

Understanding implementation of direct variable charging

Phase 1: Learning from international examples of DVC

Scottish Government

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Limitations

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Executive summary

This research was commissioned by the Scottish Government as part of their commitment to support waste reduction, improve recycling in Scotland, and maximise use of services. This is the first of two reports which will seek to learn from direct variable charging (DVC) implemented elsewhere. DVC is a system for waste collection in which households are charged according to the amount of waste they produce.

A total of nine case studies in Ireland, Italy, Flanders, Guernsey, Dordogne (France), Massachusetts, Maine, Aschaffenburg County (Germany), and Orillia (Canada) were shortlisted to explore in more detail through desk-based research and stakeholder engagement to better understand implementation. 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. There were three main types of variable charging structures identified in the horizon scan:

- **Volume-based** where residents are charged by the volume of waste they produced;
- **Weight-based** where residents are charged by the weight of the waste they produce and;
- **Frequency-based** where residents are charged based on the frequency of collections.

In most case studies, the variable charge was accompanied by a fixed charge. The rationale of the fixed charge was to ensure that the cost of all waste services is covered, whilst also preventing the variable charge from being too high. Interviewees said that if the variable charge was designed to cover all waste services, it would be a barrier to engagement, leading to the illegal dumping of waste.

Exemptions and discounts were not commonplace as DVC was seen as a fair system, with individuals responsible for the waste they produce. Where these were given, they were usually applied to the fixed tariff and not the variable charge.

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 legal, economic, and social instruments to maximise impact. 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.

In some of the case studies examined, DVC did result in some unintended environmental consequences, such as illegal dumping of waste and waste stream contamination. Often, this only lasted a short duration as residents became used to the new system. The report outlines mitigating measures that can be taken to minimise illegal activity,

Contents

Executive summary	1
Contents	3
Tables	4
Figures	4
Abbreviations	4
Glossary	4
1 Introduction	5
2 Methodology	5
2.1 Identification of case studies.....	5
2.2 Shortlisting	6
2.3 Deep-dive	6
3 Findings	6
3.1 Charging structure	7
3.1.1 Volume-based.....	9
3.1.2 Weight-based	10
3.1.3 Frequency-based.....	11
3.1.4 Hybrid.....	13
3.1.5 Discounts and exemptions.....	13
3.2 System structure	15
3.2.1 Mandatory	15
3.2.2 Voluntary.....	19
3.3 Operating structure	21
3.3.1 Waste streams.....	21
3.3.2 Collection frequency.....	21
3.4 Implementing DVC.....	22
3.4.1 Public Communication.....	22
3.4.2 Supporting measures	23
3.4.3 Collaboration	24
3.4.4 Enforcement.....	25
3.4.5 Challenges.....	26
3.5 Impact on service performance.....	30
3.6 Unintended consequences	35
3.6.1 Environmental consequences.....	35
3.6.2 Socio-economic consequences.....	36
4 Conclusion	37

Tables

Table 1: Summary of shortlisted case studies, see Annex A accompanying this report for further detail and references on each of the case studies	7
Table 2: Summary of findings from volume-based DVC case studies. See Annex A for more detail.	9
Table 3: Summary of key findings from Weight based DVC case studies. See Annex A for more detail	10
Table 4: Summary of findings from frequency-based DVC systems. See Annex A for more detail.	11
Table 5: Non compliant letters issued in Guernsey	26
Table 6: Summary of pre and post DVC implementation recycling rates	31
Table 7: Summary of pre and post DVC residual waste rates (kg/inhabitant/year)	33

Figures

Figure 1: Map showing waste authorities in Flanders, Belgium.....	18
Figure 2: Coverage of DVC in the United States of America. Source: US EPA Archives. Link.....	20
Figure 3: Per household waste generation in Massachusetts in 2020 This figure compares municipalities which have DVC (or referred to as PAYT (pay as you throw) and SMART (Save Money and Reduce Trash) in this figure).....	31
Figure 4: Residual waste per capita per year in Flanders between a weight-based system and cost per bag in a volume-based system.....	35

Abbreviations

DVC	- Direct Variable Charging
DRS	Deposit Return Scheme
EPA	- Environmental Protection Agency
EPR	- Extended Producer Responsibility
HRC	- Household Recycling Centre
PMD	- Plastic bottles, metal packaging and drink cartons.

Glossary

Direct Variable Charging	- A system for waste collection in which households are charged according to the amount of waste they produce.
Polluter Pays Principle	- Practice that those who produce pollution should bear the costs of managing it
Bring Banks	- Bring banks are a series of recycling containers provided by your local waste collection authority team. These are shared bins, located in publicly accessible areas.

1 Introduction

This research was commissioned by the Scottish Government as part of their commitment to improving recycling in Scotland. In 2022, the Scottish Government published the *Circular Economy Bill* consultation which set out proposals 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 at the same time, sets out the strategic plan to deliver these ambitions.²

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 residents a variable amount in relation to the waste they produce) is one mechanism that could be used to achieve this. DVC has been implemented in many countries globally, many of which have been in place since the early 90s. The aim of this research was to identify where DVC has been implemented, learn from the successes and challenges, and assess the applicability of these models to Scotland.

This is the first of two reports which will seek 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.

The second phase of this research will use these learnings to assess the applicability of these cases in a Scottish context.

2 Methodology

2.1 Identification of case studies

A horizon scan was conducted via desk-based research to create an initial long list of case studies that have implemented DVC. The aim of this longlist was to identify fundamental different models of structuring DVC, variations in systems and relevance to factors which would allow for successful implementation in Scotland. For each of the case studies included in the longlist, an excel spreadsheet was used to capture the following information, where available:

- Location of case study;
- Population;
- System Structure (i.e. weight-based, volume-based...etc);
- Whether the scheme is local or national;
- Who collects the waste;
- Waste stream type;
- Date of Implementation;
- Pre and post-implementation performance data, where available;
- Relevance to implementation in Scotland.

¹ Scottish Government (2022) Delivering Scotland's circular economy – proposed Circular Economy Bill: consultation: Recycle [Link](#)

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

2.2 Shortlisting

Following the identification of case studies, a meeting was held between Scottish Government and Resource Futures to discuss which case studies were to be shortlisted for the remainder of the project. A total of 10 case studies from the initial cases identified were selected to take forward as they provided a diverse range of DVC models.

2.3 Deep-dive

A deep-dive was carried out on the following nine shortlisted case studies via desk-based research and stakeholder engagement to provide further information about the design, implementation, impact, successes, and challenges for each of the DVC schemes.

1. Ireland with a focus on Cork County Council and Dublin City Council
2. Italy with a focus on Priula
3. Flanders with a focus on Limburg
4. Guernsey
5. Dordogne, France
6. Ashland, Massachusetts
7. Maine
8. Aschaffenburg, Germany
9. Orillia, Canada

Desk-based research was carried out to identify information in the public domain. Sources included government reports, waste strategies news articles and academic articles. Following desk-based research, interviews were carried out to provide further context and learnings on each of the case studies. A total of six interviews took place: Enzo Favoino, Scuola Agraria del Parco di Monza, waste expert in Italy, one anonymous stakeholder involved in the design and implementation of DVC in Italy, Irish Environment Protection Agency, US Environment Protection Agency, Guernsey Waste in the States of Guernsey and a OVAM in Flanders. Some of the organisations interviewed have requested that their organisation remains anonymous, whilst others have given permission for this to be shared.

3 Findings

Findings from the desk-based research were captured in an Excel file which can be found in Annex A, accompanying this report. Table 1, below, outlines a summary of the case studies that were shortlisted for further research. Some of the shortlisted case studies include national or regional governments which mandated that DVC be implemented (see section 3.2 for more detail) by local authorities. In these cases, there are numerous examples in how this was achieved, and this report focuses on case studies which represent the different systems implemented within each of these regions.

Table 1: Summary of shortlisted case studies, see Annex A accompanying this report for further detail and references on each of the case studies

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

3.1 Charging structure

There were three main types of variable charging structures identified in the horizon scan:

- **Volume-based** where residents are charged by the volume of waste they produced, typically through the purchasing of rubbish bags;
- **Weight-based** where residents are charged by the weight of the waste they produce and;
- **Frequency-based** where residents are charged based on the frequency of collections.

In most case studies, the variable charge was accompanied by a fixed charge³. The motivation behind introducing a fixed fee alongside the variable charge is to ensure that the cost of all waste services is covered. Interviewees from Italy, Flanders, and Guernsey said that this the splitting of waste fees into fixed and variable charge was vital to the success of the scheme. By splitting the waste cost, it becomes clear to residents which part of the service is covered by which part of the fee. The variable charge motivates individuals to take responsibility for waste production, but by separating a fixed and variable fee the variable charge does not become so high that it is seen as a barrier to engagement encouraging

³States of Guernsey, (2023) *Paying for household waste services* [Link](#)

the illegal dumping of waste.^{4,5,6} In Guernsey, a scale of options for the percentage split between the fixed and variable portion was presented to state government, and the decision was to split the fees approximately 60% fixed and 40% variable⁷. A similar split between the charges is seen in other case studies, with fixed fees ranging from approximately £70 to £150 per annum.^{8,9} In some case studies, such as Limburg.net (an intermunicipal group located in Eastern Flanders) this fixed charge includes a guaranteed number of residual waste collections, meaning the householder only incurs the variable charge if they exceed this limit. In addition to this in Limburg.net, as this organisation acquires the regions recycling parks (HRC) as part of the agreement when the local authority signs up to the DVC system, the residents can opt for their fixed charge to include an amount of waste to be disposed of at the HRC, if they foresee a regular need for this. All residents are able to use the HRC's at any time, but will be charged in line with DVC charging systems unless they have pre-emptively included this in their annual waste tax bill.¹⁰

The fixed form may be calculated depending on the size of the household (m² of property or number of residents) or type of collections that are included. In Priula, for example, the fixed and variable tariffs are designed to cover the cost of street cleansing, waste services and waste treatment.¹¹ The fixed component is charged based on the number of inhabitants in a household, and includes a minimum number of kerbside collections to encourage use of the residual waste service, preventing illegal dumping.¹² Householders which have garden waste collected must also pay a separate fee to make the system fairer, given overall, many households don't produce garden waste.

According to a representative of the Irish EPA, the 'truest form' of DVC (i.e. most effective at influencing behaviour change and accounting for all costs using the 'polluter pays' principle) is a hybrid of frequency and weight-based. A system which has 3 charging elements is the most effective, this includes:

1. A standing/fixed annual charge, written into the householder's waste collection contract with their chosen provider
2. A frequency-based 'per use' charge, where the householder is charged for the bin being lifted into the waste collection vehicle
3. A weight-based charge, where the householder is charged based on the weight of the bin lifted.

A system similar to that outlined above by the Irish EPA is used in Aschaffenburg County¹³

⁴ Interview with OVAM representative, April 2023

⁵ Interview with Guernsey Waste representative, April 2023

⁶ Interview with Enzo Favoino, Scuola Agraria del Parco di Monza, Italy April 2023

⁷ Interview with Enzo Favoino, Scuola Agraria del Parco di Monza, Italy April 2023

⁸ Interview with Guernsey Waste representative, April 2023

⁹ Interview with Consiglio di Bacino Priula, Contarina, April 2023.

¹⁰ Limburg.net, (accessed April 2023) [Waste Collection Link](#)

¹¹ Interview with Consiglio di Bacino Priula, Contarina, April 2023.

