detritus | Multidisciplinary Journal for Circular Economy and Sustainable Management of Residues

CISA

CRITICAL ANALYSIS OF SCOTTISH LOCAL AUTHORITIES BULKY WASTE SERVICES: IMPLICATIONS FOR LEAKS IN THE CIRCULAR ECONOMY MODEL

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Article Info:
Received:
4 September 2025
Revised:
4 December 2025
Accepted:
16 January 2026
Available online:
8 February 2026

Keywords:
Bulky household items
Circular economy
Fly-tipping
Kerbside collections
Scottish local authorities
Website disclosures

ABSTRACT

Fly-tipping is the illegal disposal of waste onto land and can range from a bin bag of household waste to copious quantities of domestic, commercial or construction waste. A decade after the Paris Agreement 2015 on climate change, there is increased urgency to implement inclusive policies that can contribute to sustainable waste management services and reduce the environmental impacts of fly-tipping. This study explores the characteristics of bulky waste kerbside collection services through analysis of website disclosures from local authorities across Scotland. A database was constructed to identify potential barriers to service uptake and provide insights for policy makers and waste managers. It is crucial to ensure that materials from this discrete waste stream do not leak out of the circular economy approach being pursued by the Scottish Government. The findings highlight underlying factors that may influence resident engagement with bulky uplift services and emphasise the importance of effective communication and inclusive policies for local authorities and waste managers. Our findings reveal critical gaps in accessibility, affordability, and operational design that may inhibit service uptake and contribute to fly-tipping. Recommendations include the adoption of inclusive booking and payment methods, progressive pricing policies, and coordinated digital solutions such as a unified smartphone app. These measures could support legitimate disposal behaviours, reduce environmental harm caused by fly-tipping, and strengthen Scotland's circular economy outcomes. Mitigating fly-tipping and improving bulky item disposal routes can reduce greenhouse gas emissions from landfill and support Scotland's climate targets by retaining products and materials in circulation.

1. INTRODUCTION

Scotland is positioned as a forerunner in implementing the circular economy model, (Zero Waste Scotland, 2024a). This leadership has been reinforced by recent legislation with the introduction of the Circular Economy (Scotland) Bill 2024, (NetRegs, 2024). Waste management services in the UK, including Scotland, have been identified as the 26th best managed worldwide, (Statista, 2023). Despite this strong position, illegal disposal methods such as fly-tipping continue to represent significant 'leaks' within otherwise controlled waste systems. Globally, the circular economy model faces systemic leaks when materials escape controlled collection pathways through illegal disposal, inadequate infrastructure, or informal trade routes, (Cook & Velis, 2021; Song et al., 2023; UNEP, 2024). These leaks commonly involve household waste, construction and demolition debris, which together account for a significant share of uncontrolled waste flows worldwide, (Song et al., 2023; UNEP, 2024). Such losses compromise resource efficiency, increase greenhouse gas emissions from landfill, and perpetuate environmental injustice in regions with limited waste management capacity, (Cook & Velis, 2021; UNEP, 2024). Figure 1 illustrates fly-tipping as a leak from the circular economy model, occurring at the nexus of consumption and collection.

The circular economy model aims to retain materials of value within circulation promoting economic growth while reducing environmental impacts, (Takahashi, 2020). However, waste management problems are widely recognised as 'wicked issues' due to their social and political complexity, (Salvia et al., 2021). In this context, fly-tipping is not merely a behavioural issue but a symptom of systemic barriers to legitimate disposal. Framing fly-tipping as a leak from the circular economy model allows targeted analysis of specific waste streams and their disposal routes with a goal of mitigating leakage through improved service

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https://doi.org/10.31025/2611-4135/2026.19565

FIGURE 1: Fly-tipping as a leak from the circular economy model.

design and communication. Fly-tipping exemplifies these systemic leaks with waste composition varying across contexts but typically dominated by household bulky items alongside mixed household waste and construction materials, (Comerford et al., 2018; Hodsman & Williams, 2011; Scottish Government, 2023b). Globally, these uncontrolled flows undermine circular economy objectives by diverting recoverable materials into landfill or informal processing, increasing emissions and eroding the integrity of waste systems, (Song et al., 2023; UNEP, 2024). Similar challenges have been documented internationally, where bulky waste management and fly-tipping persist despite formal service provision. Studies from Europe, Australia, and North America highlight recurring issues of access, affordability, and communication, reinforcing the need for comparative insights to inform local policy development, (Comerford et al., 2018; Keske et al., 2018; Larsen et al., 2012).

Household bulky items are the discrete waste stream most frequently encountered in fly-tipping incidents across Scotland, (Scottish Government, 2023b). Bulky items or waste are items of furniture, white goods, e-waste or any item you would take with you when moving house, (Hodsman and Williams, 2011). These items can be difficult to dispose of due to their material composition and size, (Alexander et al., 2009a; Curran et al., 2007; Keske et al., 2018). Our study analysed the information disclosed on local authority websites to provide a narrative reflection on the underlying factors that influence service uptake. Ensuring that bulky items are collected by dedicated services mitigates their potential for fly-tipping which reduces economic costs to governments and environmental impacts, (Liu et al., 2017). The insights generated are relevant to policymakers and waste managers in Scotland and beyond, as fly-tipping of bulky items is a global issue requiring effective and transparent communication strategies for disposal services.

