Supplementary Information for:

Improving Waste Separation in Public Spaces – A Field Study from Austrian Cities

Abbreviations

CL	*Contamination level*
CQ	*Collection quantity*
CR	*Capture rate*
GL	*Glass (collection fraction/ container)*
GLc	*Glass coloured (collection fraction/ container)*
GLw	*Glass white (collection fraction/ container)*
gl	*Glass waste*
LWP	*Lightweight packaging (collection fraction/ container)*
lwp	*Lightweight packaging waste*
MET	*Metal (collection fraction/ container)*
PAP	*Paper (collection fraction/ container)*
pap	*Paper waste*
PL	*Plastic (collection fraction/ container)*
PZ	*Pedestrian Zone (test location)*
rw	*Residual waste*
RWC	*Residual waste container (surrounding)*
S	*Subway square (test location)*
SC	*Separation container*
SCR	*Separate collection rate*
SM	*Supplementary material*
SS	*Separation station*
SSRWC	*Residual waste container at separation station*
TS	*Train station (test location)*
UC	*University campus (test location)*

1 Methods

1.1 Location analysis and field test setups

Each test site was examined and inspected prior to implementation to ensure that local factors were taken into account and to ensure an optimal test setup. An overview of the four test sites in Krems and Vienna is given in Table S1, and more details are given in the following chapters 1.1.1 - 1.1.4, including a brief description, information on the implementation, and possible discrepancies from the planned test setup (as described in the main article chapter 2.1).

Table S1 Overview of test locations

Code	**Name**	**City**	**No. of SS/ RWC**	**approx. catchment area (ha)**	**RWC density in catchment area (RWC/ ha)**	**Walking distance between RWCs and SS (m)**		
						Min	**Max**	**Average**
PZ	Pedestrian zone	Krems	1/6	0.19	32	10	135	83
TS	Train station square	Krems	1/13	0.35	37	7	38	23
S	Forecourt at subway station	Vienna	1/7	0.20	35	10	85	40
UC	Square at the business University Campus	Vienna	1/9	0.22	41	14	40	27
total			4/35	0.96				
Average total			**1/9**	**0.24**	**36**			**38**

1.1.1 Test location PZ- pedestrian zone in Krems

1.1.1.1 Location description

The pedestrian zone is a lively leisure and shopping street with typical old town flair, cobblestones, small shops and bars in the midst of Krems. It is frequented by residents and tourists alike and is located about five-minute walking distance from the train station square. It stretches for approx. 600m and has a small square at its midpoint (location of SS) with public toilets and seating. The car traffic is restricted. The street (Obere Landstraße) is lined with small shops, restaurants, bars and bakeries. Smaller alleys branching from the street lead to the town square, the church and other parts of the city.

Geographical coordinates: 48°24'40.3"N 15°36'02.1"E

1.1.1.2 Test setup

The test-set up in location PZ is shown in Figure S1 and the demarcation of the catchment area in Figure S2. The separation station (SS) was positioned at the small square in the midpoint of the shopping street (Täglicher Markt), in front of a passageway leading to a public toilet. Six containers were determined to lie within the catchment area. Along the shopping street cylindrical stainless-steel containers are used. At the square a "big belly" model (solar-powered with automatic compaction) was installed, which was retained as part of the SS. The new containers used at this location were 120 litre containers with round openings ("Kermit"), as no stainless-steel containers were available and the residents were already used to this type of container from a previous study conducted in Krems (see Gangl et al., 2022). At this location, the SS was only visible from one of the surrounding Residual waste containers (RWC) (no. 1). In the course of the intervention, the forwarding stickers have been affixed to both the front and top for optimal visibility.

1.1.2 Test location TS - train station square in Krems

1.1.2.1 Location description

The train station square extends directly in front of the train station building and features multiple parking spots and regular bus and car traffic. An Ice-cream shop, snack bars and a cafe surround the square. In the centre of the square, there is a waiting area furnished with wooden benches and a canopy for bus passengers on the one side and the taxi stand on the other side. The square is frequented by a mixed community of commuters, schoolchildren, tourists, residents and loitering taxi drivers.

Geographical coordinates: 48°24'34.1"N 15°36'16.0"E

1.1.2.2 Test setup

The test-set up in location TS is shown in Figure S3 and the demarcation of the catchment area in Figure S5. The SS was positioned in the middle under the canopy. Thirteen containers were determined to lie within the catchment zone. From most of the surrounding RWCs (5, 11, 12, 8, 9, 6. 14, 13) it is necessary to cross a street to reach the SS. The SS was only visible from part of the surrounding RWCs, depending on the traffic situation. The same black plastic resin containers (50 litres) which are installed across the station square were employed in the test setup. These are mostly equipped with a small ashtray at the opening. The forwarding stickers have been affixed to the front of the RWC containers.

1.1.2.3 Discrepancies

A separation container from the Austrian federal railways (ÖBB) is located directly at the entrance of the station building, which could neither be included nor removed in the course of the field test due to practical limitations (see yellow star in Figure S3 and Figure S4). However, this separation station is not in the direct vicinity of the SS and not in sight from most of the RWCs at the square. Moreover, it can be assumed that it is only approached by people entering or leaving the station building (platforms to the rear) and, therefore, has a limited impact on the field test. One RWC (no. 7) lying within the catchment area had to be excluded from the field test, as it was not suiTable for applying forwarding stickers (model: Big Belly Solar).

1.1.3 Test location S - forecourt of a subway station entrance in Vienna

1.1.3.1 Location description

Spittelau transfer station is an important junction for the U4, U6 and regional trains and is located in the 9. district. The forecourt in front of the station is free from car traffic, with the exception of occasional deliveries. To create a better quality of stay, the forecourt was redesigned in 2020. Seating furniture, shading elements and greened islands have been installed. Inside the entrance building and at the end of the accessing street there are snack bars, a bakery, a coffee shop and a tobacco shop. In the immediate vicinity, there are several amenities including a large university centre (Althanstraße), parking houses, nightclubs situated at the danube canal, a waste incineration plant, and the option to traverse the danube canal via a pedestrian bridge (Spittelauer Steg, in direction of container no.4). There is another smaller subway station entrance located along the accessing street leading away from the forecourt (direction of container no. 7). The community at the forecourt can be described as mixed, ranging from commuters, students, party-goers and passers-by.