¹² Contarina (undated) *Together with the citizens for the environment* [Link](#)

¹³ 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](#)

3.1.1 Volume-based

This section draws together key findings and learnings from DVC systems studies that implement a volume-based system. Table 2 below provides a high-level summary, with the further text providing depth and context.

Table 2: Summary of findings from volume-based DVC case studies. See Annex A for more detail.

Region	Key Findings
Guernsey ¹⁴	<ul style="list-style-type: none"> - Pre-paid stickers required to be attached to each residual bag. Pricing varies by bag size. - Waste collectors must inspect each bag for a pre-paid sticker. - Allows flexibility and resident autonomy in choice of bin bag. - This system is used across single family and multi-occupancy dwellings, potentially easier to administer.
Ireland ¹⁵	<ul style="list-style-type: none"> - Some waste companies used a volume-based system where a bag or tag is purchased based on the volume of bag.
Ashland, Massachusetts ¹⁶	<ul style="list-style-type: none"> - Households must purchase government-certified bags on top of an annual fee. - Revenue from bag sales and fee go into a Solid Waste Enterprise Account. These revenue streams cover the cost of the entire residential residual and recycling collection programme, including staff.
Maine ¹⁷	<ul style="list-style-type: none"> - 14 municipalities (31%) in Maine use pre-paid official municipal residual waste bags to dispose of waste. - Some municipalities also use pre-paid stickers or tags, or a 'punch card' to use at the HWRC.
Orillia, Canada ¹⁸	<ul style="list-style-type: none"> - Have moved from pre-paid tags to bags. Residents are now required to buy and set out a clear bag which must be purchased by the householder.. This clear bag policy allows easy inspection of residual waste, if more than 10% of waste is suspected to be recycled the collector can reject the bag. This is another tool to increase recycling rate promoting continuous improvement as performance begins to plateau over time.
Flanders ¹⁹	<ul style="list-style-type: none"> - Flanders offer a range of different collection systems for DVC allowing for flexibility of the system based on both region and household type. Some municipalities used a volume-based approach where residents are charged per bag. However, many municipalities are switching to a weight-based approach (see section 3.1.2).

The most common form of volume-based charging structures requires householders to purchase waste bags from a store or online, with larger bags typically costing more than smaller bags. In some cases, these charges will only be for residual waste, however, in others other waste streams will have different

¹⁴ Interview with representative from Guernsey Waste (April 2023)

¹⁵ Department for Environment, Climate and Communications (2021) *Waste collection charges* [Link](#)

¹⁶ Massachusetts Department of Environmental Protection (2015) *Town of Ashland Pay-As-You-Throw Program* [Link](#)

¹⁷ Maine Townsman (2014) *New approaches to solid waste* [Link](#)

¹⁸ Orillia (2019) *Solid Waste Collection Guide* [Link](#)

¹⁹ Card D. C., Schweitzer J-P. (2022) *Pay-as-you-throw schemes in the Benelux countries* [Link](#)

bags which are usually less expensive. This has been implemented by some waste companies in Ireland, 31% municipalities in Maine²⁰, in Orillia, and in some municipalities in Flanders.²¹

Other forms of this system, require households to purchase pre-paid stickers (e.g. in Guernsey) or pre-paid tags (e.g. some waste companies in Ireland) which must be placed on the waste bags. These will only be collected if these tags or stickers are in place. Through extensive consultation Guernsey arrived at a sticker system instead of bags as individuals were very particular about the refuse bag used and stickers would allow individuals to choose their preferred residual waste bag. Factors such as competition to existing retail products, faulty bags and resistance to wheelie bin use were also a consideration.²²

These systems are easier to apply across different household types, from single family dwellings to multi-occupancy dwellings, as it does not rely on the waste company billing the householder as all costs are paid upfront.

3.1.2 Weight-based

This section draws together key findings and learnings from DVC systems studies that implement a weight-based system. Table 3 below provides a high level summary, with the further text providing depth and context.

Table 3: Summary of key findings from Weight based DVC case studies. See Annex A for more detail

Region	Key Findings
Ireland ²³	<ul style="list-style-type: none"> - Some waste companies and local authorities use a weight-based system. In Cork County, local authority collection customers are charged by weight using micro-chipped bins. Each administration in Cork County Council is an autonomous authority with respect to waste management. However, that a common charge is applied equally across all divisions.
Flanders ²⁴	<ul style="list-style-type: none"> - Flanders offer a range of different collection systems for DVC allowing for flexibility of the system based on both region and household type. Most municipalities have moved from a volume-based system to a weight-based one. - Those collections that use containers are equipped with a chip. Households will then receive an invoice. They are then charged by kilo, or in some municipalities this is deducted from their free quota. - Material collected at HRCs in Flanders is always charged on a weight-based system
Aschaffenburg County, Germany ²⁵	<ul style="list-style-type: none"> - Collection trucks are equipped with a reading device and a weighing device. Data are transferred to a central facility in real time, where processing, accounting, and billing occurs. - Micro-chipped wheelie bins are used for residual waste. They are also equipped with a chip and bar code. The chip can be read by a transponder, and the bar code reader is only for delivery/return of bins.

²⁰ Campbell, G., Campbell, J. (2014). *Cutting trash in half: Secure finances with pay-as-you-throw*. [Link](#).

²¹ Money Guide Ireland (2023) *Cheapest Dublin Bin Collection Charges* [Link](#)

²² Interview with representative from Guernsey Waste, April 2023

²³ Department for Environment, Climate and Communications (2021) *Waste collection charges* [Link](#)

²⁴ Card D. C., Schweitzer J-P. (2022) *Pay-as-you-throw schemes in the Benelux countries* [Link](#)

²⁵ Morlok et al. (2017) *The impact of pay-as-you-throw schemes on municipal solid waste management: The exemplar case of the County of Aschaffenburg, Germany* [Link](#)

In systems where this is in place, waste containers are typically equipped with a chip that can be scanned on collection to identify the household. Waste collection vehicles are equipped with scales that allow for weighing in-situ. In many of the case studies examined, householders will be billed according to the waste they produce.

Flanders historically implemented a pay per bag system as outlined in section 3.1.1. Approximately, 120 municipalities in Flanders have moved to a weight-based system with wheeled bins equipped with RFID chips, which register the weight when being collected and tipped²⁶. This is deemed by OVAM to be most effective way to implement DVC as it results in the lowest residual waste generation per household, however the technology to support this takes time and finance to implement. According to one source, it costs approximately EUR 30,000 (approx.. £26,500) per waste collection vehicle to upgrade the equipment to read and record the weight of bins as they are emptied. Over the lifetime of the vehicle, this leads to an increase in cost of collection for contractors of approximately EUR 3.00 (approx. £2.66) per tonne of waste²⁷.

3.1.3 Frequency-based

This section draws together key findings and learnings from DVC systems studies that implement a frequency-based system. Table 4 below provides a high-level summary, with the further text providing depth and context.

Table 4: Summary of findings from frequency-based DVC systems. See Annex A for more detail.

Region	Key Findings
Priula, Italy ²⁸	<ul style="list-style-type: none"> - Each bin contains a transponder which identifies the householder based on a unique code and is scanned to record the date and time of emptying with the standard number of collections provided varying depending on geographical area. - In urban areas, residents can also bring their waste to mobile sites at specified time or communal bins. These facilities will scan the unique code to register the deposit. - The system is adapted to a local area, with urban areas receiving more frequent collections due to smaller vehicles.
Dordogne, France ²⁹	<ul style="list-style-type: none"> - Unlike other case studies, Dordogne maximises use of communal bins. Citizens are issued a card permitting 26 trips a year to a smart new general waste container where, after swiping, can place a maximum of two black bags per go inside. Extra visits will cost €5.22. - Communal bins are the most common collection however there are door to door collections with bins or 'bulking point' collection for bags.

²⁶ Interview with OVAM representative, April 2023

²⁷ Gallagher, L., Convery, F., and Dunne, L. (2008). *An investigation into waste charges in Ireland, with emphasis on public acceptability*. [Link](#).

²⁸ Interview with representative from Consiglio di Bacino Priula, Contarina, April 2023

²⁹ SMD3 (undated) *Billing for Pros* [Accessed April 2023] [Link](#)

<p>Orillia, Canada³⁰</p>	<ul style="list-style-type: none"> - When scheme first implemented residual waste bags required the attachment of a pre paid tag to be collected. - Originally 52 tags provided to each household per year, any required in addition to this would be charged. - The number of tags provided has slowly been reduced to 0, to allow for a phased implementation of a full DVC system.
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Another charging structure is a 'frequency-based system, whereby householders are allotted a specific amount of 'free' uses, and any additional amount must be paid for. This is the case in Orillia, a city in Ontario, Canada. Since 1997, they have been operating a 'hybrid' DVC, whereby householders are provided 52 'tags', delivered to each household free of charge, which they must ration out and attach to residual waste bags set out for collection. If any additional tags are needed, these must be purchased. The number of tags delivered to households has gradually reduced over the years, allowing for a flexible approach. In 2023, Orillia has decided to phase-in a full user-pays system. The allotment of tags per household will be only 10, and in 2024, all residual waste tags will need to be purchased. Households can choose to drop off their residual waste bags free of charge at waste depots. Waste collectors will not accept any untagged bags³¹. In Maine, some municipalities also use pre-paid stickers or tags (irrespective of the volume) to use at the kerbside, or a 'punch card' to use at household recycling centres (HRCs).

Dordogne has a unique frequency-based system, it allocates households a set quota of visits to collective bins for a fixed sum and then charges more for extra visits. Citizens are issued with a card permitting 26 trips a year to a smart new general waste container where, after swiping, a resident can place a maximum of two black bags inside³². Whereas most other case studies reviewed as part of this research have removed bring banks or communal collection containers (Italy and Guernsey), Dordogne have maintained bring banks as a core collection system.

Kerbside collection is in place for some households in Dordogne, this is similarly restricted to a fixed number of collections annually for a fee. In regions where kerbside collection have been implemented bins are microchipped, this chip is read by collection vehicle as the waste is tipped. This information is processed by the waste company and an invoice provided to households³³. In some regions where door to door collection is implemented collection vehicles cannot access individual households in these cases gathering points are located, usually at the end of the street, in an accessible location and households are provided with a set number of pre-paid bags as covered in the fixed fee³⁴.

Priula also uses a frequency-based system, where each bin contains a transponder which identifies the householder based on a unique code and is scanned to record the date and time of emptying. Some geographical areas, such as urban areas where people have less space are given more collections.³⁵ In

³⁰ Orillia (2019) *Solid Waste Collection Guide* [Link](#)

³¹ Environmental Services Division, Environment and Infrastructure Services Department (2021). *City of Orillia 2021 Waste Minimization Plan*. [Link](#).

³² SMD3, 2022 *Waste Collection* [Link](#)

³³ SMD3, 2022 *Waste Collection* [Link](#)

³⁴ SMD3, 2022 *Waste Collection* [Link](#)

³⁵ Interview with representative from Consiglio di Bacino Priula, Contarina, April 2023

urban areas, residents can also bring their waste to mobile sites at specified time or communal bins. These facilities will scan the unique code to register the deposit.