1.1 Background

Fly-tipping is the illegal dumping of waste and can range from a bin bag of household waste to large quantities of domestic, commercial or construction waste, (Scottish Government, 2023a). It is a global phenomenon that manifests heterogeneously dependent on the availability of waste management services. Developed countries with waste management services experience fly-tipping as an uncontrolled leak from a controlled system whereas developing countries lack basic waste management services and experience fly-tipping as large, open dumpsites, (Song et al., 2023; UNEP, 2024). A decade after the Paris Agreement 2015 on climate change, the urgency to implement sustainable waste management policies has intensified, (Dixon et al., 2022). Waste management is a critical system for climate action as the sector contributes approximately 4% of Scotland's greenhouse gas emissions and up to 15-20% globally, (Scottish Government, 2024; UNEP, 2024). Aligning disposal routes with circular economy principles reduces reliance on landfill, which is a major source of methane emissions, and promotes reuse and recycling pathways that conserve resources and lower carbon intensity, (Curran et al., 2007; Takahashi, 2020). Sustainable waste management directly supports climate targets under the Paris Agreement by reducing emissions associated with extraction, production, and waste degradation, (UNEP, 2024). Furthermore, the leak from the circular economy

model identified in our study primarily consist of household bulky items (furniture, white goods, and e-waste) that escape formal collection systems and enter uncontrolled disposal routes. While precise quantities are unknown, bulky items are consistently reported as the most common materials in fly-tipping incidents across Scotland, followed by mixed bags of household waste then construction and demolition debris, (Scottish Government, 2023b). National estimates suggest that fly-tipping accounts for approximately 26,000 tonnes of waste annually, highlighting the potential scale of resource loss when bulky items are diverted from reuse or recycling pathways, (Scottish Government, 2023a; Zero Waste Scotland, 2017). Once dumped, these items are typically damaged and sent to landfill, eliminating any opportunity for recovery and increasing greenhouse gas emissions from decomposition, (Curran et al., 2007; Liu et al., 2017). Beyond environmental harm, the leak from the circular economy model imposes substantial economic costs, with clearance alone estimated at £8.9–12.7 million annually, (Scottish Government, 2023a, 2023b; Zero Waste Scotland, 2017). Addressing this leak of household bulky items is therefore critical to maintaining circular economy integrity and achieving climate and resource efficiency goals.

Scotland has pursued ambitious zero waste plans for over a decade, including the rollout of segregated kerbside recycling in 2012, (Griffiths et al., 2013). Zero waste strategies aim to reduce, reuse, and recycle all municipal waste streams in alignment with circular economy principles, (Scottish Government, 2020b; Zero Waste Scotland, 2024a). The Circular Economy (Scotland) Bill 2024 strengthens this framework by mandating a national strategy and introducing enhanced enforcement measures, such as increased fines and vehicle seizure powers for fly-tipping offences, (NetRegs, 2024). These developments reflect Scotland's commitments to climate action and emphasise the importance of addressing disposal routes for household bulky items as a waste stream frequently found in fly-tipping incidents, (Scottish Government, 2023b). Bulky items, including furniture, white goods, and e-waste, pose unique challenges due to their size, material complexity, and incompatibility with standard collection systems, (Hodsman and Williams, 2011; Keske et al., 2018). Their improper disposal not only contributes to environmental degradation but also incurs significant economic costs (Liu et al., 2017). As Scotland advances its circular economy ambitions, ensuring that bulky items are diverted from illegal disposal and integrated into circular reuse or recycling pathways is essential to reducing waste and supporting climate goals. Diverting bulky items from illegal disposal and integrating them into reuse or recycling systems prevents the loss of recoverable products and materials, avoiding emissions from landfill, reinforcing the link between waste management and climate action, (Curran et al., 2007; Scottish Government, 2024).

1.2 Economic and environmental impacts of fly-tipping

Fly-tipping is prohibited under section 33 (1) of the Environmental Protection Act 1990, (Murdo, 2022). Despite this, Scotland records between 60,000 and 66,000 fly-tipping incidents annually with estimated clear up costs of between £8.9m to £12.7m, (Scottish Government, 2023a, 2023b; Zero Waste Scotland, 2017). These figures likely underestimate the true cost, as incidents on private land are not systematically recorded and data collection by local authorities can be inconsistent, (Dixon et al., 2022; Scottish Government, 2023a). When indirect costs are included, albeit aggregated with littering costs, the total economic burden rises to an estimated £280.8million annually, (Scottish Government, 2023b). This represents a significant strain on public finances and taxpayers, (Webb et al., 2006; McNeill et al., 2021), especially in the context of an ongoing cost-of-living crisis, (Scottish Affairs Committee, 2024). These financial pressures underscore the importance of understanding the factors that influence uptake of legitimate waste services and how improved facilitation could reduce both economic and environmental impacts.

Beyond its financial burden, fly-tipping poses serious environmental and public health risks. The waste management sector contributes 4% of Scotland's greenhouse gas (GHG) emissions, making sustainable resource use essential to meeting climate targets, (Scottish Government, 2024). Fly-tipping is a serious source of pollution as the materials can contain substances that are destructive to land, the habitats of wildlife and human health, (Liu et al., 2017; Purdy et al., 2022; Song et al., 2023). Pollutants leaching from fly-tipping sites can contaminate soil and freshwater sources damaging fragile ecosystems, (UNEP, 2024). When dumped in or near our waterways, this can contaminate water sources or create flood risks by blocking rivers, (Purdy et al., 2022). Even after removal, items damaged by the illegitimate dumping process will always be destined for landfill or recovery despite any pre-dumping potential for reuse or recycling, (Curran et al., 2007). These outcomes undermine Scotland's circular potential and highlight the need for scrutiny of disposal routes, (Cook and Velis, 2021). Accordingly, our study analyses website disclosures from Scottish Local Authorities (SLA) concerning kerbside collection services for household bulky items given their prevalence in fly-tipping incidents across Scotland.

1.3 Scottish local authorities waste management services for household bulky items

Waste management in Scotland is delivered by thirty-two local authorities, commonly known as councils, responsible for providing multiple public services to the communities they serve. Household bulky items have two local authority disposal routes. There are dedicated facilities called Household Waste Recycling Centres (HWRCs) in every region where residents can transport their items for free, and there are chargeable kerbside collection services where residents can have bulky items picked up in proximity to their property. There are also other informal bulky item disposal routes which include to sell or donate. However, this study focuses upon formal disposal routes, specifically the kerbside collection service due to logistical challenges many residents face transporting bulky items. Bulky items form a discrete waste stream with significant

implications for circular economy outcomes, (Scottish Government, 2016). However, their importance is often obscured by broader recycling targets and limitations in waste composition data, (Chung et al., 2010). Our study is the first known analysis of SLA household bulky item kerbside collection services. By examining service design and accessibility, we aim to identify opportunities to reduce fly-tipping and offer insights for policymakers in Scotland and other regions facing similar challenges.