Geographical coordinates: 48°14'06.7"N 16°21'30.5"E

1.1.3.2 Test setup
The test-set up in location S is shown in Figure S6 and the demarcation of the catchment area in Figure S7. Cylindrical metal containers (type "Abfallhai") of the same design as the existing RWCs, but slightly smaller (150 litres), were used to build the SS, which was positioned centrally on site (Note: the red and white markings affixed to the containers are a necessary measure required by the municipal department of road administration to improve visibility of obstacles in low light conditions and for visually impaired individuals). Seven containers were determined to be within the catchment area. The SS was visible from all surrounding RWCs, with the exception of RWC no. 6 and 2. The forwarding stickers have been affixed to both the front and top for optimal visibility.

1.1.3.3 Discrepancies
For practical reasons, the installation of the SS had to take place at an earlier date, which resulted in an extended first acclimatisation phase of 19 days (see chapter 1.2 time schedule).

1.1.4 Test location UC - square at the business university campus in Vienna

1.1.4.1 Location description
The Campus of Vienna's University of Economics and Business (approx. 22.000 students) with modern architecture is located centrally in the city (2. district). The selected square area is situated at the Welthandelsplatz in front of the entrance to its largest lecture hall (entrance between container 7 and 4). It comprises greened islands and large wooden benches, providing students and pedestrians with a place to rest. The square is mainly frequented by students but also by pedestrians. Between RWCs 6 and 8 there is an entrance to a supermarket that offers numerous take-away food options. Moreover, there are further restaurants and a mensa nearby. Directly adjacent to the campus area is Vienna's largest green area (Prater), as well as numerous sports facilities, an amusement park and exhibition halls.

Geographical coordinates: 48°12'44.4"N 16°24'36.8"E

1.1.4.2 Test setup
The test-set up in location UC is shown in Figure S8 and the demarcation of the catchment area in Figure S9. At the campus separate waste collection was already established, both inside the buildings as well as in the outdoor areas. As the chosen square area already had two SSs installed for the separate collection of residual waste, plastic packaging, metal packaging, glass (coloured and white separately), only modifications were necessary. To create a single, centralized SS that could act as the exclusive target station, one of the two SS was removed and the other was relocated to a more centralized spot. The SS had to be extended by a paper fraction which was provided by the university's facility management. As the separation station was already equipped with clear signage showing waste items as icons, this was not changed to the separation signage designed for field tests (see chapter 1.4). The SCs in place are designed as metal containers with colored roofing. The surrounding RWCs are futuristic stainless-steel models, most equipped with ashtrays. The forwarding stickers have been affixed to both the front and top for optimal visibility.

1.1.4.3 Discrepancies
The collection system at the university campus differs slightly from those at other test locations as glass is separated by colour and plastic and metal are still collected separately (despite nationwide standardisation in 2023). This system and separation station signage design were not adapted during the field test to prevent confusion due to inconsistencies with the rest of the recycling scheme on campus. During the waste audit the collection fractions were kept separate. For the later assessment, the fractions of plastic and metal waste were combined as a theoretical LWP fraction, as well as the

separately collected fractions of coloured and white glass, in order to be comparable with the other test setups. Unfortunately, the residual waste container's signage mistakenly displayed a coffee cup for takeout (actual target fraction: LWP), which went unnoticed.

Due to an unscheduled event at the university campus right after the intervention, involving the installation of a cocktail bar and increased gatherings and consumption of alcohol in the test area, the post audit had to be postponed to avoid disruptions and the acclimatization period was extended to seven weeks (see chapter 1.2 time schedule). Ten RWCs situated within the catchment area of the SS were originally included in the field test. The most distant RWC (No. 10) had to be excluded from the field test after the 5th day during baseline waste audit, as it was obstructed (due to the installation of the cocktail bar) and could not be emptied. The container was henceforth completely excluded from the field test and the sample mass of the first five days in RWC 10 (7.38 kg) was retrospectively subtracted from the sample mass. However, the container contents are included in the composition of the first four days, as all of the RWC containers were always combined into a single sample for sorting.