3.1.4 Hybrid

In Limburg the charging system as detailed above is based on a fixed fee and a variable charge however, Limburg operates an interesting hybrid structure which is dependent on the type of dwelling. Households are allocated an annual waste allowance per year depending on the size of the family, and the number of collections required³⁶. Some residents of the region are on a weight-based system. For this system on collection, waste bins (which are microchipped) are weighed and the total weight is subtracted from the householder's annual allowance. If they go over this allowance, they must pay a fee³⁷. Multi-family dwellings such as flats have communal bins which are equipped with scales and chips that weigh the waste when deposited. The total weight is aggregated across the entire property and Limburg.net charge each household individually³⁸ based on a fair split. If the property as a whole go over the allowance the property manager is contacted to authorise the additional cost of collection. It is unclear how this additional cost is split; it could be assumed that this continues to be split fairly across all tenants.

Limburg also operates what they refer to as a volume-based system which equates bags used for disposal to litres of waste. Practically this system is close to what has previously been described as a frequency-based pay per bag system. Similarly, to the weight based system a 'quota' of waste is permitted per household, however for this system the quota is bags of residual waste as opposed to kg of waste collected, for example 1 person = 2 rolls of 22L bags, i.e. 660L total; 4 people and more 3 rolls of 44L bags, i.e. 1320L total. By combining the number of collections and the volume or weight, residents are encouraged to only set out full containers.

In Limburg underground containers are used for certain households. These households have a frequency-based system by which households are given a certain number of times they can deposit waste in the containers. When the quota is met individuals pay an additional charge for each deposit, a maximum of 20 deposits can be transferred to the next year if quota is left remaining at the end of the year. The number of times an individual deposits waste is registered by a household 'container pass' which is free of charge and swiped in order to access the waste containers³⁹. However, if the property (apartment block as a whole) requires an excessive number of waste collections the property manager will be contacted and charged for these additional collections.⁴⁰

3.1.5 Discounts and exemptions

Discounts and exemptions were identified for each of the case studies shortlisted in this research. These can take many forms:

³⁶ Limburg.net, (accessed April 2023) *Waste Collection* [Link](#)

³⁷ Limburg.net, (accessed April 2023) *Waste Collection* [Link](#)

³⁸ Limburg.net, (accessed April 2023) *Waste Collection* [Link](#)

³⁹ Limburg.net, (accessed April 2023) *Waste Collection* [Link](#)

⁴⁰ Limburg.net, (accessed April 2023) *Waste Collection* [Link](#)

- **Multi-occupancy households** – In the US, multi-occupancy households (e.g. flats and condominiums) of four families or more are typically excluded from municipal waste collections and required to have their waste collected by a private contractor. This is often organised as part of a property factor.⁴¹
- **Low-income households** – In the case studies examined, discounts are usually applied to the fixed tariff and not the variable charge. There are however, some exceptions to this. In Flanders, some municipalities give lower income households a certain number of free residual waste collections⁴². However, these interventions are not commonplace as residual waste generation is seen as an individual responsibility regardless of income.⁴³ Some municipalities in Ireland also offer discounts for low income households. For example, in Cork County Council, households which use the local authority’s collection service are offered waivers based on income or other ⁴⁴ Households which choose to use private waste companies are not eligible for discounts.
- **Home-composting** – In Priula and Aschaffenburg County⁴⁵ discounts are provided for people who compost at home to incentivise more widespread use of this.⁴⁶ As opposed to providing a discount for home composting, municipalities in Flanders charge for organic waste, at a rate only slightly cheaper than residual waste collection, in order to stimulate at-home composting⁴⁷.
- **Families with young children** – In Flanders, some municipalities provide families with young children with free collection for absorbent hygiene products⁴⁸. Similarly in Aschaffenburg offer subsidises for families which use reusable nappies⁴⁹. Discounts are also given in some local authorities in Ireland based on the number of dependents in a family.⁵⁰
- **Accessibility** – In Dordogne, measures have been put into place following public pressure to increase accessibility of the service for those with a disability. If a household receives in-home care, the staff members are provided with a special badge to allow them to dispose of waste for all homes that they service. Households can also arrange for kerbside collection if they are unable to access a waste container, however they must pay the relevant charges.
- **Building use** – In Dordogne, properties which use private waste companies, such as those which are partially used for commercial purposes receive discounts from the fixed fee⁵¹.

Interviewees in Flanders, Guernsey and Italy said that there is a perception among the public that DVC is a fair system, particularly in comparison to systems that were previously in place. In Guernsey, the social housing sector was consulted with extensively prior to implementation of DVC. Whilst waste

⁴¹ Interview with US EPA representative, April 2023

⁴² Interview with OVAM representative, April 2023

⁴³ Interview with representative in Flanders, April 2023

⁴⁴ O’Callaghan-Platt and Davies (2007) *A nationwide review of Pay-by-use* [Link](#)

⁴⁵ 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](#)

⁴⁶ Zero Waste Europe (2018) *The story of Contarina* [Link](#)

⁴⁷ Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

⁴⁸ Interview with OVAM representative, April 2023

⁴⁹ 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](#)

⁵⁰ O’Callaghan-Platt and Davies (2007) *A nationwide review of Pay-by-use* [Link](#)

⁵¹ SMD3 (2022), *Billing for Pros* [Link](#)

production is seen as the responsibility of all, it was recognised that these more vulnerable members of society may need additional support. Though residents of social housing are still required to buy and use the DVC stickers, this is considered by those responsible for the benefits system.

3.2 System structure

The shortlisted case studies provided examples of mandatory DVC where a national or regional government mandated that local authorities must implement variable charging for waste generated by householders, or voluntary, where local authorities chose to implement variable charging. In Europe, municipalities typically have greater control over waste management, and the case studies examined in this report had the powers to charge for waste. The polluter pays principle, making polluters bear the costs of managing waste, is the driver behind implementing DVC. Many of the enabling principles for DVC such as kerbside collection, separate collection of recyclables and separately collected organics are outlined within the EU's Waste Framework Directive⁵², with the implementation interpreted differently in different regions. It was however noted that little to no legislation, at an EU or local level, is supported by legally binding targets, which means there is no accountability or assurance that changes made are having the positive desired impact⁵³. This section outlines how this is structured in each of the short-listed case studies.

3.2.1 Mandatory

Of the shortlisted case studies, Italy, Ireland, France, Guernsey, and Flanders have regulatory instruments in place which mandate that local authorities must charge householders for the waste they generate. In some of these cases, local authorities were required to do this through a specific DVC system and in others there was more autonomy to decide which measures could be used to achieve this outcome. What each of these case studies have in common is that the local authorities have the autonomy to decide how these measures are implemented and how their services are designed. This section outlines the different regulatory instruments in place, to provide context for the design and implementation of DVC outlined in subsequent sections of this report.

3.2.1.1 Republic of Ireland

In the Republic of Ireland, DVC is mandated by the national government. Ireland's Waste Management (Collection Permit) Regulations of 2007 require all waste collection permit holders to satisfy certain conditions, one of which is to "apply charges for household waste collection which respect the polluter pays principle"⁵⁴. The method of charging is left open to the waste collectors. As such, many kinds of charging mechanisms (variable and non-variable) have developed, allowing Irish householders to 'shop' for the type of collection service that most suits them.

This is a unique kind of system structure, allows maximum flexibility for householders. Several government bodies and working groups (both within government departments and across government

⁵² The EU Waste Framework Directive sets out the basic concepts and definitions related to waste management in Europe.

⁵³ Interview with Enzo Favoino, Scuola Agraria del Parco di Monza, Italy (April 2023)

⁵⁴ Irish Statute Book (n.d). *Statutory Instrument No. 820/2007 - Waste Management (Collection Permit) Regulations 2007*. [Link](#).

levels) have been established to oversee the system, such as the Price Monitoring Group and Waste Advisory Group, which both support in the development, monitoring, and implementation of DVC in Ireland. There are also three Waste Enforcement Regional Lead Authorities (WERLA) responsible for co-ordinating the waste enforcement actions of local authorities – grouped into three regions and led by their respective WERLA – setting priorities and common objectives for waste enforcement and ensuring consistency of enforcement of waste legislation⁵⁵.

Despite these efforts, some have criticised that waste collection in Ireland has developed into an overly complex system, with some local authorities having as many as 11 different waste collection companies each with a different charging system, causing inefficiencies in collection⁵⁶. This inefficiency is the result of the privatisation of waste collections, which prevents a standardised approach to DVC.

For example, Dublin City Council (DCC) waste collection has been entirely privatised since 2012. This was due to DCC being unable to offer competitive prices as compared to the private collection companies. In response to these lower charges, DCC amended their waste management plan so only they or their contractors could collect waste at the kerbside. However, in 2009, two private companies brought a legal action against this, and the court ruled in their favour, saying DCC's policy was 'anti-competitive and a breach of its dominant position'⁵⁷. Because of this move, DCC backed out of collecting waste altogether, and private operators took over waste collections entirely in 2012. There has since been a recent move to try and 're-municipalise' waste collections again. While the central government is not in favour, DCC's environment committee has recently commissioned a study of the issue, and it is expected that there will be a 'vigorous lobbying campaign' on this⁵⁸.

3.2.1.2 Italy

The Italian Government requires municipalities to measure the amount of residual household and commercial waste and apply charges according to a polluter pays principal.⁵⁹ There is little interaction between the national and municipal government regarding DVC. Some NGOs have tried to influence for a national mandate on DVC, however this has been politically unfavourable and unlikely to be successful.⁶⁰ In 2017, the Italian Government outlined different methods that are available to measure and charge householders for their waste, but did not recommend which should be implemented by municipalities.⁶¹ As a result of autonomy that has been given to local authorities there is a wide variation in how the polluter pays principal has been applied. As of 2020, only 10% of the 7,918 Italian municipalities, had implemented a form of DVC.⁶² In most cases, Italian municipalities (such as Parma,

⁵⁵ Waste Enforcement Regional Lead Authorities (n.d.). *About WERLA*. [Link](#).

⁵⁶ Interview with representative from Irish EPA, April 2023

⁵⁷ Independent (2023). "Should Dublin City Council take back control of our bins?". [Link](#).

⁵⁸ Independent (2023). "Should Dublin City Council take back control of our bins?". [Link](#).

⁵⁹ Interview with Consiglio di Bacino Priula, Contarina and Enzo Favoino, Scuola Agraria del Parco di Monza, April 2023

⁶⁰ Interview with Consiglio di Bacino Priula, Contarina, April 2023

⁶¹ Banca D'Italia (2020) *Wasted in waste? The benefits of switching from taxes to Pay-as-you-throw fees: the Italian Case study* [Link](#)

⁶² Banca D'Italia (2020) *Wasted in waste? The benefits of switching from taxes to Pay-as-you-throw fees: the Italian Case study* [Link](#)

Cappanori, Navigili Municipality, Seveso and Miglianico) have designed and implemented a form of DVC at the municipal level.