2. METHODS

2.1 Setting and study design

Scotland is one of four countries within the United Kingdom. It shares a border with England and has over eight hundred islands, with an approximate population of 5.48 million, (Statista, 2024a). Some of the largest areas have the smallest population densities, (Scottish Government, 2023b). The country's diverse geography and population density result in regional variations in waste management practises. To account for these differences, this study uses the Rural & Environment Science & Analytical Services (RESAS) classification system, which categorises regions as urban city, urban with significant rural, rural, and highland and island (Scottish Government, 2018). This framework supports context-specific analysis of service provision and resident needs. To complement this, we used Scotland's census data on property types, and multiple deprivation using the national index to explore how these factors affect the capacity to store bulky items and influence disposal behaviours.

2.2 Data extraction

Website disclosures on SLA kerbside bulky item collections, known as and referred to hereafter as bulky uplifts, were accessed and analysed to consider the resident-facing process for service provision. Data was extracted from the websites of all 32 SLA. Data collection occurred in two phases: February to March 2024 and April to May 2024, with accuracy checks in September 2024 and March 2025. This allowed for two consecutive financial years to be incorporated into the analysis exploring temporal variations. The database compiled includes service details such as booking methods, accepted items, charges, payment options, and waiting times, alongside data on population density, deprivation levels, and property types.

2.3 Standardised charge benchmarking

To compare service costs across SLA, a standardised charge (£/item) was calculated based on a 'maximum utility' assumption. Maximum utility entails residents storing items until they have the maximum number of items collected per uplift arranged, (Curran et al., 2007). Several SLA with non-comparable pricing structures were excluded. While this approach simplifies complex pricing models, it provides a useful benchmark for understanding cost variation.

2.4 Smartphone app availability

Smartphone app availability was assessed by searching Apple and Android app stores in April 2024, with follow-up checks in August 2024 and March 2025. The analysis considered whether SLA offered apps, their functionality, developer details disclosed, and whether they supported bulky item bookings or fly-tipping reporting features.

2.5 Literature review contextualisation

A literature review was conducted using Scopus and Google Scholar to identify research on household bulky waste and fly-tipping. Three search strings were used:

- "household" AND "bulky" AND ("items" OR "waste");
- ("kerbside" OR "curbside") AND "bulky" AND "collection";
- "illegal dumping" AND "household" AND ("bulky" AND "items" OR "waste").

The review included peer-reviewed and grey literature to ensure broad coverage with articles from several databases: Emerald, Elsevier, JSTOR, Sage, SciFlo, SciSpace, Taylor and Francis, and Wiley. While current literature is important to frame the issue within contemporary thinking, applying a date range arbitrarily was not considered appropriate for this study. A flow diagram provided in Figure 2 illustrates the screening and inclusion process.

The review conducted was systematic in approach however, it does not meet strict criteria for a formal Systematic Literature Review (SLR) due to the inclusion of non-academic sources. While not presented as a standalone section, insights from this review informed the framing of the research and are referenced throughout the results and discussion.

3. RESULTS AND DISCUSSION

3.1 Scottish local authority bulky uplifts

Bulky uplifts are a separate service from regular kerbside collections and must be booked by contacting the local authority. Despite online assertions about free uplifts available, (Zero Waste Scotland, 2021), this is a service which is charged for by all but one of the SLA. This could be quite provocative or frustrating for residents who access a local authority website and find that free bulky uplifts are not available in their region. Especially when we consider that charges are in addition to council tax that residents already pay for other waste services, (Curran et al., 2006; McNeill et al., 2021). Failure to capture reusable bulky items within controlled systems not only undermines circular economy goals but also increases emissions associated with landfill and replacement production, (Curran et al., 2007; UNEP, 2024). Evidence from other regions demonstrates that the barriers identified in Scotland are not unique. In England, research found that charges for bulky uplifts and limited booking options reduced service uptake and increased the risk of fly-tipping, (Curran et al., 2006; Hodsman & Williams, 2011). Studies in Australia and Canada reported similar patterns, with seasonal free collection schemes improving compliance and reducing illegal dumping, (Comerford et al., 2018; Keske et al., 2018). In Denmark, monthly kerbside collections in urban areas were associated with higher reuse potential, while rural regions continued to face logistical challenges, (Larsen et al., 2012). These findings align