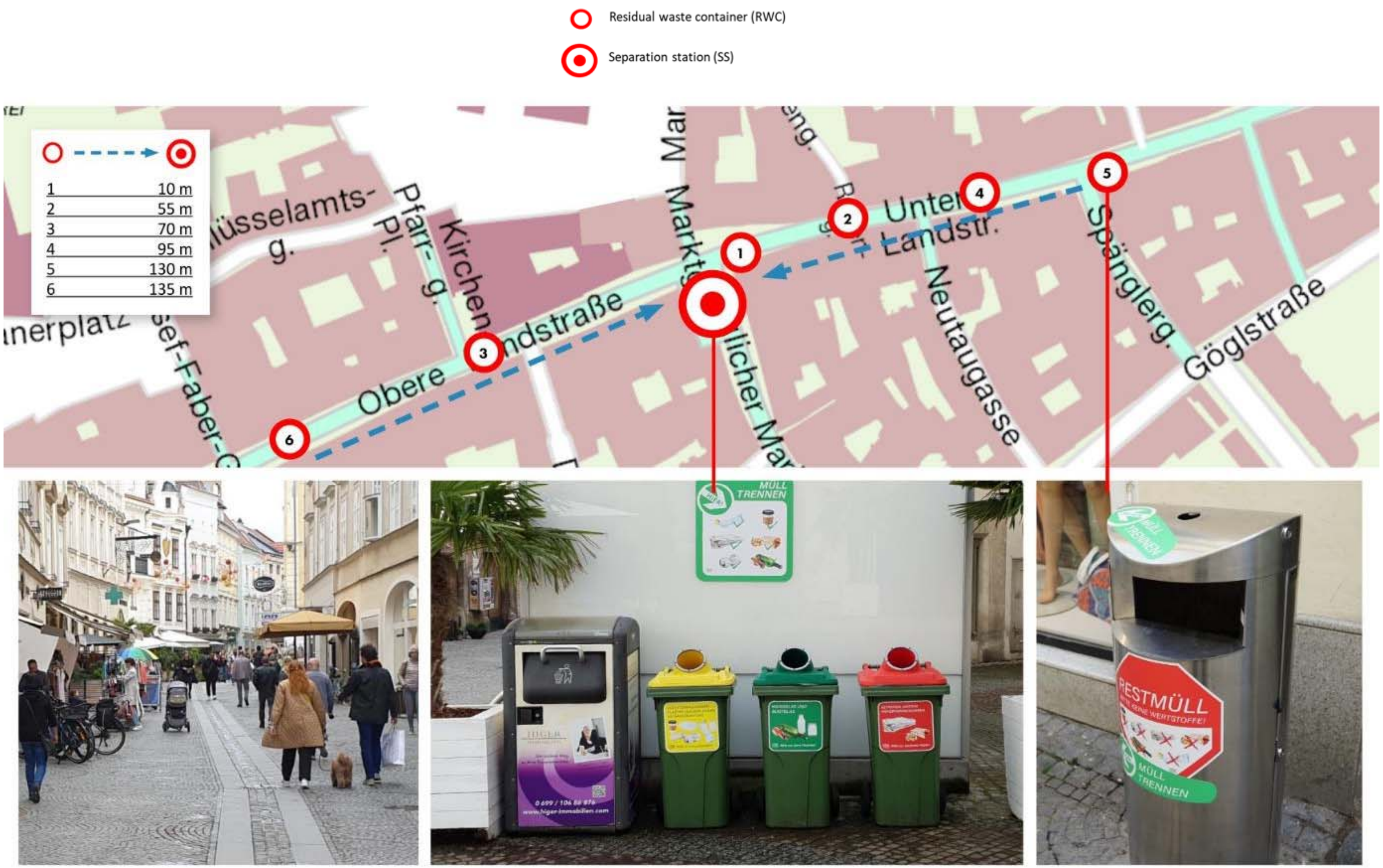

Figure S1 Test location pedestrian zone (PZ) in Krems

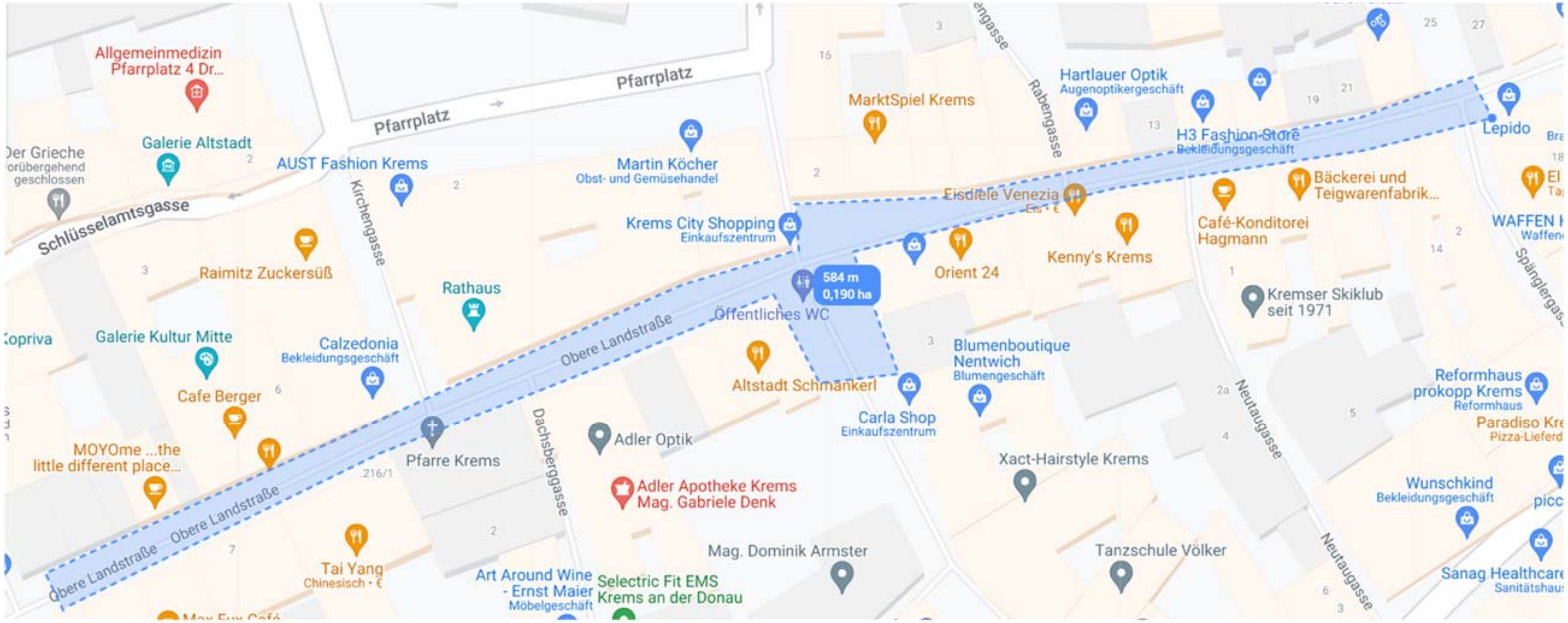

Figure S2 Approximate demarcation of catchment area at test location PZ (measured using Google My Maps)

Figure S3 Test location train station square (TS) in Krems

Figure S4 Separation container from federal railways (ÖBB

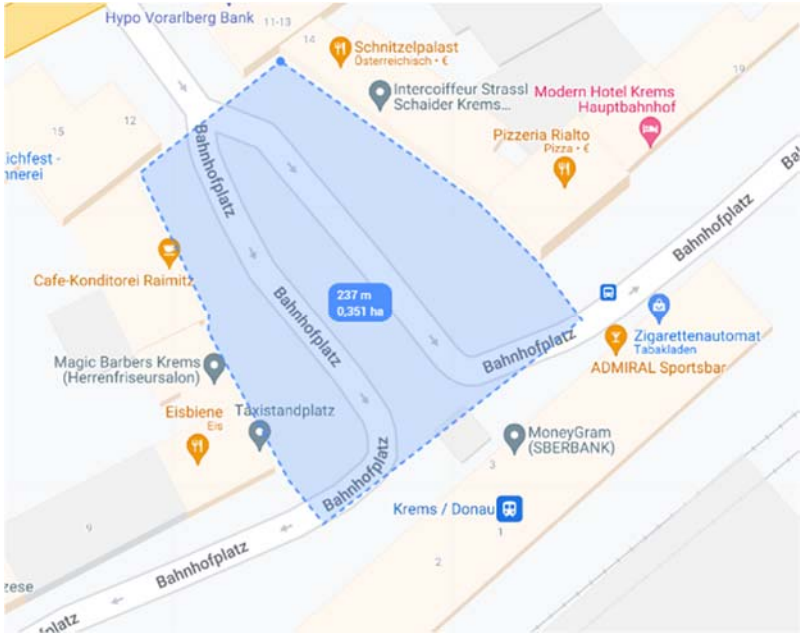

Figure S5 Approximate demarcation of catchment area at test location TS (measured using Google My Maps)