The region of Priula in the North-East of Italy has taken a different approach in meeting their obligations. An inter-municipal waste group of 49 municipalities was formed to manage waste collection in 1989. Originally, there were two distinct consortia, which have now joined to form one consortium. These municipalities represent a geographically diverse area, including mountainous rural regions, densely populated urban centres, and historic town centres⁶³. This is governed by a council, consisting of mayors from each of the municipalities, which is responsible for the design and implementation of measures related to waste collection and overseeing the waste contractor.⁶⁴ Contarina, the waste contractor appointed in this region, is responsible for applying the tariff, service delivery and enforcement of non-compliance.⁶⁵

3.2.1.3 France

The implementation of DVC though mandated has less penetration across the country than other shortlisted case studies. In France, Article 70 of the energy transition law for green growth of 2015 requires, 'incentive financing for the public waste service', this legislation sets a target for this system to reach 15 million inhabitants (approximately 23% of the population) in 2020, then 25 million (approximately 37% of the population) in 2025.⁶⁶ The collection of waste in France is governed by the General Code of Local Authorities (CGCT, articles R2224-23 to R2224-29-1) and it is the mayor or the president of the local authorities who sets the decree for the waste collection in the region, as well as the financing system to support this. As of 2013, 5.4 million French citizens (approximately 8% of the population) were placed on some form of direct variable charging scheme. Dordogne, which is one of the shortlisted case studies, was the first whole department (administrative divisions of France, the department is one of the three levels of government under the national level ("territorial collectives"),) to introduce this form of charging system in 2022⁶⁷.

3.2.1.4 Flanders

Environmental policy in Belgium is almost entirely devolved to the three regions: Wallonia, Brussels, and Flanders⁶⁸. There is no national mandate in Belgium to implement DVC systems, decisions on waste management are made at the regional level. In Flanders, there are two regulatory instruments, The Waste and Materials Decree, and Vlarema, which set out the municipalities responsibilities regarding municipal waste management.⁶⁹ The material hierarchy is embedded in this legislation, with prevention as the first step. This decree includes 10 key measures on waste prevention one of which is obligatory

⁶³ Interview with representative from Consiglio di Bacino Priula, Contarina, April 2023

⁶⁴ Interview with representative from Consiglio di Bacino Priula, Contarina, April 2023

⁶⁵ Interview with representative from Consiglio di Bacino Priula, Contarina, April 2023

⁶⁶ Ministère de l'économie des finances et de la souveraineté industrielle et numérique (2023) *What is waste incentive pricing?* [Link](#)

⁶⁷ Euractiv (2016) *'Pay as you throw' cuts waste and encourages recycling, French report finds* [Link](#)

⁶⁸ Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

⁶⁹ Flemish Government (2011) *Materials Decree* [Link](#)

separate collection and DVC schemes⁷⁰. This regional legislation was born out of a public resistance in the 90s to landfill and incineration⁷¹.

OVAM, the public waste agency of Flanders, is the regulatory body for environmental policy in Flanders. They also support the different municipalities in undertaking waste management activities. The municipalities are legally responsible for collecting and treating the municipal waste and are the competent authorities for levying taxes on the collection and processing of municipal solid waste, however, they have autonomy in how this is carried out.

Collection and management of municipal waste is organised into inter-municipal organisations, which are voluntary partnerships between municipalities. These partnerships are formed to make waste management service provision is cost effective⁷². The size of these inter-municipal organisation varies, with some consisting of a few municipalities and other consisting of an entire province of up to 50 municipalities (Figure 1). Limburg province in East Flanders has an intermunicipal organisation Limburg.net which serves 43 of the 44 municipalities within this region. Each municipality has autonomy as to how the DVC system is implemented within the region. The minimum tariff for DVC waste streams is mandated through OVAM and to be eligible for certain grants/support from OVAM regions will have to comply with certain waste collection service offerings⁷³.

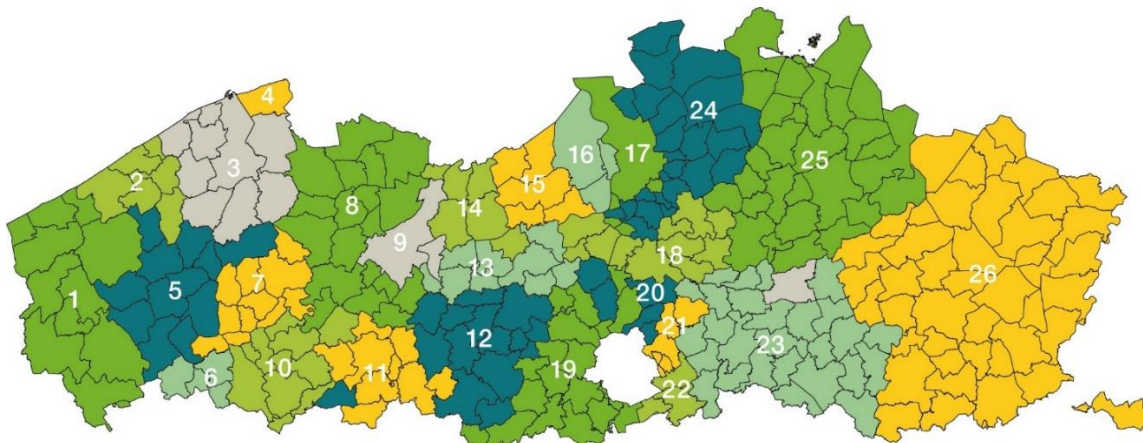


Figure 1: Map showing waste authorities in Flanders, Belgium⁷⁴

3.2.1.5 Guernsey

The decision to implement a DVC system was taken by the States of Guernsey in 2014, as part of its waste strategy. Guernsey has not given autonomy to local government with regards to DVC and it is instead designed at the state level⁷⁵. The 10 parishes were consulted with extensively throughout the process to design DVC. The parishes have the legal responsibility to arrange waste collections for households in their

⁷⁰ European Environment Agency (2016) *Overview of national waste prevention programmes in Europe: Country Fact Sheet: Belgium Flanders*

⁷¹ Regions for Recycling (2014), *Good practice Flanders: PayT*

⁷² Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

⁷³ Interview with OVAM representative, April 2023

⁷⁴ Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

⁷⁵ Guernsey does not have the same sort of central/local government as the UK. Guernsey is made up of 10 Parishes which are more akin to UK Parish Councils. The largest parish has approximately 8,000 households, and the smallest has approximately 400.

Parish but the streams that are collected, how frequently they have to be collected and where the waste/recycling is delivered to is mandated by the Waste Disposal Authority. All 10 parishes are required to enforce that DVC is adhered to while undertaking their collection duties, although all currently delegate their enforcement powers to take action to Guernsey Waste to carry out.

In Guernsey, the last remaining landfill site has reached capacity and no further sites are currently available. Originally, the intention was to build an energy from waste plant, following in the footsteps of other neighbouring autonomous islands such as Jersey. However, this was met with public resistance and the government decided not to follow through with these plans. With no future landfill site or on-island energy from waste options, Guernsey has opted to export residual waste for treatment and processing – as it does with all its materials for recycling. Implementing DVC was seen as a mechanism to assist in the minimisation of waste (one of the core aims of the waste strategy) and also to reduce the costs of treating and processing waste. In addition to this the waste strategy ultimately set a target of 70% household recycling rate by 2030, and DVC was seen as one mechanism to achieve this.

3.2.2 Voluntary

There are many examples globally where DVC is implemented at a local authority level by individual local authorities to achieve environmental objectives. There are also examples where consortiums have been formed to implement DVC. Whilst this is not mandated by government, some local authorities receive support from government as DVC helps to achieve overarching waste and resource targets. The shortlisted case studies represent this range of examples.

3.2.2.1 Examples of individual local authorities

Aschaffenburg in Germany and Orillia in Canada are two examples of Local Authorities which have voluntarily implemented DVC. They are also two of the earliest examples of DVC, dating back to 1997. German waste collection adheres strongly to the polluter pays principle with extensive Extended Producer Responsibility (EPR) implemented, however there is no national mandate for this principle to be actioned via DVC. Certain regions however have chosen to undertake this payment structure. Orillia has previously provided subsidised waste collection by delivering an allocated number of 'tags' to residents for free, which must be attached to their residual waste. Orillia has reduced the number of free tags over the years, until 2023, when all tags must now be purchased, in a move to phase in a full 'user pays' system.

3.2.2.2 USA

DVC is not mandated by the Federal Government in the USA. Instead, the national government plays a supporting role in outreach and communications, supporting states to encourage DVC within their jurisdictions. This is done through dedicated federal funding, providing toolkits and communications resources, and data collection and monitoring. The US Environmental Protection Agency (EPA) has individual representatives supporting states with DVC through their ten regional offices.

The role of the EPA was particularly strong in the early 2000s, propelled by national priorities to push for 'full cost accounting', defined as 'a systematic approach for identifying, summing, and reporting the

actual costs of solid waste management⁷⁶. A key reason DVC became so widespread (with over 7,000 programmes in place, and 30 of the largest 100 cities in the US implementing DVC⁷⁷) was due to the use of grants funded through the EPA to state governments. For example, the Massachusetts state government promoted the use of DVC within its municipalities by providing higher rebates the smaller the bin offered to residents, paid for by US EPA grants to states promoting ‘full cost accounting’. However, since about 2010, the EPA stopped this support/outreach programme, including the grant programme, due to a shift in federal priorities in waste, e.g. to organic waste diversion over DVC. The toolkits⁷⁸ and resources⁷⁹ are archived, but still available to states and municipalities. Despite an end to DVC support by the federal government, states and municipalities continue to implement these systems, with some states having over 200 DVC municipalities (see Figure 2 below).

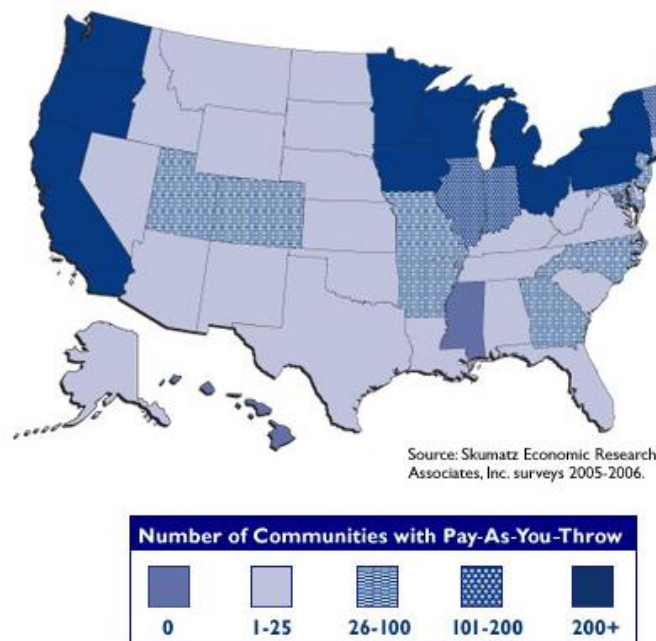


Figure 2: Coverage of DVC in the United States of America. Source: US EPA Archives. [Link](#).

Massachusetts and Maine are two US states championing DVC. Ashland, Massachusetts is one of the municipalities highlighted in the US EPA archives for its success implementing DVC. In 2014, the Ashland town manager stated, “We began the program in 2006, and in the last eight years, we have saved close to \$1 million, reduced gas emissions equal to what 5,500 cars would produce and saved enough energy to power 2,100 homes for that same period of time”⁸⁰. Municipalities in Massachusetts, such as Ashland, receive support and incentives from the state government to help encourage increasing recycling rates, such as performance-based (i.e. tonnage-based) grants for municipalities that adopt specific DVC programmes.

⁷⁶ US EPA Archive (2016). “Wastes - Resource Conservation - Conservation Tools”. [Link](#).

⁷⁷ US EPA Archive (2006). “PAYT in the United States: 2006 Update”. [Link](#).

⁷⁸ US EPA Archive (2016). “PAYT Toolkit”. [Link](#).

⁷⁹ US EPA Archive (1997). “Full Cost Accounting for Municipal Solid Waste Management: A Handbook”. [Link](#).