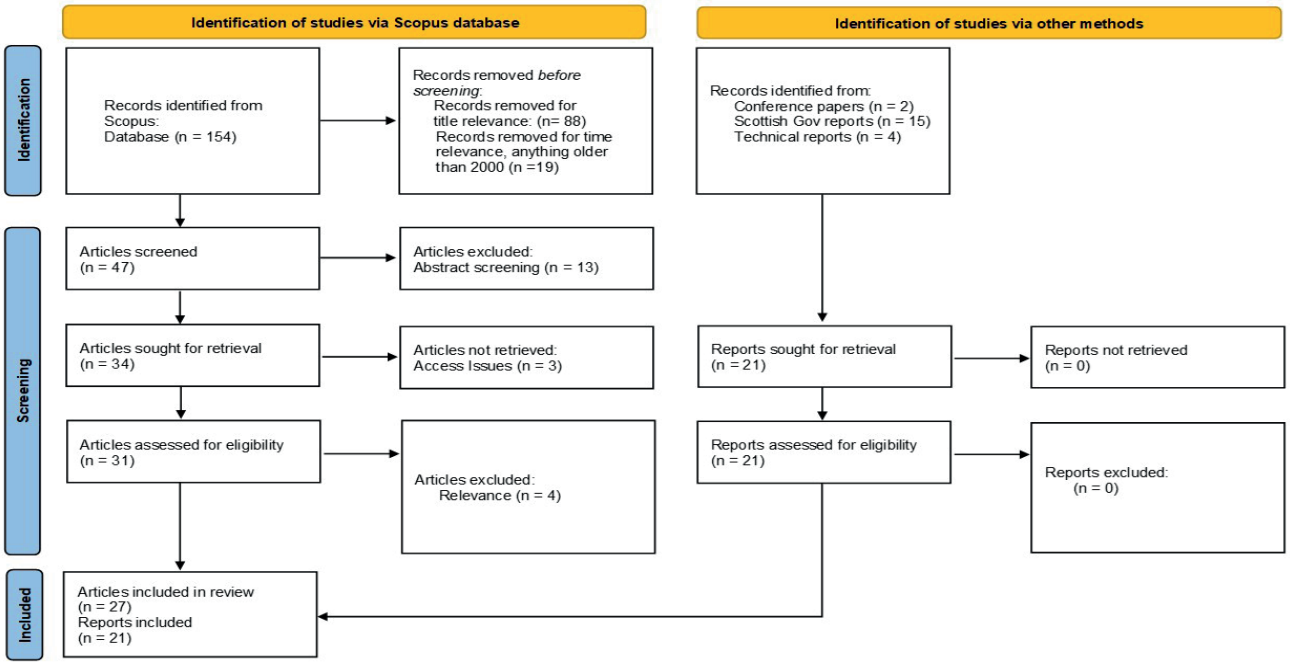

FIGURE 2: Systematised literature review flow diagram.

with our results, indicating that service design, affordability, and communication are critical determinants of legal disposal behaviour across diverse contexts. Addressing these factors through inclusive policy development is therefore essential to mitigate systemic leaks from the circular economy model. Figure 3 provides our resident facing service cycle for SLA bulky uplifts.

The service cycle provided has been used to systematically analyse SLA website disclosures for the points of contact identified. The analysis of SLA website disclosures leads to a better understanding of the resident-facing process for services and captures the underlying factors that require consideration for facilitation of bulky uplifts. Household bulky items are the most frequently encountered materials in fly-tipping incidents in Scotland, (Scottish Government, 2023b). The issue of household bulky items in fly-tipping incidents is not just a UK phenomenon, it has been observed as a source of fly-tipping or associated with

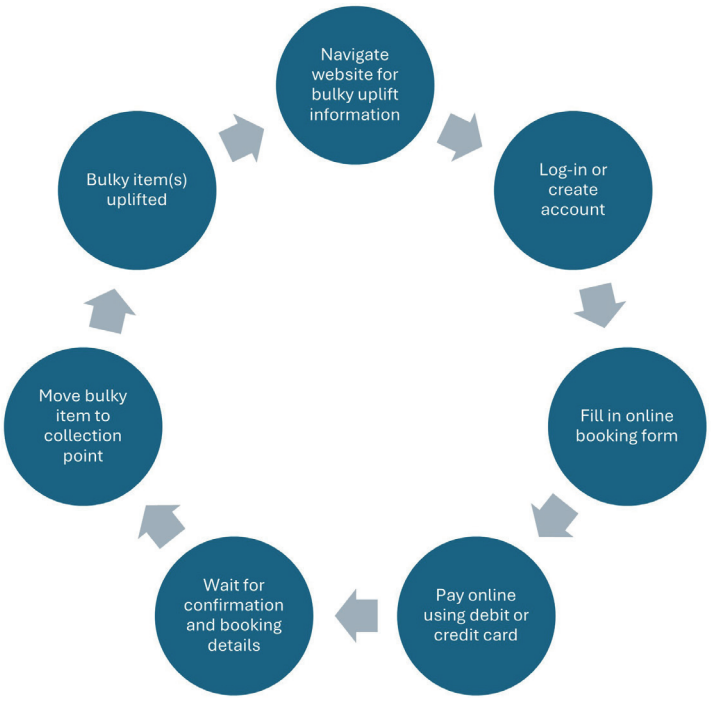

FIGURE 3: Service cycle for bulky uplifts provided by Scottish local authorities.

problematic disposal routes worldwide, (Comerford et al., 2018; Guérin et al., 2018; Hodsman and Williams, 2011; Ito and Colombo, 2019; Song et al., 2023; Vimpolšek et al., 2022). Our study analysed the resident facing process for bulky uplifts by examining SLA website disclosures. It must be acknowledged that the insights generated from our analysis of the SLA websites were critical assessment rather than formally derived opinions and perspectives of residents across Scotland.

3.2 Scottish local authority website navigation

Website navigation is a critical component of service accessibility. All SLA websites include a 'bins and recycling' tab on their homepage, yet locating specific information on bulky uplifts often requires navigation of multiple other pages. When considering bulky uplifts, charges, accepted items, and the process for both booking and receiving the service will be of key interest to residents. The layered structure of website pages could hinder service uptake, particularly for residents with limited digital fluency, (Purdy et al., 2022). Transparent communication is essential to facilitate informed decision-making around waste disposal, (Curran et al., 2006). The information provided on SLA websites should be transparent concerning service processes and provide residents further options for bulky items, such as reuse organisations and charities, (Curran and Williams, 2010; Cox et al., 2010; Zero Waste Scotland, 2024b). However, only 44% of SLA provide direct links to reuse organisations or charities, with a further 12% mentioning them without actionable guidance. This leaves a significant gap in the promotion of sustainable alternatives to end-of-life disposal for household bulky items. Given the diversity of resident preferences, SLA should consider expanding communication channels beyond websites. Options such as printed leaflets, social media, and smartphone apps could improve outreach and inclusivity, (Ito and Colombo, 2019).

3.3 Smartphone app availability across Scotland

Smartphone ownership in the UK reached 94% in 2024, (Statista, 2024b), positioning mobile platforms as a key channel for communicating public service delivery. Across Scotland, only 25% of SLA currently offer smartphone apps for public waste services information. These vary in functionality, with some supporting fly-tipping and other waste issue reporting, and others providing bins and recycling information. While no apps currently support bulky uplift bookings, this reflects the early stage of digital development in the sector and presents a timely opportunity for SLA to commit resources to a collaborative effort to define future app functionality. Our smartphone app search revealed that there are three apps which have been developed in-house by SLA, and one provided by an independent specialist company. In-house app development demonstrates initiative and SLA responsiveness to local needs. However, without coordination, this could result in fragmented systems for residents. A unified approach, led by a dedicated specialist, offers greater potential. Albion Environmental Ltd are a UK leading consultancy who specialise in waste management, environmental, health and safety solutions. As leading developers of a bins and recycling smartphone app, they are uniquely positioned to advance this effort. They provide a digital solution based on sector-specific expertise which is a foundation for scalable development. A single integrated platform could support user authentication, provide real-time updates when residents move between SLA regions, and offer consistent access to bin schedules, booking processes, and reuse options. Furthermore, such a system could be co-designed with SLA and residents to reflect local priorities and ensure inclusive service delivery nationwide.

