first phase should focus on implementing a volume-based system, as it has several advantages. Volume-based systems are proven to enhance recycling rates and can be easily applied to all types of dwellings. Furthermore, they require less investment in infrastructure and are simpler for householders to comprehend and budget for. In addition, volume-based systems can work in conjunction with frequency modulation, making them even more effective.

Taking a phased approach can serve as a foundational step before implementing more ambitious actions. It provides a one-size-fits-all solution and can seamlessly integrate with existing waste collection practices and recyclables handling in Scotland. By introducing residents to the concept of variable charges for waste disposal, the stage is set for more progressive measures. These may involve increased investment in infrastructure and administration, including stronger behaviour change incentives in frequency and weight-based charging, alongside an expansion of the range of materials eligible for collection.

There are several considerations that should be taken into account during the implementation process if DVC were to be adopted. Scotland already has extensive kerbside collection coverage, particularly for food and garden waste. To ensure fairness, exemptions should be established for low-income individuals, the elderly, large families, and residents with mobility issues related to health.

Rural and remote areas require special attention due to the geographical characteristics of Scotland. In some communities studied, frequent collections without additional charges were implemented to address waste management in urban areas. Taking advantage of the existing Scottish collection system,

which already incorporates frequency elements in many local authorities, would facilitate the implementation of a combined frequency based and variable charge approach. Furthermore, the ongoing standardization of bin sizes, with a trend towards smaller bins, presents an opportunity for the adoption of volume-based DVC.

Initially, the variable charge system should only apply to residual waste. Considering the currently low recycling rates in Scotland, it would be counterproductive to charge for recycling at this stage. Instead, measures should be taken to improve food waste collections, such as increasing collection frequency, and a focus on enforcement to ensure good waste separation and management.

To ensure public acceptance and minimize resistance, it is crucial to establish a transparent and fair pricing structure for the variable charge. Given the historical coverage of waste management through council taxes, it is important to link the variable charge primarily to the costs associated with the transport and disposal of general waste. These costs may include fuel expenses, general waste collection, gate fees, and the disposal taxes related to landfilling or incineration.

4.2 What is needed to ensure DVC is a success?

To maximise the success of DVC, coordinating measures need to be in place. It is recommended that these include:

- **Legislative framework:** with provision for a nationally mandated adoption of DVC that provides flexibility for local authorities to adapt system design to local context. This framework should take into account the other policy developments currently in play, such as DRS, EPR, biowaste landfill ban.
- **Communications:** Establish a comprehensive communication strategy for the implementation of the variable charge system. This strategy should include preparation and ongoing support for operations. Clear and consistent messaging should be provided to educate residents about the changes, benefits, and guidelines of the new system. There should also be transparency surrounding the fixed charge through existing council tax billing.
- **Expansion of Separate Collections:** Expand the range of separate waste collections to include new waste streams such as WEEE (Waste Electrical and Electronic Equipment), small household appliances, and textiles. This expansion should be linked to Extended Producer Responsibility (EPR) regime to tap into new funding sources for managing these waste streams effectively.
- **Focus on Food Waste Collection:** Place a strong emphasis on increasing food waste collection rates. Consider transitioning local authorities with fortnightly collection schedules to weekly, and those with weekly collection to even more frequent pickups. This approach is particularly crucial in densely populated areas.
- **Coordination of Waste Policies:** Ensure effective coordination among various waste policies to avoid double counting of fees. Harmonize regulations and guidelines to streamline the variable charge system and prevent confusion or overlapping charges for waste management services.
- **Consideration of Exemptions and Free Bags:** Provide exemptions for low-income families to alleviate the financial burden of the variable charge system. Additionally, consider offering free waste bags to certain groups, such as young children or individuals with medical needs, to facilitate proper waste disposal.

- **Implement Supporting Measures:** Implement robust supporting measures to address issues like fly-tipping and waste contamination. Focus on enforcement actions targeting poor waste separation practices and non-compliance with designated collection times. These measures should include effective enforcement mechanisms, public awareness campaigns, and penalties for offenders.

By following these recommendations, the success of the variable charge system can be maximized. Effective communication, expansion of waste streams, increased food waste collection, policy coordination, exemptions, and supporting measures will contribute to the smooth implementation and operation of the DVC system while ensuring a cleaner and more sustainable waste management approach.

4.3 How can DVC help Scotland achieve its targets?

DVC has significant potential to support the achievement of all of Scottish Government's 2025 waste and recycling targets.⁷⁸ By implementing DVC alongside supporting policy measures and effective communication strategies, it can have a particular impact in the following areas:

- **Increasing Recycling Rates:** DVC can serve as a strong incentive for householders to divert materials from the residual waste stream into recycling bins. By attaching variable charges to residual waste, individuals are motivated to separate recyclable materials, thereby increasing the overall recycling rate. *This can contribute to reaching the target of a 70% recycling rate across all waste streams.*
- **Reducing Food Waste:** Food waste as percentage of total waste arisings in the UK was calculated at 18% in 2017, with per person food waste arisings estimated at over 70Kg per person per year.⁷⁹ These numbers point to a significant amount of food waste still ending up in general waste bins. DVC, when combined with supporting measures and targeted communication, can encourage householders to dispose of food waste separately. *By increasing awareness, providing more frequent collections, and offering incentives, DVC can help achieve the target of a 33% reduction in food waste, against a 2013 baseline.*
- **Waste Reduction and Circularity:** DVC can act as a powerful policy lever to drive waste reduction. By attaching costs to the disposal of waste, individuals are incentivized to minimize their waste generation and adopt more sustainable consumption practices. *This aligns with the target of a 15% reduction in all waste, against a 2011 baseline, promoting circularity and resource efficiency.*
- **Landfill Disposal Reduction:** Reducing the amount of waste going to landfill is crucial to meet the target of a maximum of 5% of all waste being sent to landfill by 2025 and achieve the biodegradable landfill ban. DVC, combined with efforts to increase recycling rates and separate food waste, can significantly contribute to this objective. *By diverting materials from the residual waste stream, particularly food waste, the volume of waste destined for landfill can be reduced.*

⁷⁸ Scottish Government (undated) *Managing Waste* [accessed 29 June 2023] [Link](#)

⁷⁹ WRAP (2017) *National Household Waste Composition*, [Link](#).

Overall, DVC, when implemented alongside supporting measures and effective communication, has the potential to drive significant progress in achieving the 2025 waste and recycling targets. By incentivizing recycling, promoting separate collection of food waste, driving waste reduction, and reducing landfill reliance, DVC can play a pivotal role in shaping a more sustainable and circular waste management system.

5 Next Steps

Whilst this report shows that there is potential for DVC to drive performance in Scotland, further research needs to be conducted prior to deciding if and how DVC should be implemented. Although recommendations have been made on beginning with a volume-based scheme, this can take many forms and further research and analysis needs to be conducted to define the parameters of DVC system. Further research should aim to:

- Provide further understanding of existing waste management practices in Scotland;
- Estimate one-off and ongoing costs and savings of implementing DVC;
- Estimate the impact of DVC on performance and potential carbon savings and;
- Understand public perceptions of DVC charges.

Early-stage stakeholder engagement should be considered to help inform this further analysis.

Understanding the aims listed above will help to define the parameters of any DVC scheme and if a decision is made to go ahead with implementation, will help to get stakeholders on board. Further research should also help to inform the development of the fee structure, ensuring that it is fair and equitable.