⁸⁰ Livability (2014). “Many Cities Reduce Waste With ‘Pay as You Throw’ Trash Programs”. [Link](#).

3.3 Operating structure

3.3.1 Waste streams

For all DVC systems identified in this research, households are charged according to the amount of residual waste they produce, with recyclables and/or food waste collected separately and free of additional or variable charge to incentivise use. The cost of these separate collections is typically covered through a fixed fee as outlined in section 3.1.

Most municipalities in Ireland and Flanders also charge a variable fee for other waste streams, although this is typically at a lower charge. One interviewee said that they thought not charging for recycling or food waste collection might give householders the perception that these services are free and sends the wrong message about the polluter pays principle, according to one interviewee. In Flanders region, paper and card recycling is free, PMD (light weight packaging) stream is charged nominally at the cost of the collection sack itself, this is because the collection and treatment of material is funded through the existing EPR system, organic waste is also charged for.

It is recommended by one Italian stakeholder that bring banks are also removed as part of the transition to a DVC system⁸¹, though this is counter to the approach of the DVC system in France. It is argued that bring banks, similarly to other forms of communal bins remove the individual responsibility and visibility of waste, which is a key part of the successful implementation and behaviour change required for DVC. For most case studies investigated DVC charges still apply at HRC's. In Flanders this is weight based, regardless of whether the municipality household collections are frequency or weight based⁸². In Guernsey residual waste disposed of via the HRC is still charged on the pre-paid bag rates. The public can bag up and sticker the waste themselves and drop off for free without further charge. For bulky non-recyclable items, (i.e sofas) HRC operatives have been trained/provided with guidance on how to relate an item to a black bag equivalent, and there is a set charge for some specific items (e.g. sofas, mattresses, etc).⁸³.

3.3.2 Collection frequency

Where a frequency-based DVC system is not in place, collection frequency is used in many of the shortlisted case studies as another measure of incentivising recycling. Often, residual waste is collected less frequently, limiting the space householders have for this waste stream. Aschaffenburg County is an exception to this, with residual waste being collected fortnightly and recycling monthly. Waste stream dependent collection frequencies can also help to stagger collections throughout the geography to ensure wider coverage, or in the case of Guernsey where collection frequency is the same across the island⁸⁴.

For hygiene purposes, most municipalities collect organic waste on a weekly basis. In Aschaffenburg County, fortnightly organic collections increase to weekly during the summer months. In some regions of Italy food waste collection service is provided multiple times a week to support the reduction of

⁸¹ Interview with Enzo Favoino, Scuola Agraria del Parco di Monza

⁸² Interview with OVAM representative, April 2023

⁸³ Interview with Guernsey Waste representative, April 2023

⁸⁴ States of Guernsey, () *Household Recycling and Bin collection*, [Link](#)

residual waste set out to as low as six times per year per household (though the collection vehicles are service more frequently than this).

The attached spreadsheet in Annex A, contains a case-by-case summary of collection frequency for the different case studies.

3.4 Implementing DVC

Interviewees were asked about the process of implementing DVC in their respective regions. They were asked about factors that led to success, their greatest challenges and what they would do differently if they had to go through this process all over again. This section summarises the insights from these interviews.

3.4.1 Public Communication

Interviewees emphasised the importance of public communication pre and post implementation in ensuring a successful DVC scheme. Guernsey undertook extensive stakeholder engagement, both with Parish Councils, Social Housing and other organisations who would be impacted by the change as well as members of the public. This communication began years before any changes were made, allowing for key organisations to have input into the design of the system, as well as maximum buy in from key stakeholders. Guernsey Waste took time to troubleshoot the system, aiming to design out as many problems at the point of inception on.⁸⁵

It was noted that Guernsey is a tight-knit community which is a unique environment to implement DVC. Though there was resistance in the design and engagement phase, once the scheme was rolled out most residents got on board, which the interviewees attributed to a sense of community spirit and effective implementation. There were extensive communication campaigns that tapped into normal practices of the island and were described by interviewees as a 'social call to action' - aiming to build on the trust and sense of doing good for the community⁸⁶. This has helped them to achieve a 99% participation rate (2020)⁸⁷.

Contarina began communicating with householders a year prior to implementation to ensure they were ready for DVC. Interviewees said that this year was an essential time to get people on board with the system and ensure that they understood their responsibility. Communications remain a central part of Contarina's strategy in ensuring the continued success of DVC. This includes public events, tours of waste facilities, education in schools, sharing information on social media, informational websites and an information point where householders can ring for advice.

Communication has also been key to the success of the system in Flanders. Communication comes in many different forms and has evolved since the original implementation in the 90s⁸⁸. Municipalities are responsible for communications with their citizens, but also receive support from OVAM and other

⁸⁵ Interview with Guernsey Waste representative, April 2023

⁸⁶ Interview with Guernsey Waste representative, April 2023

⁸⁷ Guernsey Waste, (2023), *Annual Waste Management Report 2022*

⁸⁸ Interview with OVAM representative, April 2023

organisations, such as those which administer EPR schemes⁸⁹ These EPR organisation, who have more finances at their disposal, commission TV advertisements to remind the public to separate their waste. OVAM also regularly run surveys to ensure that the services that they provide meet the requirements of its citizens⁹⁰. This continuous dialogue includes stakeholders such as producers, citizens, and individual municipalities as well as the private companies that collect waste. This data is used to improve and refine service design and provision. It was also noted by OVAM that communication as part of DVC systems never stops, and is an important and ongoing part of maintain an effective system⁹¹.

3.4.2 Supporting measures

DVC is rarely implemented in isolation and other measures are in place to reduce waste and increase recycling rates. One interviewee said that in their opinion, the key to success is using three policy instruments in tandem with each other:

- 1) **Legal Instruments.** In Flanders there is a clear legal framework with mandatory kerbside collection for separate materials alongside other supporting measure to reduce waste production such as reuse programmes, reusable nappy schemes
- 2) **Economic Instruments.** Across Europe the cost of sending material to landfill and incineration is rising, which is incentive to reduce the volume of waste being sent for disposal, in addition to this polluter pays principle is often enforce via nationally mandated EPR schemes allowing the cost of disposal to be shouldered by the producer of packaging or products levies on landfill, financial support for local authorities, both these systems work alongside EPR. Financial support can also be provided (likely from central government on regional waste authorities) to local regions to support with the capital costs of waste system change.
- 3) **Social Instruments.** These include but are not limited to public awareness raisings, education at schools.

The interviews and desk-based research highlighted that DVC alone is not sufficient to improve performance within a region, and that supporting measures must be in place to maximise success. These supporting measures must ensure individuals take responsibility and compliance is incentivised as much as possible. Infrastructure is an important element in achieving this and it must be accessible and easy to use, with good opening hours.⁹² Separate kerbside collections have played an important role in the success of DVC in all of the shortlisted case studies as it makes it easier for householders to recycle more. In some of the case studies, such as Priula, kerbside collections were introduced in the year preceding DVC implementation and in the case of Guernsey, DVC was implemented at the same time as separate organics collections. Interviewees highlighted the importance of separate organics collections to facilitate behaviour change.⁹³ In case studies such as Flanders where organic collections are not in place in all municipalities, this is a barrier to performance improvement.

⁸⁹ Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

⁹⁰ Interview with OVAM representative, April 2023

⁹¹ Regions for Recycling (2014), *Good practice Flanders: PayT*

⁹² Interview with OVAM and Enzo Favoino, Scuola Agraria del Parco di Monza, Italy (April 2023)

⁹³ Interviews with Enzo Favoino, Scuola Agraria del Parco di Monza, Italy and OVAM (April 2023)

Infrastructure can be improved in other ways. For instance, waste management could be considered in relation to building permits, particularly when considering the building of new apartments/communal properties to ensure that regulation requires the provision of a specific waste room, to support the implementation of DVC in communal properties⁹⁴. In Massachusetts, reuse programs such as swap events or libraries were found to compliment DVC.⁹⁵

Steps should also be taken to maximise the opportunity for personal accountability and responsibility of individual householder's waste. In Guernsey, this was achieved through the removal of as many communal bins and bring banks as possible. In other case studies, this has been achieved through special considerations for communal bins (see section 3.4.5.1) and charges at HRCs.

Accurate monitoring and recording of waste generated was also highlighted as key to the success of DVC by representatives from Italy, Guernsey, and Flanders as this allows for an understanding of success and shortcomings and target interventions for improvement. Accurate monitoring and recording of non-compliant waste generated was also highlighted as key to the success of DVC by representatives from Guernsey, as this allows for an understanding of success and shortcomings and target interventions for improvement. For Guernsey Waste regular monitoring and evaluation was vital pre and post implementation, with regularity reducing as the system becomes more established.

3.4.3 Collaboration

Where there is a driver from national or regional government to implement DVC, whether mandated or not, collaboration between local and national governments is important. Views shared by interviewees highlight that this has helped get buy in from local government and support implementation to encourage greater success.

According to US EPA regional representative interviewed (representing six states in the northeast region), DVC is more suited to local implementation, as the design of each scheme is dependent on local conditions, such as rurality, affordability, and existing waste collections mechanisms (e.g. whether they use bins or bags). As such, the national government's role is better suited to developing resources to encourage uptake of DVC, with individual municipalities choosing which system works best for them. According to the EPA representative, this balance of power has been very successful in increasing uptake of DVC across the USA (see Figure 2).

To help local government understand costs to implement DVC in their jurisdictions, the US EPA provided a 'full cost accounting toolkit' that went into detail regarding the 'real cost' of waste management. The toolkit included a calculator for municipalities to understand the cost of waste management, to support in understanding how much and what to charge residents. The calculator was very successful in helping to make the financial argument to switch over to DVC, as it usually always demonstrated savings for the municipality. This was helpful, as then the financial departments of the municipalities tended to support the system, making implementation easier (particularly if state incentives were offered, which was often the case)⁹⁶.

⁹⁴ Interview with Enzo Favoino, Scuola Agraria del Parco di Monza, Italy (April 2023)

⁹⁵ Smith, R (2022) *Spring into PAYT: How to make it work for you* [Link](#)

⁹⁶ Interview with representative from US EPA, April 2023.

OVAM place great importance on fostering positive relationships between themselves and local authorities. They provide municipalities with financial support in the form of grants to transition to DVC. To qualify for these grants, the municipality must be providing all mandated collection services to the public⁹⁷.

Interviewees in Italy said that one of the biggest challenges in implementing DVC in Priula, was getting the municipal mayors, who govern waste strategy in the region on board with DVC. They said that mayors were concerned with the popularity of this policy and whether it could affect their ability to be re-elected. The sentiment of the difficulty in the waste authority influencing what are seen as political decisions (most commonly the exact charging rate of the variable part of DVC charging) was echoed by interviewees from Italy and OVAM. Communication with both local government and the public was an important step in overcoming this challenge.

3.4.4 Enforcement

Enforcement is a key tool to ensuring compliance with any scheme. Some of the interviewees spoke about measures in place to ensure successful compliance. Although the collections are the responsibility of Parish Councils, they have delegated the role of enforcing non-compliance to Guernsey Waste, ensuring consistency and scales of efficiency across the island. Collection crews will log (using GPS) any bags that have been left without a sticker. These are subsequently collected by an enforcement officer, if in a communal/public area where the owner is unlikely to remediate the issue, and hand sorted to determine if an individual can be identified. If they can be, they will be sent a polite notice warning them of their action. In the case of a second offence, an official warning notice will be sent. Fines (of £60) are only issued for a third offence and if this is paid in a timely manner it is reduced to £40. For every offence after this point a fine will be issued. This was a successful method at the start of the implementation phase. Where there are persistent offences in certain areas, namely central town areas that have communal set out points, Guernsey Waste is now aiming to identify the hotspot areas and design an intervention plan, which could include considering CCTV, door knocking and frequent monitoring and education.