Features such as image uploads, Apple/Android Pay integration, and notification features could enhance reuse potential while also generating valuable data to inform service improvements, (Wang et al., 2020; Salim et al., 2023). The booking process for bulky uplifts could be enabled with notifications and reminders of bookings. Features used in the gig-economy for estimated arrival times could be used by collection crews to provide further information to residents with bookings, (Purdy et al., 2022). Pro-active communications at key seasonal points, like Christmas and Spring sales, could facilitate reuse options for bulky items, (Alexander et al., 2009a; Keske et al., 2018), and notification features of smartphone apps could increase awareness of reuse opportunities for residents at these strategic moments. Furthermore, collaboration between SLA, reuse organisations, and charities could encourage diversion of reusable bulky items from SLA services simultaneously increasing environmental and social benefits, (Alexander and Smaje, 2008; Cox et al., 2010; Curran and Williams, 2010; Zero Waste Scotland, 2024b). Investment in a national digital solution would support Scotland's circular economy ambitions by improving accessibility, communication, transparency, and resident engagement. SLA should consider collaborative development of a smartphone app for public services using the sector-specific expertise available to ensure equitable service provision, avoid duplication of effort, and to conserve scare financial resources. However, reliance on digital solutions must also be balanced with other communication methods such as regular leaflets to account for the preferences of diverse populations, (Ito and Colombo, 2019). The key objective is to facilitate sustainable behaviour through provision of information using methods of communication that reflect the diverse needs of residents, designed in collaboration with experts in the industry and experts in lived experience.

3.4 Booking methods for bulky uplifts

Booking methods for bulky uplift services vary across SLA, with notable spatial and temporal differences. While online booking is the most common method, some SLA also offer phone, email, postal, or in-person options. Over the two financial periods analysed (2023-24 and 2024-25), several SLA expanded their booking channels, while others reduced them potentially limiting accessibility for residents. Figure 4 illustrates the booking methods available over the periods assessed.

The figure provides an overview of all SLA booking methods, however the spatial variations suggest that urban SLA predominantly rely on online-only booking, whereas rural, highland, and island regions tend to offer more

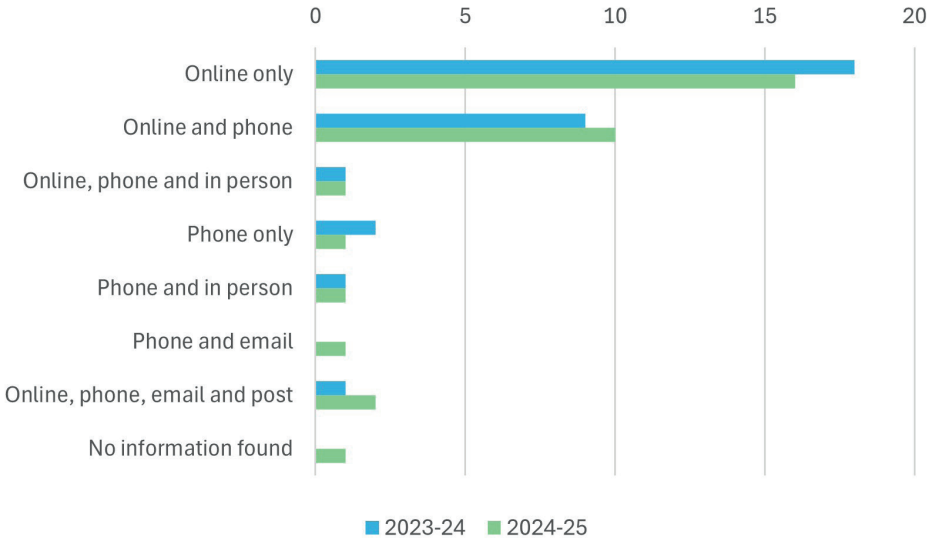

FIGURE 4: Overview of booking methods for bulky uplifts provided by Scottish local authorities over the periods 2023-24 and 2024-25.

varied options. However, one SLA removed in-person booking entirely, and another provided no booking information during the second period. These inconsistencies may create confusion and deter service uptake, particularly among residents who prefer or require non-digital communication methods (Ito and Colombo, 2019; Purdy et al., 2022). To improve accessibility and align with circular economy goals, SLA should offer a variety of booking options that reflect resident preferences. Integrating booking functionality into a unified smartphone app which could be co-designed with SLA and residents, would streamline the process, support authentication, and enable reuse assessment through image uploads (Wang et al., 2020). This would reduce barriers to service use and support legitimate disposal routes for bulky items.

3.5 Charges for bulky uplifts

Charges for bulky uplift services vary significantly across SLA, with most applying a minimum charge based on item volume; 75% increasing to 78% over the periods observed. While one SLA offers the service free of charge to all residents, the remaining authorities apply a range of pricing structures, including minimum charges, itemised lists, time-based charges, and blended models. These differences can be confusing for residents, especially when items like a three-piece suite are counted as multiple units for collection, (Purdy et al., 2022). Furthermore, residents may be unwilling to pay for services, (Alexander et al., 2009a). Resident perceptions in similar contexts have been that charges in addition to existing payments for regular waste management services are unreasonable, (Cox et al., 2010; Curran et al., 2006). The impact of charges is the decrease of demand for the service, not the decrease in need for the service, (Curran et al., 2006; Hodsman and Williams, 2011; Purdy et al., 2022). To enable comparison, a standardised charge (£/item) was calculated using a 'maximum utility' assumption, where residents will store items until the maximum number of items allowed per uplift is reached, (Curran et al., 2007). Table 1 presents the spatial and temporal variation in both minimum and standardised charges across four SLA classifications: urban cities, urban with significant rural, rural, and highland and island regions.