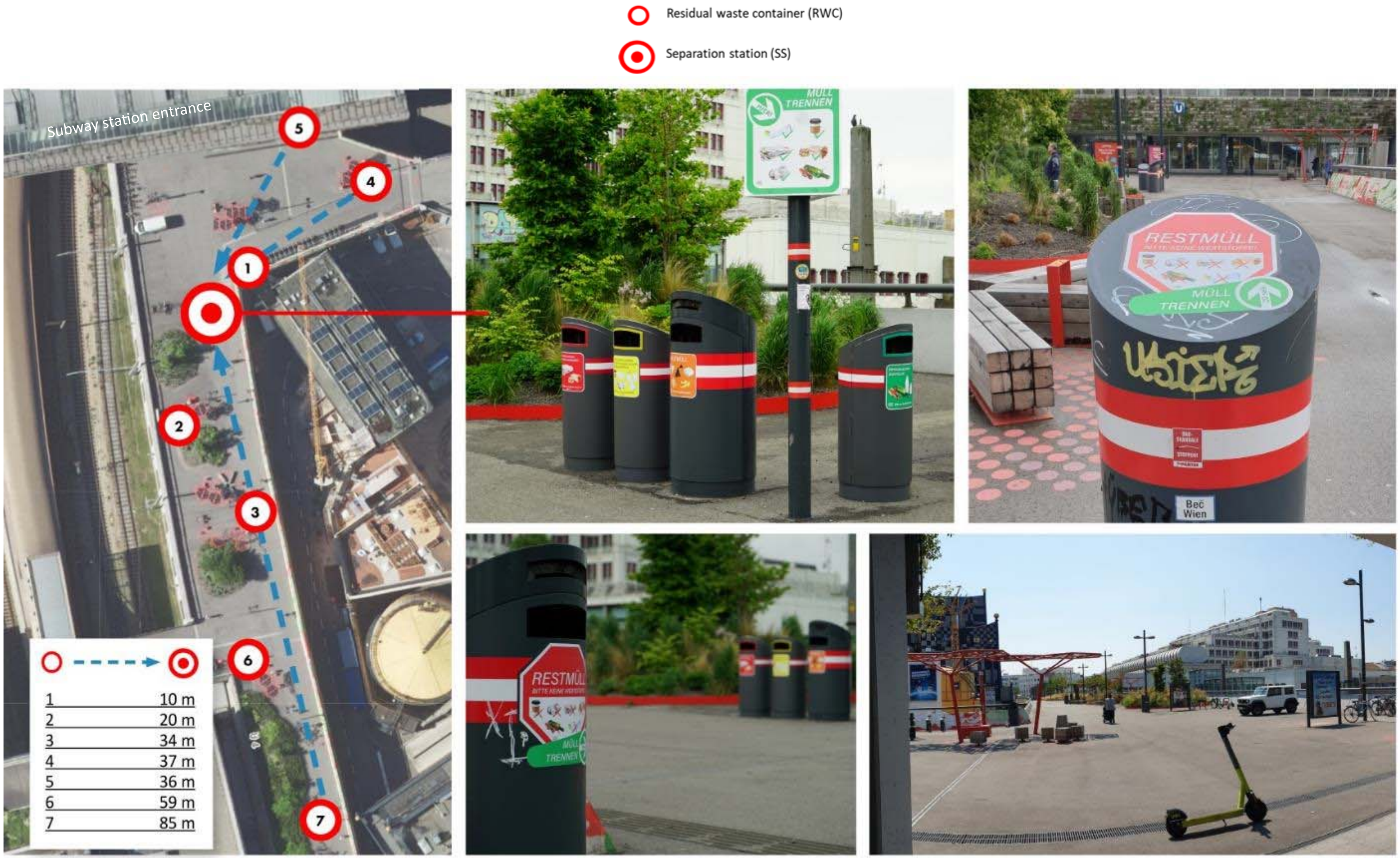

Figure S6 Test location forecourt at the subway station entrance (S) in Vienna

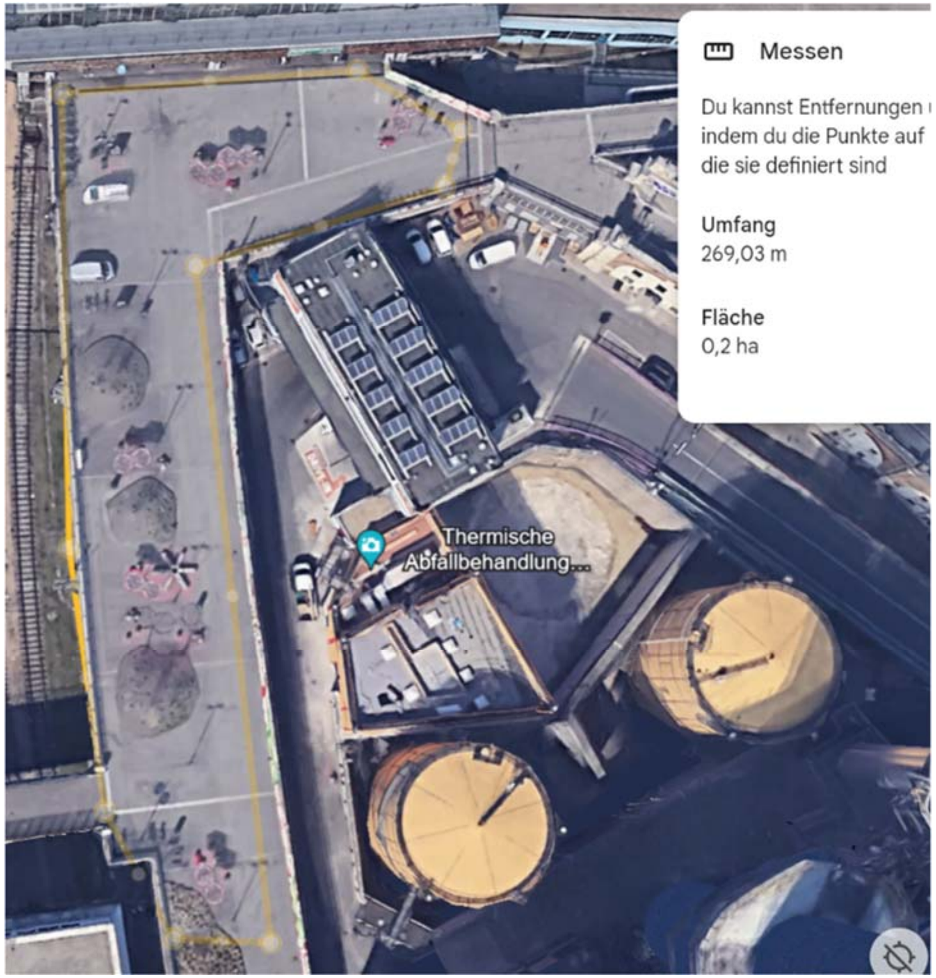

Figure S7 Approximate demarcation of catchment area at test location S (measured using Google Earth)

Figure S8 Test location at university campus (UC) in Vienna

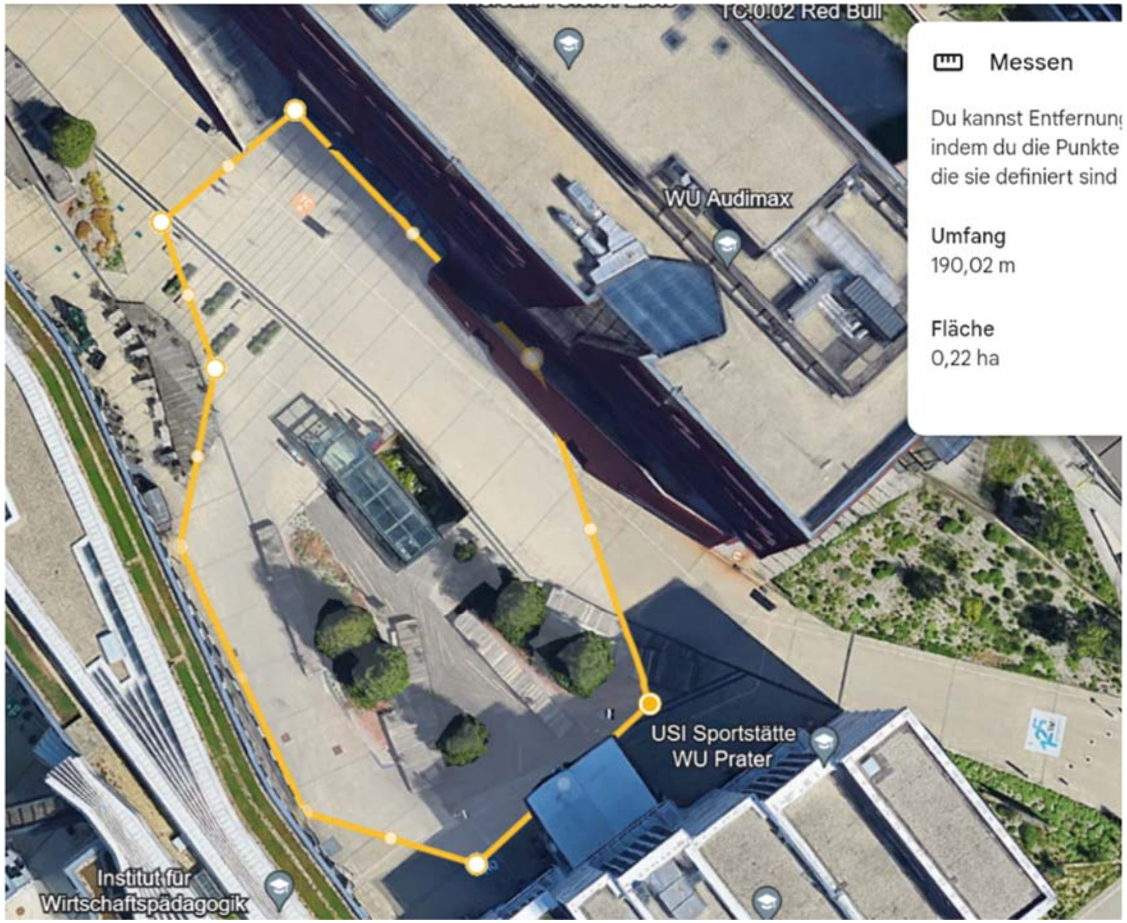

Figure S9 Approximate demarcation of catchment area at test location UC (measured using Google Earth)

1.2 Time schedule

When scheduling the field test, precautions were taken to avoid time periods in which factors influence waste quantity and separation quality to an unusual extent. For example, academic breaks, examination weeks, public holidays or public events taking place at the test-locations were avoided. In Table S2 the time schedule of the field test for each location is given.

Table S1 Time schedule of field tests

Test location	Installation/ Modification of central separation station (SS)	Acclimatization I	Baseline waste audit	Intervention	Acclimatization II	Post waste audit
PZ	13.04.	13.04. - 21.04. (9 days)	22.04. – 28.04 (7 days)	29.04.	29.04. – 05.05. (7 days)	06.05.- 12.05. (7 days)
TS	13.04.	13.04. - 21.04. (9 days)	22.04. – 28.04 (7 days)	29.04.	29.04. – 05.05. (7 days)	06.05.- 12.05. (7 days)
S	17.04.	17.04. – 05.05. (19 days)	06.05. – 12.05. (7 days)	13.05.	13.05. – 20.05. (8 days)	21.05. – 27.05. (7 days)
UC	14.04.	14.04. – 22.04. (9 days)	22.04. – 28.04. (7 days)	29.04.	29.04. – 16.06. (49 days)	17.06. – 23.06. (7 days)

1.3 Weather record

The weather can have a strong influence on waste generation and waste behaviour in public places. Tables S3 and S4 below show the weather records for the two cities of Krems and Vienna during the field test period. Overall, weather conditions during the audit weeks were fairly consistent, with average maximum temperatures of 17–23°C, minimum temperatures of 7–12°C, and *relatively low rainfall* (0.7–2.2 L/m³). An exception was the post-audit week at the university campus, held later in June, which experienced *slightly* warmer and sunnier weather (see Table *S3*).