Enforcement is a key tool to ensuring compliance with any scheme. Some of the interviewees spoke about measures in place to ensure successful compliance. The use of clear plastic bags in Orillia, Italy, and Flanders are in place to ensure that people are separating their waste correctly. In these cases, it is the responsibility of the waste handlers to ensure that no incorrect items are placed in the wrong bag. In regions of Flanders and Guernsey, these bags are hand sorted and if the owner is identified, they can be issued with a fine^{98,99}.

Although service delivery is the responsibility of Parish Councils, based on consultation with the Parish Councils Guernsey Waste play a role in enforcing non-compliance to ensure consistency across the island. Collection crews will log any bags that have been left without a sticker and hand sort to determine if an individual can be identified. If they can be, they will be sent a polite notice warning them of their action. In the case of a second offence, an official warning will be sent. Fines (of £60) are only issued for a third offence and if this is paid in a timely manner it is reduced to £40. For every offence

⁹⁷ Interview with OVAM representative, April 2023

⁹⁸ Interview with OVAM representative, April 2023

⁹⁹ Interview with Guernsey Waste representative, April 2023

after this point a fine will be issued. This was a successful method at the start of the implementation phase, however now citizens are becoming wise to the process and are working out ways around this system. The next stage for Guernsey Waste is to identify hotspot areas and design an intervention plan, that will likely consist of CCTV alongside door knocking as a method of providing education and support around separating recyclables directly to each household¹⁰⁰.

In Guernsey, around 50 tonnes of unstickered bags – 3,260 bags of general waste and some occasions where recycling bags were used for general waste – were collected in 2022. This is approximately 1% of the total household general waste set out at the kerbside. Detailed breakdown of non-compliance since implementation is covered in Table 5 below¹⁰¹.

Table 5: Non compliant letters issued in Guernsey¹⁰²

	2020	2021	2022
Polite Notices¹⁰³	385	311	154
Warning Notices	22	16	18
Civil Fixed Penalties	4	4	4

In Priula, enforcement measures were also required when DVC was first required. Interviewees said that non-compliance was much higher at first, however reduced over time. They said that this was the result of communication and increased support of DVC instead of enforcement deterring these actions. Whilst enforcement is necessary for a minority of individuals, they said that most residents were supportive and compliant with these measures. This may indicate that communication is more successful in ensuring compliance than enforcement.

3.4.5 Challenges

3.4.5.1 Communal Bins

Communal bins provide a challenge with most types of DVC systems, and it was a challenge that was reflected on in most of the interviews¹⁰⁴. These challenges arise as it becomes more difficult to connect waste with an individual household. Guernsey overcame this challenge by removing communal bins set out arrangements where possible to allow for waste to be presented outside of the household. Where this is not possible to ensure compliance, single bags are removed from communal bins (where in place) by collection crews by hand to ensure the each are stickered. Any that don't have stickers are left in the bin. If bags are left in these areas it is the responsibility of the management company to share this problem with the tenant and motivate action. However, Guernsey Waste will provide support and guidance¹⁰⁵.

¹⁰⁰Interview with Guernsey Waste representative, April 2023

¹⁰¹ Guernsey Waste, (2023), *Annual Waste Management Report 2022*

¹⁰² Guernsey has a population of roughly 65,000 and 25,000

¹⁰³ Included those sent to communal properties

¹⁰⁴ Interviews with representatives from Consiglio di Bacino Priula, Contarina, Guernsey Waste, Irish EPA and OVAM

¹⁰⁵ Interview with Enzo Favoino, Scuola Agraria del Parco di Monza, Italy (April 2023)

Flanders has also struggled with implementation of DVC in apartments and flats, and to date has not found an effective solution. As opposed to designing out communal bins regions of Flanders, municipalities have attempted new solutions to administering DVC charging systems in communal properties. Underground containers have been trialled, these systems are generally volume based due to the cost and difficult infrastructure required for volume-based systems. Systems such as this have made use of ID cards to open containers, which are linked to the charging system, despite this, individuals still abused the system by disposing of residual waste via the cheapest waste stream. To overcome this, cameras have also been explored to remove the anonymity of disposal. Underground storage was found to be particularly problematic for organic waste due to humidity, rotting and corrosion. Due to the escalating cost, difficult management, and lack of success in improving system compliance underground containers are being removed¹⁰⁶.

Limburg.net have a variety offer a mixture of weight, volume and frequency-based systems for DVC as discussed in section 3.2, this allows for flexibility in how communal bins are tackled. Limburg.net do use underground containers as detailed above, access to these is granted via swipe card access that register the number of visits per year. Alternatively, some communal bins are chipped that register the weight of waste as it is deposited. This information is processed by Limburg.net and the consolidated weight for the entire apartment block divided between each household, who is billed directly from Limburg.net. If the overall building allowance is exceeded the property manager will be contacted and offered additional collections at an additional charge, it will be their decision (potentially in conjunction with tenants) whether to purchase additional weight to be collected and how this charge is shared with the tenants¹⁰⁷.

In Ireland and in many cases in the USA, flats are typically treated as a commercial waste customer, so are often exempt from variable charges. For example, a waste collector might negotiate a contract for waste collection with the management company of the apartment block. Residents would then pay a fee, which is often fixed, to the management company. However, this sort of system, whilst easiest to implement, means that there is little to no incentivisation, and the performance of the DVC system is poor with very high levels of contamination. This is understood to be a growing issue, with more flats being developed and built than houses.

Dordogne has seen issues with moving away from kerbside pick up to larger communal bins. In many towns and villages, there are narrow roads and pathways which make vehicle access difficult. This has led some areas paying more for door -to-door collection, when in fact there are bulking points at the end of the street¹⁰⁸.

3.4.5.2 Non-compliance

There have been reported cases of individuals attempting to avoid waste charges through bin sharing or dumping (when a householder dumps their waste into a neighbour's bin) or contamination of other waste streams (when a householder diverts waste from residual bin to recycling to avoid charges). In

¹⁰⁶ Interview with OVAM representative, April 2023

¹⁰⁷ Limburg.net, (Accessed April 2023) *Waste Collection* [Link](#)

¹⁰⁸ SMD3 (2023), *Dordogne: A limited volume of household waste per household? Presented as the solution to reduce them, it divides* [Link](#)

Flanders and Guernsey, public litter bins were either locked or given smaller apertures to prevent illegal use .

In Guernsey there has been an increase in contamination of one of the recycling streams, however, it is unknown if this is a direct result of DVC or a result of additional people using the scheme in recent years or confusion around what is recyclable with a constant change to materials and packaging info, namely plastics.

Contamination may also occur in 'good faith' (popularly termed 'wish-cycling', whereby residents dispose of questionable items in the recycling bin, hoping they can be recycled)¹⁰⁹. This can cause significant problems for local authorities, particularly those with multi-stream collections, whose recycling facilities are not able to handle high levels of contaminated recycling streams. This may not be the case for local authorities operating co-mingled collections, as this recycling stream is known to be more contaminated.

However, according to an Irish EPA representative, issues related to contamination can still be very high even with comingled collections. Contamination of the recycling stream in Dublin was apparently as high as 30%, partially attributed to people avoiding waste charges. One private collection company implemented an innovative technology solution to try and curb contamination levels, whereby a camera was fixed onto the truck lift mechanism which took a series of photos as the bins' contents were dumped into the truck. A person would be analysing the photos in real time, and if high levels of contamination were identified, a warning letter would be issued to the householder, whose address was identified through the micro-chipped bin.

According to the US EPA representative interviewed, municipalities typically expect some contamination, and thus plan to spend extra resources in the transition months to check on recycling habits after DVC implementation. For example, they might attach 'Oops' tags when collectors find items that are not recyclable; the source estimated that around 10%-15% of households will require targeted messaging (such as oops tags) to align with the boundaries of the DVC scheme.

Another approach to preventing contamination of other waste streams is the use of clear recycling bags. In Orillia, householders must purchase clear bags for their residual waste, and if the waste collector believes that more than 10% of the bags' contents is recyclable, can choose not to collect the bag. This ensures that the DVC has the desired effect of not only reducing residual waste, but increasing recycling as well, which has been identified as a more challenging impact. Householders are allowed up to two grocery-sized 'privacy bags' to put in the clear residual waste bags, for any waste they would like to keep private.

In Priula, on the other hand, there was no increase in waste stream contamination as the result of the introduction of DVC. One interviewee attributed this to the introduction of separate collections shortly before implementation of DVC and Contarina's communication strategy which provides extensive support to the public, particularly during the early stages of DVC implementation. In the year prior to implementation, Contarina focused on educating the public to maximise compliance ahead of introduction.

¹⁰⁹ Interview with US EPA representative (April 2023).

Fraudulent stickers were also a concern raised to Guernsey Waste through public consultation, residents were worried that individuals would try and circumvent the charges associated with sticker purchasing by creating fraudulent stickers or taking ones off of other's bags. This was overcome by the stickers being designed with a number of anti-fraudulent designs such as using iridescent ink on the stickers, a torch was provided to collection crews who could check stickers they suspected were not legitimate.¹¹⁰

3.4.5.3 Technology

Most of the DVC systems required implementing new technology systems, such as introduction of microchipped bins, and swipe card access bins. The volume-based systems required lower technological investment than the frequency and weight-based systems. Most of the interviewees did not report any significant technical challenges as part of implementation. However, Contarina did report that when DVC was first implemented, there were issues with transponders being damaged by rain or during collection. However, they did highlight that this was pioneering technology at the time and now that it is widely available, they no longer have significant issues.

It was also reported that the weighing trucks in Aschaffenburg County required frequent maintenance and calibration owing to vibrations during operation of the truck. However, increased maintenance costs were compensated by increased rates of collection for recyclables. The data collected is also used to measure economic efficiency of the system and to optimise logistics.¹¹¹

3.4.5.4 Financing

Guernsey experienced unexpected financial challenges in the transition to DVC. The system was designed to be wholly self-funding, with relation to DVC this included the ongoing additional costs required for communications, and manufacturing and distributing stickers. However, DVC was so successful in reducing residual waste that incoming fees from DVC were lower than anticipated and were not sufficient to cover all operational costs. To overcome this the States of Guernsey decided to provide a 'grant' to Guernsey Waste levied through general taxes to compensate for the financial deficit. There was consideration in increasing the charge of the stickers or introducing a variable charge for recyclables, however, this was not done, because of the risk of reduced engagement with the service, and the fact that this decision was being made during the height of the cost-of-living crisis in 2022¹¹². In Massachusetts, DVC resulted in increased administrative costs compared to the previous system. This was covered through the savings that were made in the reduction of residual waste treatment.¹¹³

However, not all cases have experienced this challenge and many of the shortlisted cases have been able to successfully design waste tariffs (including fixed and variable charges) to successfully cover the collection and treatment of waste. In Maine, one municipality (Waterville) reported 26,891 USD (19,071 GBP) in savings with DVC in the first 8 weeks of implementation, projected savings of 175,000 USD

¹¹⁰Interview with US EPA representative (April 2023).