Table 1 shows that charges increased in most regions between 2023-24 and 2024-25, with rural and island communities consistently facing higher costs. This 'rural premium' reflects the logistical challenges of servicing large, sparsely populated areas, (Curran et al., 2006; Óskarsson et al., 2022). However, rising costs may discourage legal disposal and increase the risk of fly-tipping, particularly in areas with high deprivation, (Curran et al., 2006). SLA should exercise caution when adjusting charges and consider the broader implications for service uptake. Progressive pricing policies, such as free or discounted uplifts for low-income households, could reduce fly-tipping and support circular economy goals, (Tilley, 2020). This has been observed in countries where the fly-tipping of household waste has never been a major policy issue, (Ichinose, Yamamoto and Yoshida, 2013). To ensure equitable access to bulky uplift services, SLA should consider whether free bulky uplifts for all residents would mitigate fly-tipping

TABLE 1: Spatial and temporal variation of minimum charge and standardised charges (£/item) for Scottish local authority bulky uplifts for the periods 2023-24 and 2024-25.

	Urban cities		Urban with significant rural		Rural		Highland & island	
	2023-24	2024-25	2023-24	2024-25	2023-24	2024-25	2023-24	2024-25
Minimum charge	£17.25	£20.50	£33.40	£36.75	£30.90	£32.31	£39.50	£42.30
Standard charge	£5.58	£6.33	£5.21	£6.12	£7.89	£7.81	£7.57	£8.03

costs sufficiently to be viable. Even a free seasonal service can assist with waste reduction strategies and prove popular with residents, (Brosius et al., 2013; Comerford et al., 2018; Keske et al., 2018). If a universal free service cannot be justified, SLA should, at a minimum, ensure that pricing strategies account for both regional disparities and household income levels. This includes targeted discounts and benefits for residents facing financial hardship, particularly in areas with high deprivation. Such measures would support legitimate disposal behaviours and reduce the risk of fly-tipping, while aligning with Scotland's circular economy ambitions.

3.6 Discounts and free uplifts provided by Scottish local authorities

The availability of discounts or free bulky uplift services varies significantly across SLA, with notable spatial and temporal differences. Analysis of website disclosures from 2023-24 and 2024-25 revealed that most SLA do not offer financial support for residents on income-related benefits or in council housing. This is particularly concerning given the high levels of deprivation in many regions. According to the Scottish Index of Multiple Deprivation (SIMD), urban cities show deprivation levels ranging from 10.2% to 45.4%, while urban with significant rural areas range from 3.8% to 44.7%. Rural regions range from 2.6% to 31.3%, and highland and island communities from 0% to 10.4%, (Scottish Government, 2020a). These figures highlight the need for targeted support in areas where residents may face financial barriers to accessing legitimate disposal routes. Figure 5 illustrates the spatial and temporal variation of the availability of discounts or free bulky uplifts provided by SLA over the periods analysed.

As shown in Figure 5, urban SLA with higher deprivation levels consistently offered no discounts or free uplifts across both periods. In urban with significant rural regions, one SLA introduced a progressive policy offering free bulky uplifts to all residents, while another revoked a previously available set number of free uplifts. Rural SLA showed limited support, with only two offering targeted discounts or free uplifts. Highland and island SLA were similarly restrictive, with just one providing a discount for benefits recipients. These findings highlight a lack of consistency and equity in service provision. SLA serving areas with higher deprivation should prioritise inclusive discount and free uplift policies to ensure that financial barriers do not prevent residents from accessing legitimate disposal routes. Free or discounted bulky uplift services for low-income households could reduce fly-tipping, support circular economy goals, and promote social equity, (Curran et al., 2006; Hodsman and Williams, 2011; Purdy et al., 2022). To support transparency and uptake, SLA should clearly communicate eligibility criteria and integrate discount options into booking and payment systems. This offers further support for use of a smartphone app as a unified digital platform which could streamline these processes, ensuring that residents are aware of available support and can access services without unnecessary complexity.

3.7 Payment methods for bulky uplifts

Payment methods for bulky uplift services are inconsistently disclosed across SLA websites. Analysis from 2023-24 and 2024-25 shows that most SLA do not specify accepted payment options, with 22 out of 32 failing to provide this information in the latter period. This lack of transparency may deter residents from using the service, particularly those who rely on cash or alternative payment methods. In Scotland, cash remains more commonly used than in other parts of the UK, (UK Parliament, 2022), and digital exclusion continues to affect vulnerable groups. Restricting payment to debit or credit card alone may unintentionally exclude residents who do not have access to online banking or who prefer in-person transactions. This is especially concerning in the context of a cost-of-living crisis, where financial flexibility is crucial, (Scottish Affairs Committee, 2024). To improve accessibility and uptake, SLA should clearly communicate available payment options and consider offering a range of methods, including cash, PayPal, and mobile payment systems such as Android/Apple Pay and Google Pay. Integration of payment functionality into a unified smartphone app could further streamline the process, allowing residents to complete bookings and

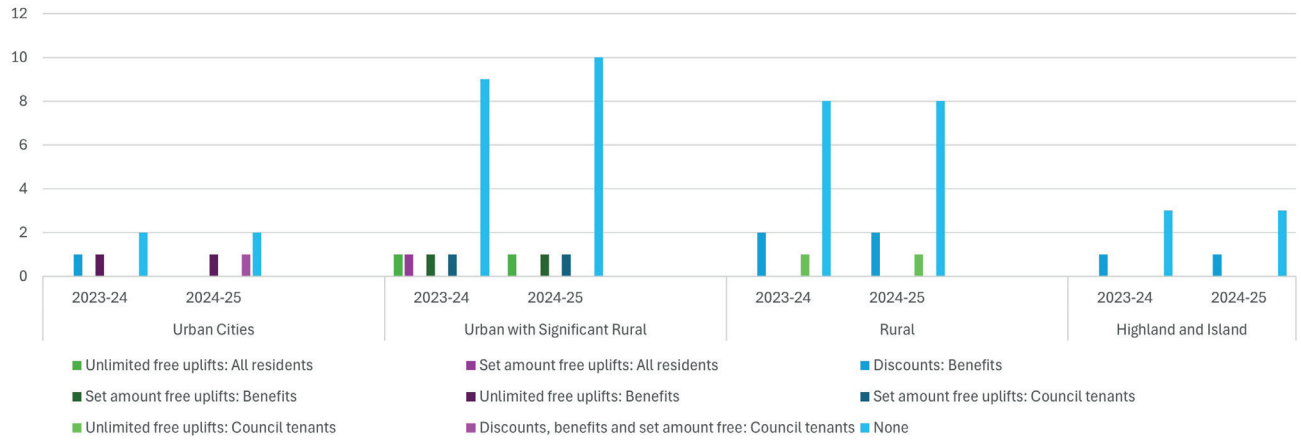

FIGURE 5: Spatial and temporal variation of the availability of discounts or free bulky uplifts provided by Scottish local authorities over the periods 2023-24 and 2024-25.