Table S2 Weather record in Krems during field test

Krems					
Pedestrian zone (PZ) and Train station square (TS)	Date	Temp max.(C°)	Temp min.(C°)	Duration of sunshine (hours)	Precipitation (L/m³)
Baseline waste audit	22.04.2023	21	6	13	0
	23.04.2023	22	8	9	0
	24.04.2023	15	8	3	8
	25.04.2023	15	7	7	0
	26.04.2023	12	5	9	0
	27.04.2023	15	5	10	0
	28.04.2023	19	7	6	0.5
Average		**17.0**	**6.6**	**8.1**	**1.2**
Intervention	*29.04.2023*	*19*	*11*	*6*	*5*
Post waste audit	06.05.2023	21	12	6	0.6
	07.05.2023	19	8	11	0
	08.05.2023	16	8	8	0
	09.05.2023	18	5	11	0
	10.05.2023	19	8	5	0.3
	11.05.2023	19	13	6	0.2
	12.05.2023	12	10	2	14
Average		**17.7**	**9.1**	**7.0**	**2.2**

Table S3 Weather record in Vienna during field test

Vienna							
	Forecourt of a subway station (S)	University campus (UC)	Date	Temp max.(C°)	Temp min.(C°)	Duration of sunshine (hours)	Precipitation (L/m³)
		Baseline waste audit UC	22.04.2023	21	8	13	0
			23.04.2023	22	11	9	0
			24.04.2023	14	11	3	4
			25.04.2023	16	8	6	0.6
			26.04.2023	12	7	9	0.1
			27.04.2023	15	4	6	0
			28.04.2023	17	6	12	0.5
Average				**16.7**	**7.9**	**8.3**	**0.7**
		Intervention	*29.04.2023*	*17*	*12*	*5*	*7*
	Baseline waste audit S		06.05.2023	21	15	6	3
			07.05.2023	19	8	9	0
			08.05.2023	17	8	12	0
			09.05.2023	18	7	12	0
			10.05.2023	20	10	13	0
			11.05.2023	18	11	3	2
			12.05.2023	12	10	3	9
Average				**17.9**	**9.9**	**8.3**	**2.0**
	Intervention		*13.05.2023*	*13*	*10*	*3*	*1.8*
	Post waste audit S		21.05.2023	25	12	8	0
			22.05.2023	25	12	6	0
			23.05.2023	27	13	7	0.4
			24.05.2023	20	13	5	0
			25.05.2023	21	11	6	0
			26.05.2023	23	12	7	0
			27.05.2023	21	10	8	0
Average				**23.1**	**11.9**	**6.7**	**0.1**
		Post waste audit UC	17.06.2023	23	16	10	0
			18.06.2023	27	14	15	0
			19.06.2023	30	17	15	0
			20.06.2023	32	20	12	0
			21.06.2023	33	22	11	0.2
			22.06.2023	30	18	10	0
			23.06.2023	26	18	8	7
Average				**28.7**	**17.9**	**11.6**	**1.0**

1.4 Separation station signage

In the following Figures, S10 – S14, the separation station signage that was designed for the field tests and that was applied in the form of stickers on separation containers (SC) of the separation station (SS) are shown. The design focused on using established colour coding for Austrian waste types and displaying waste items that are frequently found in public spaces. The illustrations were chosen in photographic style as these are often preferred over icons (Gangl et al., 2022; YaHan, 2020) and were based upon frequent public waste found in prior waste analysis (Kladnik et. al 2024). Wu et al. (2018) found that the display of the "wrong" items together with the "correct" items does not provide any benefits at the point of separation; hence, on the SCs only the "correct" items were displayed in the form of photographs.

Figure S10 Sticker on separation container for residual waste in Vienna. Orange was chosen as this corresponds to the colour coding used in the city. Text: Residual waste, please separate recyclables!

Figure S 11 Sticker on separation container for residual waste in Krems. Grey was chosen as this corresponds to the colour coding used in the city. Text: Residual waste, please separate recyclables!

Figure S 12 Sticker on separation container for glass. Text: White glass and coloured glass, please only empty bottles!

Figure S 13 Sticker on separation container for paper. Text: Waste paper, cardboard, paper packaging, please only clean paper!

Figure S 14 Sticker on separation container for lightweight packaging. Text: Lightweight packaging, plastic bottles, cans, beverage cartons, packaging only please!

1.5 Waste collection practice

The waste in the containers in the test locations was collected daily at the same time of day either by the sorting team and/or with the support of the responsible cleaning operatives on site. Littered material on site was, in general, not collected. On the university campus, overflowing residual waste bins were occasionally observed on weekdays, which is not unusual according to the university's facilities management. In these cases, all waste lying within a 1-meter distance of the container was collected and analyzed, as it can be assumed that it fell from the overfilled container.

1.6 Waste audit

1.6.1 Detailed sorting catalogue

In the sorting analysis, a focus was set on the most common waste fractions that are generated in a public context and on differentiating fractions that are easily misunderstood. Waste fractions, such as non-PET plastic beverage bottles (e.g. for washing detergent bottles), that are hardly present in public waste were therefore not considered. A detailed sorting catalogue with examples for each sorting fraction is given in Table S5.