¹¹¹ Morlok J. et al. (2017) *The impact of pay-as-you-throw schemes on municipal waste management: The exemplar case of the county of Aschaffenburg, Germany* [Link](#)

¹¹² Interview with representative from Guernsey Waste (April 2022).

¹¹³ Smith R. (2022) *Spring into PAYT: How to make it work for you*. [Link](#)

(124,000 GBP) in its first year¹¹⁴. Contarina also highlighted the opportunity that DVC could provide in savings for waste management. In 2021, Contarina spent €117 per inhabitant, compared to €166 to €222 in other regions of Italy where DVC was not in place.¹¹⁵

US EPA guidance states that in order to ensure that DVC is cost-effective, regardless of the systems structure, a few basic principles need to be considered when designing DVC¹¹⁶. First, there must be sufficient funds raised to cover the fixed and variable costs of DVC. The pricing of DVC should consider costs beyond waste management, such as covering anti-fly-tipping campaigns or other policies to address any unintended consequences, providing services for individuals who lack mobility, and providing discounts for low-income households. They also advise establishing an accurate municipal solid waste baseline to allow for evaluating and designing pricing. As mentioned in section 3.4.3, the US EPA provide local authorities with a tool kit to support setting pricing.

3.5 Impact on service performance

All the shortlisted case studies saw an increase in recycling rates and reduction in residual waste following the implementation of DVC (see Table 6 and Table 7). DVC was not introduced in isolation, and it is difficult to separate the impact of DVC and other policy measures (such as introduction of kerbside collection or separate collections) on performance. In some regions, comparisons have been made between local authorities which have implemented DVC and those which have not. Local authorities which have implemented DVC tended to have higher recycling rates and lower municipal solid waste than those that did not.^{117,118} For example, Figure 3, shows differences in waste generation between municipalities in Massachusetts with and without DVC in place.

¹¹⁴ Clark, P., Beneski, B. (2023). *Maine Solid Waste Generation and Disposal Capacity Report for Calendar Years 2020& 2021*. [Link](#).

¹¹⁵ Data provided by Consiglio di Bacino Priula, Contarina

¹¹⁶ US EPA (undated) *Designing an integrated unit pricing program* [accessed May 2023] [Link](#)

¹¹⁷ Banca D'Italia (2020) *Wasted in waste? The benefits of switching from taxes to Pay-as-you-throw fees: the Italian Case study* [Link](#)

¹¹⁸ Clark, P., Beneski, B. (2023). *Maine Solid Waste Generation and Disposal Capacity Report for Calendar Years 2020& 2021*. [Link](#).

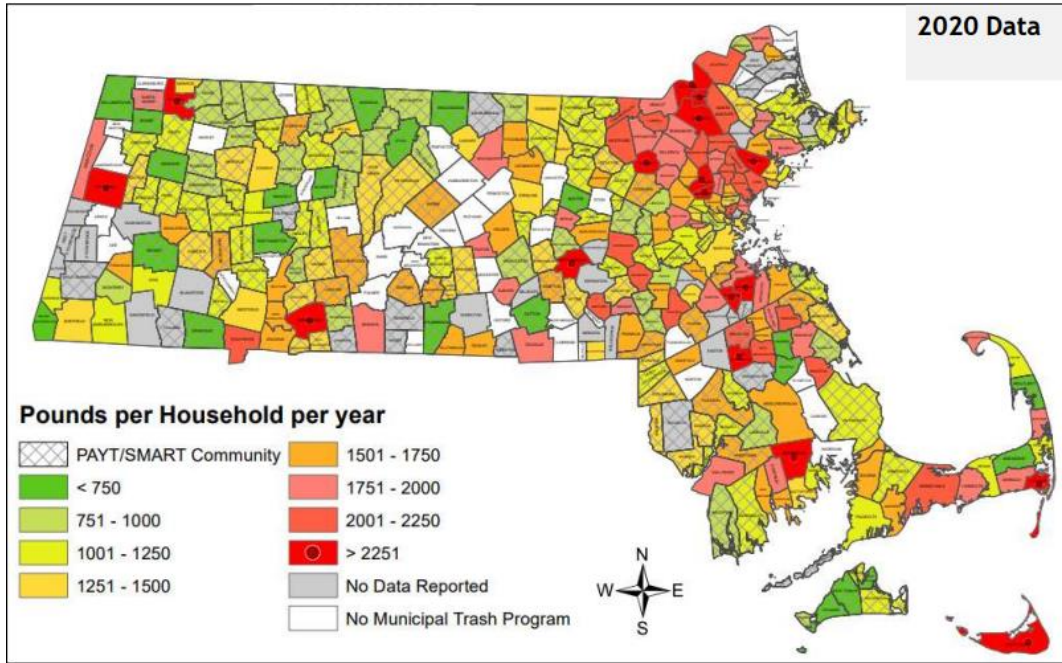


Figure 3: Per household waste generation in Massachusetts in 2020¹¹⁹ This figure compares municipalities which have DVC (or referred to as PAYT (pay as you throw) and SMART (Save Money and Reduce Trash) in this figure).

In Italy, Priula’s recycling rate is higher at 90% than Italy’s national average at 63%.¹²⁰ It’s residual waste generation per capita per year was also 139kg lower than the national average.¹²¹

Table 6: Summary of pre and post DVC implementation recycling rates

Case Study	Year	Pre-implementation (%)	1 year post implementation (%)	Most recent year
Guernsey ¹²²	2019	55 (2018)	73 (2019)	72 (2020)
Priula ¹²³	2002	66 (2000)	74 (2004)	90 (2021) ¹²⁴
Treviso ¹²⁵	2009	68 (2008)	79 (2010)	
Ireland ^{126,127}	From 2003	28 (2003)	34 (2004)	41 (2020)

¹¹⁹ Smith, R. (2022) *Spring into PAYT: How to make it work for you* [Link](#)

¹²⁰ Data provided by Consiglio di Bacino Priula, Contarina

¹²¹ Data provided by Consiglio di Bacino Priula, Contarina

¹²² Guernsey Waste (2021) *Guernsey Waste Annual Report* [Link](#)

¹²³ Data provided by Consiglio di Bacino Priula, Contarina

¹²⁴ Priula and Treviso originally implemented DVC separately. These regions are now operated by Contarina.

¹²⁵ Data provided by Consiglio di Bacino Priula, Contarina

¹²⁶ EPA (2004) *National Waste Report 2004* [Link](#)

¹²⁷ EPA (2022) *Municipal waste statistics for Ireland* [Link](#)

Case Study	Year	Pre-implementation (%)	1 year post implementation (%)	Most recent year
Flanders ¹²⁸	From 1995	4 (1995)	5 (1996)	62 (2020)
Aschaffenburg County ¹²⁹	1997	Information not found	Information not found	86 (2017)
Ashland ¹³⁰	2006	13 (2005)	39 (2008)	Information not found
Orillia ¹³¹	1997			69 (2002) ¹³²

¹²⁸ Indicators.be (2022) *Waste recycling* [Link](#)

¹²⁹ Morlok J. et al. (2017) *The impact of pay-as-you-throw schemes on municipal waste management: The exemplar case of the county of Aschaffenburg, Germany* [Link](#)

¹³⁰ Massachusetts Department of Environmental Protection (2009) *Case study: Town of Ashland Pay-as-you-throw (PAYT) Program* [Link](#)

¹³¹ City of Orillia (2022) *Solid waste management operations annual report* [Link](#)

¹³² Note, this is a diversion rate

Table 7: Summary of pre and post DVC residual waste rates (kg/inhabitant/year)

Case Study	Year	Pre-implementation	1 year post implementation	Most recent year
Guernsey ¹³³	2019	170 (2018)	97 (2019)	110 (2020)
Priula ¹³⁴	2002	321 (2000)	100 (2004)	42 (2021) ¹³⁵
Treviso ¹³⁶	2009	131 (2008)	77 (2010)	
Ireland ^{137,138}	From 2003	428 (2003)	430 (2004)	372 (2020)
Flanders ^{139,140}	From 1995	325 (1994)	260 (1996)	140 (2021)
Aschaffenburg County ¹⁴¹	1997	163 (1995)	48 (2000)	Information not found
Beleves, Dordogne ¹⁴²	2022	264 (2020)	158 (2022)	NA
Montpon, Dordogne ¹⁴³	2022	180 (2019)	114 (2022)	NA
Orillia ¹⁴⁴	1997	Information not found	Information not found	127 (2022)
Maine ¹⁴⁵	2012	Information not found	Information not found	500 (2021)

As seen in Tables 6 and 7, the extent of the improvement of these rates varies across the short-listed case studies. When interpreting the most recent data, the potential impact of the pandemic should be considered. Nonetheless, the figures show an improvement in performance across the case studies. The case studies in the USA and Ireland have experienced a slower improvement in recycling rates in comparison to the other case studies. In the case of Ireland, this could be the result of the complex waste system that is in place. Many of the case studies have also experienced stagnation or slowing of improvement, albeit at a high level, with time. Whilst there may be some differences in improvements as the result of the DVC system design, there is evidence that other policy measures are required to continue to drive performance improvements. Stakeholder interviews highlighted the importance of

¹³³ Guernsey Waste (2021) *Guernsey Waste Annual Report* [Link](#)

¹³⁴ Data provided by Consiglio di Bacino Priula, Contarina

¹³⁵ Priula and Treviso originally implemented DVC separately. These regions are now operated by Contarina.

¹³⁶ Data provided by Consiglio di Bacino Priula, Contarina

¹³⁷ EPA (2004) *National Waste Report 2004* [Link](#)

¹³⁸ EPA (2022) *Municipal waste statistics for Ireland* [Link](#)

¹³⁹ Data provided by OVAM, April 2023

¹⁴⁰ ACRplus (2022) *Significant reduction of residual waste in Flanders* [Link](#)

¹⁴¹ Morlok J. et al. (2017) *The impact of pay-as-you-throw schemes on municipal waste management: The exemplar case of the county of Aschaffenburg, Germany* [Link](#)

¹⁴² SMDC (2023) *Dordogne: A limited volume of household waste per household?* [Link](#)

¹⁴³ SMDC (2023) *Dordogne: A limited volume of household waste per household?* [Link](#)

¹⁴⁴ City of Orillia (2022) *Solid waste management operations annual report* [Link](#)

¹⁴⁵ Smith R. (2022) *Spring into PAYT: How to make it work for you.* [Link](#)

separate organic waste collections as just one of these important measures. In Guernsey, separate food waste collections were implemented at a similar time to DVC. These two policy measures have resulted in 73% of household waste being sent to recycling or composting compared to 50% just 3 years earlier in 2017¹⁴⁶. One stakeholder in Italy said that whilst other measures are in place in Priula, they see DVC as the main driver to behaviour change and continued performance improvements are the result of DVC. They said that whilst some increase in recycling rates were seen immediately, it took time for this behaviour change to embed in the community.