payments in one place. Inclusive payment design is essential to ensure that all residents can engage with bulky uplift services regardless of digital access or financial circumstances. Transparent and flexible payment systems would support equitable service provision and reduce barriers to legitimate disposal routes.

3.8 Waiting times for bulky uplifts

Waiting times for bulky uplift services are inconsistently disclosed across SLA websites. Analysis from 2023-24 and 2024-25 shows that 75% of SLA did not provide a clear timeframe for service delivery. Where timeframes were specified, they ranged from within 7 days to up to 28 days, with longer durations more common in highland and island regions as illustrated in Figure 6.

Waiting times can be a source of dissatisfaction for residents, (Curran et al., 2007; Hodsman and Williams, 2011). Uncertainty around waiting times may discourage residents from using legitimate disposal routes, particularly when alternative, informal options legitimate or otherwise offer faster collection, (Purdy et al., 2022). This is especially problematic for residents with limited storage space, such as those in flats or temporary accommodation, who may struggle to retain bulky items for extended periods (Alexander et al., 2009b). Clear communication of expected waiting times is essential to support service uptake and reduce the risk of fly-tipping. SLA should consider publishing standardised timeframes and offering real-time updates through digital platforms. Integration of booking and scheduling into a unified smartphone app could allow residents to receive notifications, estimated arrival times, and reminders which would mirror similar features used in the gig economy, (Purdy et al., 2022). Improved transparency around waiting times would enhance resident certainty, support planning, and contribute to more efficient service delivery. It would also help preserve the reuse potential of items by reducing the likelihood of damage during prolonged outdoor storage.

3.9 Collection point for bulky uplifts

All SLA require residents to place bulky items outside at their usual kerbside collection point. While this standardised approach simplifies logistics, it presents challenges for residents who may struggle to move large items safely, particularly older residents or those with mobility issues, (Curran et al., 2006; Hodsman and Williams, 2011; Purdy et al., 2022). Outdoor placement also risks damage to items from weather exposure or vandalism, which can compromise their reuse potential. Once damaged, items are typically diverted to landfill or recovery, even if they were originally suitable for reuse, (Alexander et al., 2009a; Curran et al., 2007). This undermines circular economy goals and increases the environmental impact. Charities and reuse organisations often collect items from inside homes, preserving their condition and extending their life cycle, (Hodsman and Williams, 2011; Wilkinson and Williams, 2020). SLA could adopt similar practises by training collection crews to safely retrieve items from within properties, particularly for vulnerable residents. This would improve accessibility, reduce health and safety risks, and support reuse outcomes.

In multiple household buildings, shared waste areas and limited storage space within individual properties further complicates bulky item disposal. Collaboration between SLA, housing associations, and landlords could help establish appropriate collection points and bespoke procedures for property types and resident needs, (Bernstad et al., 2012; Larsen et al., 2012; Ordoñez et al., 2015). Revisiting collection point policies with a focus on inclusivity and reuse potential could enhance service uptake and reduce fly-tipping. A flexible, resident-centred approach would better align with Scotland's circular economy ambitions and support equitable bulky waste management.

3.10 Spatial variation of property types across Scotland

Property type plays a significant role in shaping bulky waste disposal behaviours and service accessibility. Data

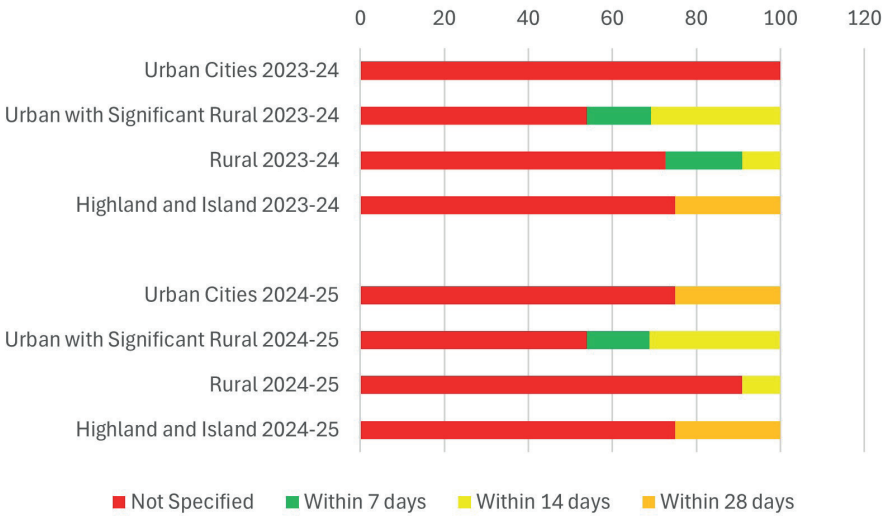

FIGURE 6: Spatial and temporal variation of waiting time disclosed for bulky uplifts by Scottish local authorities over the periods 2023-24 and 2024-25.

from Scotland's Census (2022) reveals distinct spatial patterns across SLA classifications. Urban cities and urban with significant rural regions have high population density and the greatest proportion of multiple household buildings, with deprivation levels ranging from 3.8% to 45.4%. In contrast, rural, highland and island regions are characterised by lower population densities, higher proportions of detached homes, and lower deprivation levels ranging from 0% to 31.3% (Scottish Government, 2020a). Our findings concerning area size, population density, and property type distribution are illustrated in Table 2.