Table S4 Detailed sorting catalogue including examples

Waste sorting fraction			Subfraction	Abbr.	Examples
1	Residual waste target fractions (rw)	1.1	biogenic waste unavoidable food waste and organics	ufw	Branches, twigs, leaves, grass, hay, fallen fruit, weeds, plants, flowers, soil, fruit and vegeTable peelings, apple cores, radish leaves, coffee grounds including filters, tea bags, eggshells, bones, etc.
		1.2	biogenic waste avoidable food waste - unpackaged	fwu	Cooked leftovers, unfinished fruit and vegeTables, loose pasta, leftover bread and sandwiches, beverage residues (unpackaged)

		1.3	biogenic waste avoidable food waste and beverages - packaged (incl. packaging)	fwp	Food and beverage leftovers in packaging, unopened food such as whole pasta bag, leftover dairy products, unopened tins, leftovers in take-away box, half eaten bakery in paper bag, beverage bottles with residues
		1.4	Hygienic paper and sanitary articles	hyg	Handkerchiefs, tissue paper, napkins, kitchen paper, cleaning towels, paper towels, toilet paper, diapers, feminine hygiene items, wet wipes, other hygiene items such as cotton swabs, cotton pads, etc.
		1.5	Dog feces	dog	Dog feces (mainly in doggy bags)
		1.6	Other waste	otw	other non-allocable waste such as toys, wood (NVP), kitchen sponge, lighters, decorative items, razors, dietary supplements, ceramic parts (NVP), pens, candles, umbrellas, full coffee capsules (are not legally considered packaging), Covid masks, glass non-packaging (glass misthrows; wired glass, glass dishes, lead glass, glass plates from furniture/kitchen appliances etc.), nylon stockings, carpets etc.
		1.7	Paper non-packaging contaminants	pco	Thermal paper such as receipts, tickets, lottery receipts, heavily coated (non-packaging) paper that is difficult to tear, wax paper, paper with adhesive applications such as sticky notes and labels
2	Paper, Cardboard, Corrugated board (PCC) target fractions	2.1	PCC packaging[1]	ppa	Paper, cardboard and corrugated cardboard packaging such as flower wrapping paper, cardboard boxes, pizza carton, egg carton, bakery bags, rice boxes, detergent boxes, shoe boxes, shipping carton etc. Coated PCC packaging such as cardboard boxes, bakery bags with plastic windows and coated freezer cartons with label "folded to waste paper"
		2.2	PCC non-packaging	pnp	Newspapers, periodicals, magazines, catalogues, magazines, flyers, booklets, copy paper, calendars, books, notes (without adhesive), coasters, cardboard folders, puzzle pieces, envelopes, letters, wrapping paper
3	Lightweight Packaging target fractions	3.1	Plastic beverage bottles	pbb	Beverage bottles (mainly PET)
		3.2	Other plastic packaging	opp	Film packaging and snack wrappers, hollow bodies such as cups, bowls and trays, other plastic packaging such as nets, cans, tubes, disposable plastic cutlery, polystyrene boxes, plant pots, bottles for cleaning agents, plastic bags, bioplastic packaging

[1] *According to the classification for packaging licensing in Austria, all paper packaging with ≥ 20% plastic content is to be classified as composite packaging. Papers that are coated on both sides and papers coated with kerosene or wax are in any case considered composite packaging, irrespective of the material mass proportions. Coated paper/cardboard packaging with less than 80% fiber (which is classified as paper packaging) must bear a notice/ sorting label on the packaging (e.g. "cleaned and folded to waste paper")*(ARA, 2022)*. Composite packaging is classified as target of the LWP collection, as well as coated paper packaging according to the national and Viennese sorting recommendations ("Coated paper packaging", coated freezer packaging (excluding packaging labelled 'folded waste paper')* (BMNT, 2019; City of Vienna, 2023). *Based on these specifications, the distinction between PPC packaging and PPC composite packaging was practiced in a way, that all clearly recognizable coated and difficult-to-tear PPC packaging that did not have a separation notice ("folded to waste paper") printed on, was assigned to subfraction cpa.*

		3.3	Metal beverage packaging	mbp	Beverage cans (mainly aluminium)
		3.4	Other metal packaging	omp	Aluminum foil, aluminum grill trays, food cans, crown caps, loose screw caps, yoghurt pot lids, metal tubes, metal lids
		3.5	Composite packaging - beverage carton	cbc	Beverage carton (with and without aluminium)
		3.6	Composite packaging - PCC composite packaging and coated PCC packaging[1]	cpa	Composite packaging of at least two different materials based on paper/ cardboard/ corrugated board which are not separable by hand (material is glued, welded, laminated, coated, riveted or pressed) where there is no indication of disposal ("folded to waste paper") printed on. For example; soup bags, coated cardboard cups for take-away food, coffee bags, bakery bags with plastic windows, welded blister packs with cardboard, thermoformed packs for cheese, sandwich packaging, sausage and delicatessen paper, vacuum packaging with glued-in plastic bags, boxes with glued-in EPS molded parts, aluminum-paper laminations, coated freezer cartons, butter paper, chocolate bar wrapping paper, chewing gum wrapping paper, cardboard boxes with welded plastic or metal bottoms
		3.7	Composite packaging - coated cardboard cups for liquid food and beverages[2]	ccc	Coated cardboard cups for liquid foods and beverages (coffee, soup, cold beverages, ice cream)[3]
		3.8	Composite packaging - plastic-metal composites	cpm	Plastic-metal composite packaging such as blister packs, coffee bags, cat food bags, firm pouches, squeezable bags for fruit puree *metalized packaging such as steamed film packaging and snack wrappers are under the category "other plastic packaging"*
		3.9	Other lightweight packaging	olw	Ceramic, textile, wooden and cork packaging (mainly wooden cutlery)[3]
4	Glass packaging target fraction	4.1	Coloured glass packaging	cgl	Disposable and returnable glass bottles, lemonade bottles, small beer bottles, oil bottles, milk bottles, jars, etc. from white glass
		4.2	White glass packaging	wgl	Disposable and returnable glass bottles, lemonade bottles, small beer bottles, oil bottles, milk bottles, jars, etc. from coloured glass (brown, green, blue)

[2] *Coated cardboard cups* are not directly addressed in the national sorting recommendations (BMNT, 2019), but are addressed as *"coffee cups" under the Viennese sorting instructions* (City of Vienna, 2024) *and "paper cup, coated inside" under the Kremser sorting instructions* (Municipal association Krems, 2024) *as target of the LWP collection, as well as on the official information website of the Verpackungskoordinierungsstelle (VKS).*

[3] *Disposable tableware and cutlery is not considered packaging, but is subject to the Packaging Ordinance and Manufacturers and importers of disposable tableware and cutlery must participate in an authorized collection and recycling system for household packaging (source: Einweggeschirr (bmk.gv.at)). For small quantities of wooden packaging, disposal in the LWP applies according to the national sorting recommendations (BMNT 2019). Wooden cutlery is also categorised as "other light packaging" in the guidelines for residual waste sorting analyses* (TA Sortieranalysen, 2017)*. Therefore, wooden cutlery was classified as target of separate lightweight packaging collection in this study.*