It is important to consider the context of when DVC was implemented in these case studies when interpreting the impacts on performance. Many of the case studies outlined in this report are longstanding, so the performance of DVC case studies where such measures are already in place may be different. In Flanders, a minimum charge was introduced with the intention of increasing cost over time to help to continue driving performance, however, due to political factors pricing has only increased in line with inflation.¹⁴⁷

The type of DVC system will also have an impact on performance rates. Previous analyses of DVC in Europe have shown that a weight-based fee structure is most effective in reducing residual waste.^{148,149} The conclusion was that weight-based charges are the most effective DVC system prompting the highest per-household recycling levels, highest diversion rates from landfill, and lowest total kerbside waste figures¹⁵⁰. This is supported by findings from OVAM, Flanders who have also seen that municipalities who implement DVC with higher variable charges for a volume-based system or a weight-based system have lower levels of residual waste per capita (Figure 4)¹⁵¹.

Analysis of DVC in other studies has shown that it does not have a significant effect on the long-term total amount of waste generated per capita and that further policies are required at a national or regional level to support this.¹⁵² This was reflected in Flanders, where overall waste levels per capita have increased since the implementation of DVC.¹⁵³

¹⁴⁶ Circular Online (2020) *Guernsey's recycling rate increases 23% after implementing new waste strategy* [Link](#)

¹⁴⁷ Interview with representative from OVAM, April 2023

¹⁴⁸ [ACR+ \(2016\) Cross-analysis of "pay-as-you-throw" schemes in selected EU municipalities](#)

¹⁴⁹ Catalonia Waste Agency (2010) *Guide for the implementation of pay-as-you-throw systems for municipal waste*

¹⁵⁰ O'Callaghan, A., Coakley, T. (2011). "Study of Pay-by-use Systems for Maximising Waste Reduction Behaviour in Ireland". [Link](#).

¹⁵¹ Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

¹⁵² Morlock, J. et al. (2017) *The impact of pay-as-you-throw schemes on Municipal Solid Waste Management: The exemplar case of the county of Aschaffenburg, Germany* [Link](#)

¹⁵³ Interview with representative from OVAM, April 2023



Figure 4: Residual waste per capita per year in Flanders between a weight-based system and cost per bag in a volume-based system.¹⁵⁴

3.6 Unintended consequences

3.6.1 Environmental consequences

There are several environmental consequences that have been attributed to the implementation of DVC, including:

- Fly-tipping;
- Burning of waste and;
- Waste tourism (disposing of waste in a region with cheaper tariffs or via a cheaper waste stream)

These issues occur when individuals are unwilling to pay for their waste to be collected and resort to methods that are free of charge to them. This has been reported in some jurisdictions operating DVC (such as in Ireland, Dordogne and Flanders). However, it is also the case that in many jurisdictions (such as Guernsey and Priula), no increase in fly tipping has been reported¹⁵⁵. In Maine, for example, some municipalities experienced 'significant increases in fly tipping, while others experienced no increases at all¹⁵⁶. For this reason, it is difficult to make a direct link or association between DVC and fly-tipping;

¹⁵⁴ Public Waste Agency of Flanders (OVAM) (2016) *Waste & Materials Management in Flanders Presentation*

¹⁵⁵ Interviews with representatives from Irish EPA, OVAM, Consiglio di Bacino Priula, Contarina, and Guernsey Waste, April 2023

¹⁵⁶ Blackmer, T., Criner, G. (2014). *Impacts of Pay-as-you-throw and other residential solid waste policy options: Southern Maine 2007-2013*. [Link](#).

sources have confirmed that the motivations and behaviours around fly-tipping are complex and multi-faceted¹⁵⁷

In the case of Priula, there were instances of illegal waste activity such as fly-tipping when DVC was first introduced. One of the interviewees said this only lasted a few months and residents quickly complied with the regulations. Nonetheless, a small minority have continued to participate in illegal behaviours, which they try and prevent through behaviour change campaigns. Regular investigations and video surveillance are carried out to try and deter and enforce such behaviour. Overall, they say they have low litter and fly-tipping rates, which the interviewee attributed to DVC as it changed responsibility and motivated behaviour change. Guernsey has reported similar impacts of DVC on fly-tipping. Those interviewed said that the public are more aware of waste since implementation and people report fly-tipping, however, have not seen a rise in fly-tipping rates. In addition to this, anecdotally, the abuse of litter bins has appeared to reduce, attributed to the renewed communication campaign reminding people how services should be correctly used.¹⁵⁸

The individual interviewed in Flanders said that they have had problems with waste tourism and have been trying to harmonise tariffs across the region for several years as this would help to prevent and/or minimise some of the illegal waste handling practises. However there has been little progress with this as the rate setting is a political decision taken by individual municipalities¹⁵⁹. OVAM has introduced a minimum tariff that increases each year in line with inflation to help aid this process. They have also put in other measures to mitigate illegal waste activity, including education, locking public bins, smaller apertures for bins and fines¹⁶⁰.

3.6.2 Socio-economic consequences

Interestingly, most of the sources identified and stakeholders interviewed did not express many challenges related to socio-economics or social acceptance. Stakeholders interviewed said that public perceived DVC as more fair than previous systems, as payment was linked to household residual waste generation and provided the opportunity for households save money, as households will only be paying for their waste and not subsidising the waste of others.¹⁶¹ In Priula, on average, families paid €198 in 2021 across the fixed and variable charges, which was lower than other regions without DVC in place, where families paid between €282 and €359.¹⁶² However, as discussed in section 3.1.5, Guernsey Waste recognised that some vulnerable citizens may require more support.

Ireland is perhaps an exception to this, as they experienced many challenges in the implementation of DVC in the early 2000s. There was an organised rebellion in parts of Dublin in late 2003 and 2004 against the nation-wide charges, causing a disruption in services, involving protests and a substantial media debate, throwing the success of the new charge into doubt. Protesters have been in court and

¹⁵⁷ Purdy et al. (2022) *Fly-tipping: Drivers, deterrents and impacts*. [Link](#)

¹⁵⁸ Interview with Guernsey Waste representative, April 2023

¹⁵⁹ Interview with OVAM representative, Paril 2023

¹⁶⁰ Regions for Recycling (2014), *Good practice Flanders: PayT*

¹⁶¹ Interviews with representatives from Guernsey Waste and Consiglio di Bacino Priula, Contarina

¹⁶² Data provided by Consiglio di Bacino Priula, Contarina

some even in jail, and the city council reportedly nearly collapsed under the issue¹⁶³. However, it is probable that the lack of social acceptance was fuelled by political reasons, and not reasons directly related to unfairness or other socio-economic factors. One source suggested that there seemed to be less resistance in areas where the charge was privatised; when the local authority implements DVC, it had the tendency to be perceived as more of a political issue¹⁶⁴. However, there are also challenges with privatisation, explained in section 3.2.1.1.

The final challenge seen in France has been the difficulty for households with disabled, elderly or sick residents to use the system. As part of this research no information on discounts, exemptions or support were found. This dissatisfaction by vulnerable communities has resulted in the creation of the AMCODD- The Association of the Dissatisfied with the Collection of Waste in the Dordogne as a result¹⁶⁵. Currently household with limited mobility are required to sign up for door-to-door collection with is a higher cost that the communal bin drop off points. With no discounts or exemptions in place it is felt that families with young children are being unfairly penalised. It has been stated that in protest to the new charges residents are purposefully dumping rubbish bags outside the containers, with bins being vandalised by disabling the scanner so more rubbish can be added¹⁶⁶.

There was found to be one positive outcome from Contarina, with the increased number of jobs required to successfully implement the DVC system and other complimentary policies. These were deemed to be 'green jobs' and the supporting of the growth of a green economy. Contarina staff have grown from 58 to 84 since the system was implemented and it is projected that as more of the region sign up to DVC systems that more the organisation will grow, if 1 million inhabitants were under DVC systems Contarina believe they would grow by 350 staff members. The level of growth is partly due to the move to separate kerbside collection¹⁶⁷.

4 Conclusion

DVC has the potential to improve waste performance, including improving recycling rates, diverting waste from landfill, and decreasing waste generation through personal responsibility. The learnings from the shortlisted case studies show that the extent of this success will depend on:

System design: Careful consideration needs to be given to the charging structure to ensure it achieves any objectives of implementation. Accompanying the variable rate with a fixed rate has been implemented in each of the case studies explored in this report. This was viewed as an important element to finance service provision, whilst also ensuring the variable fee is not too high. Views from those interviewed highlighted that careful consideration needs to be given to the variable tariff as it needs to be high enough to incentivise individuals to reduce residual waste, but not too high to drive non-compliance. Although, historically, weight-based systems have been shown to be more effective, views shared as part of this research show that success is not just dependent on the type of charging

¹⁶³ Gallagher, L., Convery, F., and Dunne, L. (2008). *An investigation into waste charges in Ireland, with emphasis on public acceptability*. [Link](#).

¹⁶⁴ Gallagher, L., Convery, F., and Dunne, L. (2008). *An investigation into waste charges in Ireland, with emphasis on public acceptability*. [Link](#).

¹⁶⁵ AMCODD (2021), *The Association* [Link](#)

¹⁶⁶ The Connexion (2023), *Maggots, protests: Dordogne reacts to 'pay-as-you-throw' waste system* [Link](#)

¹⁶⁷ Contarina Spa Integrated waste management Presentation (undated approx. 2015) [Link](#)

system. Reduction in residual waste has been seen in all the case studies with DVC systems in place, however, due to the context of other measures (such as separate collections, DRS etc) in place make it difficult to directly compare the direct impact of DVC. In Italy for example, those interviewed saw Contarina's frequency-based model as a success as it helped to embed a culture of individuals taking responsibility for their waste production.

The improvement of recycling rates varied more between case studies, with some experiencing greater increases than others. Whilst there is some thought that volume-based systems may be more effective at increasing recycling rates due to the light weight of recyclables, comparison of the cases (such as Ireland and those in the USA) shows that improvements in recycling performance won't be as significant without other complimentary measures. It is also important to consider that DVC was often implemented around the same time as kerbside and/or separate collections. The importance of implementing separate organic collections, was highlighted as an important co-measure amongst many of the interviewees.

Fairness: Majority of interviewees suggest the DVC is an inherently fair system and support to vulnerable communities should be provided through other avenues and not exemption the variable part of the DVC charge. However, this should still require close consideration at within the local context of where DVC is being implemented. Fairness was often focused on households with low incomes; however, consideration must be given to other groups such as those with additional medical requirements.

Complimentary measures: Measures in place alongside DVC are a factor which will determine the success of DVC in improving performance. There must be appropriate infrastructure in maximise opportunities for individuals to reduce their waste and/or recycle and to maximise individual responsibility. Separate collections, including organics, played an important role in achieving this. Additional supporting measures varied, with some removing as many communal bins and bring banks as possible, and others integrating these into the system's design.

Communication: Implementation needs to be accompanied by a strong communications campaign to explain why charges are coming in, opportunities to reduce household costs and responsibility for separating waste. This communication should begin in advance of implementation and be ongoing to support householders.

Support of local government: Design and implementation at a local government level was thought to be most effective as it allows tailoring to the local context. However, this requires support from central government through measures such as financial resources (for example, grant funding), cost modelling toolkits, and best practice guidance.

Consideration of challenges: Implementation of DVC in multi-household dwellings was a clear challenge amongst all the case studies and each case addressed this by implementing a system within these dwellings that aimed to put responsibility on the individual household as much as possible.

There were also some challenges with fly-tipping and other illegal waste activity. However, this doesn't have to be a consequence of implementing DVC and strong supporting measures could help to prevent these consequences.

These case studies have provided valuable insight into the successes and challenges associated with the implementation of DVC. This information will be used in phase 2 of this project to evaluate these types of systems in a Scottish context to under whether DVC could help to improve recycling performance in Scotland.