Residents in multiple household properties, more commonly known as flats, often face constraints in storing bulky items, particularly when waiting for uplift services. Shared waste areas and limited indoor space can increase the likelihood of informal disposal, especially when waiting times are long or collection points are impractical, (Alexander et al., 2009b; Purdy et al., 2022). However, in high-density urban areas, placing bulky items on pavements poses a significant risk to public health and safety, (Alexander et al., 2009a). Residents in detached homes may have greater storage capacity, allowing them to use a 'maximum utility' approach however, outdoor storage can compromise reuse potential, (Curran et al., 2006). These spatial differences underscore the need for tailored service design. SLA should consider property type when developing collection policies, booking systems, and communication strategies. Collaboration with residents, housing associations and landlords could help establish appropriate collection points and support residents in multiple household buildings, (Bernstad et al., 2012; Larsen et al., 2012; Ordoñez et al., 2015). A resident-centred approach that accounts for property type and spatial context would improve service accessibility, reduce fly-tipping, and support Scotland's circular economy ambitions.

4. CONCLUSIONS

Our study on SLA website disclosures for bulky uplifts revealed critical gaps in accessibility, communication, and transparency that are presented for consideration of policy makers and waste managers. As these websites are the primary source of information for residents, it is crucial that they are easy to navigate and provide enough knowledge to assist in decision making, (Alexander et al., 2009a; Curran et al., 2006; Purdy et al., 2022). Smartphone apps offer promising opportunities to streamline booking, payment, and item classification, potentially enhancing reuse and reducing waste, (Purdy et al., 2022; Salim et al., 2023; Wang et al., 2020). Moreover, a national digital solution provides a unique opportunity for SLA to use sector-specific expertise and collaboration to ensure effective communication of public services. However, reliance on digital methods must be balanced with inclusive access for all residents. Offering a variety of communication, booking, and payment methods could facilitate uptake of bulky items kerbside collection services.

Charging structures vary across SLA, with most applying a minimum charge based on item volume. Rural, highland, and island communities often facing a rural premium with higher charges, (Curran et al., 2006; Óskarsson et al., 2022). These disparities may discourage legal disposal and increase the risk of fly-tipping, ultimately raising public clean-up costs. While some progressive policies do exist, with one region providing the bulky uplift service free of charge to all residents, these remain limited. Over the periods observed, nominal increases to charges were made that were reflected in the increases in standardised charges (£/item) over most regions. Charge increases should be exercised with caution as increasing costs for residents could negatively influence the demand for bulky uplifts, though not necessarily the need for them, (Curran et al., 2006; Hodsman and Williams, 2011; Purdy et al., 2022). Our findings suggest that free bulky uplift services should be considered by SLA, especially given the considerable clearance costs for fly-tipping. Furthermore, discounted bulky uplift services for low-income households should be a minimum standard, especially in regions with high levels of deprivation, (Curran et al., 2006; Hodsman and Williams, 2011; Purdy et al., 2022). Other opportunities for SLA are seasonal free uplift schemes for all residents which could prove popular mirroring successful models used elsewhere, (Brosius et al., 2013; Comerford et al., 2018; Keske et al., 2018).

Operational factors also influence service uptake. Uncertainty around waiting times, kerbside collection point requirements, and limited collection support from collection crews may deter residents, (Curran et al., 2007; Hodsman and Williams, 2011). Providing clear timeframes and allowing trained crews to collect items from within homes could improve accessibility, reduce health and safety risks, and preserve the reuse value of items. Additionally, property type affects storage and disposal options with residents in multiple household properties facing greater constraints than those in detached homes, (Alexander et al., 2009b; Purdy et al., 2022). Collaborative approaches between SLA, communities, housing associations and landlords could help develop inclusive policies for bulky uplift services which match local needs and priorities, (Bernstad et al., 2012; Larsen et al., 2012; Ordoñez et al., 2015). Further research is required to assess public willingness to engage in such efforts as this remains uncertain.

TABLE 2: Spatial variation of area size, population density, and property types, modified from (Scotland Census, 2022).

SLA region classification	Area m²	Population density m²	Whole houses %	Flats %	Mobile structures %
Urban cities	65	6,183	42.65	57.27	0.08
Urban with significant rural	260	1,082	71.74	28.12	0.14
Rural	1,992	210	80.22	19.53	0.25
Highland & island	1,215	38	87.27	12.44	0.29

This is the first study to consider analysis of local authority bulky uplift services from publicly available information across Scotland. Our future research will focus on exploring resident perspectives concerning fly-tipping and bulky item disposal practices to validate these findings and develop inclusive local policies to inform service provision. Mitigating fly-tipping as a leak from the circular economy model can contribute to waste reduction and climate targets providing safer, cleaner communities and ensuring a safer end of engineered life for household bulky items. A limitation to our approach is reliance on website disclosures, which may not fully capture operational nuances such as informal practises, seasonal variations, or resident experiences. While the analysis provides valuable insights into service design and accessibility that could facilitate understanding of service design in other regions, future research incorporating direct stakeholder perspectives would strengthen understanding of service barriers and opportunities for improvement. Our insights offer a foundation for evidence-based policy development, supporting more inclusive, efficient, and sustainable household bulky waste services across Scotland. By reducing uncontrolled disposal and promoting reuse and recycling, local authorities can contribute directly to Scotland's net-zero ambitions and global climate commitments, (Scottish Government, 2024; UNEP, 2024). Insights from international studies confirm that the systemic barriers observed in Scotland mirror those found globally, underscoring the need for locally tailored yet globally informed solutions to advance circular economy objectives, (Comerford et al., 2018; Curran et al., 2006; Hodsman & Williams, 2011; Keske et al., 2018; Larsen et al., 2012). Mitigating the leak of household bulky items from the circular economy model by improving service accessibility and promoting reuse pathways is essential to preserve product and material value, reduce landfill dependency, and strengthen circular economy outcomes.

ACKNOWLEDGEMENTS

We would like to acknowledge the University of the West of Scotland Vice-Chancellor Studentship Scheme for providing the funding for the PhD project.

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