5	Other collection points target factions (o)	5.1	Problem waste	prw	Paint residues, medicines, used cooking oil, paints, varnishes, solvents, acids, motor oil, oil-contaminated waste, oil filters, aerosol cans and gas cartridges that have not been fully emptied, fire extinguishers, chemical residues, cleaning agents and residues, asbestos products, fertilizers, hair dyes, disinfectants, X-ray images
		5.2	WEEE, batteries and lamps	wbl	Small electronic devices, e-cigarettes, lamps, batteries, mobile phones, blenders, coffee machines, radios, computer accessories (USB sticks, mouse, keyboard), electric toothbrushes
		5.3	Metals non-packaging	mnp	Metal cookware, metal pipes, metal tools, small metal (screws, etc.), drying rack, metal toys, etc.
		5.4	Textiles	tex	Usable and intact clothes, shoes, bags, household linen and blankets
6	Sorting residue (sr)	6	Sorting residue	sor	Non-identifiable sorting residue including cigarettes butts

rw is considered as non-recyclable; pap, lwp, gl are considered target fractions of separate collection and as recyclables.

1.6.2 Sorting practice

In general, sorting was carried out according to residual waste sorting analysis guidelines (TA Sortieranalysen, 2017). No sieving was practised prior to sorting. Stacked packaging and easily disassembled packaging components made of different base materials (e.g. plastic cups with removable cardboard wrap, plastic cups with aluminum plate) were disassembled and assigned to the respective target collection fraction (see Figure S15). Firmly attached components (e.g. glued labels, plastic coating on paper packaging) or packaging aids from the same material (e.g. plastic closure on plastic packaging) were not separated but assigned to the main material of the fraction. Packaging that contained food or beverage leftovers, where the amount clearly exceeded the weight of the packaging and was still considered worth consuming, was categorised as packaged avoidable food waste, including the packaging. Adhering packaging aids (attached closures, labels etc.) were left on the packaging and are included in the respective fraction of the main component. Leaking beverage contents from (semi-) open bottles and cans were captured to the best ability and categorised as packaged avoidable food waste.

A differentiation based on the degree of contamination of packaging (e.g. soiled/ clean paper) was not considered in the waste sorting as it was not possible to clearly determine whether spoilage was caused by the product usage or from ambient waste after the disposal. Unpackaged and packaged food waste (including packaging) was sorted separately and classified as residual target waste (no option for organic waste separation in the field test setup).

Figure S 15 Disassembly of stacked packaging and packaging components from different base material

1.7 Identifying outliers

Significant quantities of unauthorized waste in a sample could potentially skew the outcomes, and the occurrence in a sample was therefore documented. However, exact quantities were mostly difficult to delineate (e.g. does the large amount of coffee cups stem from unauthorized disposal from coffee shop owners or regularly from pedestrians?). One exception where clearly a substantial amount of unauthorized old books (4.9 kg) was disposed of in the PAP SC of the PZ paper was later removed from the analysis, after it was identified as an extreme outlier from the average collected paper amounts in the pedestrian zone using visual methods (see boxplot Figure S16).

Deskriptive Statistics

	N	Min	Max	Average	SD
PZ_SS PAP_CQ_pre	7	,1300	5,2700	1,248186	1,8890057

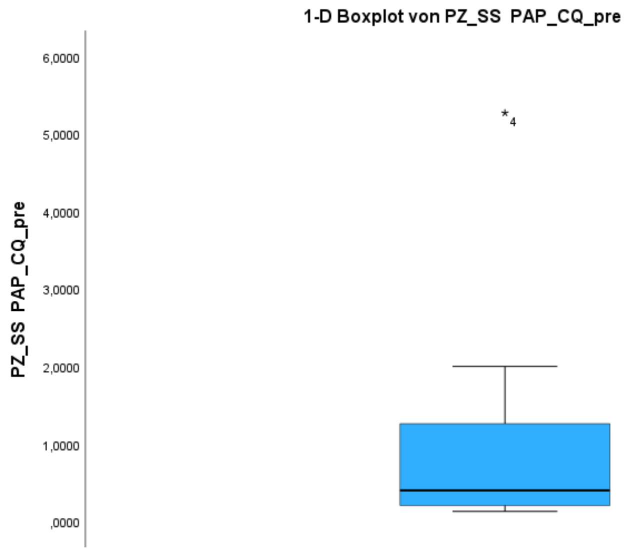

Figure S 16 Daily collected waste in the paper container (PAP) during baseline week in the pedestrian zone (n=7). Data point 4 represents the mass collected in paper bin including unauthorized waste (4,9 kg of old books from household waste) which was subsequently eliminated from the sample.

2 Results

2.1 Collection quantities

Collected waste quantities are presented in Figure S17 and in Table S6 per test location and in total (cumulated waste from all test locations) for each collection week (baseline and post audit), including Standard deviation (SD) and relative standard deviation (RSD).

About 795 kg of waste was collected and analysed during the Baseline waste audit, and 870 kg in the Post waste audit in total. Waste amounts varied quite much between the different test locations and over the course of the week, which is reflected in high standard deviations of average daily amounts (see Figure S17). Collected waste amounts increased moderately in all of the test locations in the week of post-audit. If the mean values of the weekly collected waste quantities (total) of the individual test locations during baseline and post week are analysed using a permutation paired t-test, no significant increase is indicated (see test results in chapter 2.3.5 under test variable ΔCQ = change in collection quantity). There was also no significant increase in the test locations of S, PZ and UC, but a slight significant result in TS (see test results in chapter 2.3.1-2.3.4 under test variable ΔCQ = change in collection quantity). These results indicate that, overall, the amount of generated waste in the test locations stayed rather consistent in both weeks.

If a total average is considered across all test locations and both weeks of analysis, approximately 17.8 kg are collected in an RWC container per week, 17.2 kg in SSRWC, 7.2 kg in PAP, 7.8 kg in LWP and 20.3 kg in GL. Compared to the average public RWCs in Austria, estimated between 1.9 kg and 11.5 kg/week, depending on municipality size (TBH, 2021), the containers at the “waste hot-spots” test locations had a high load.

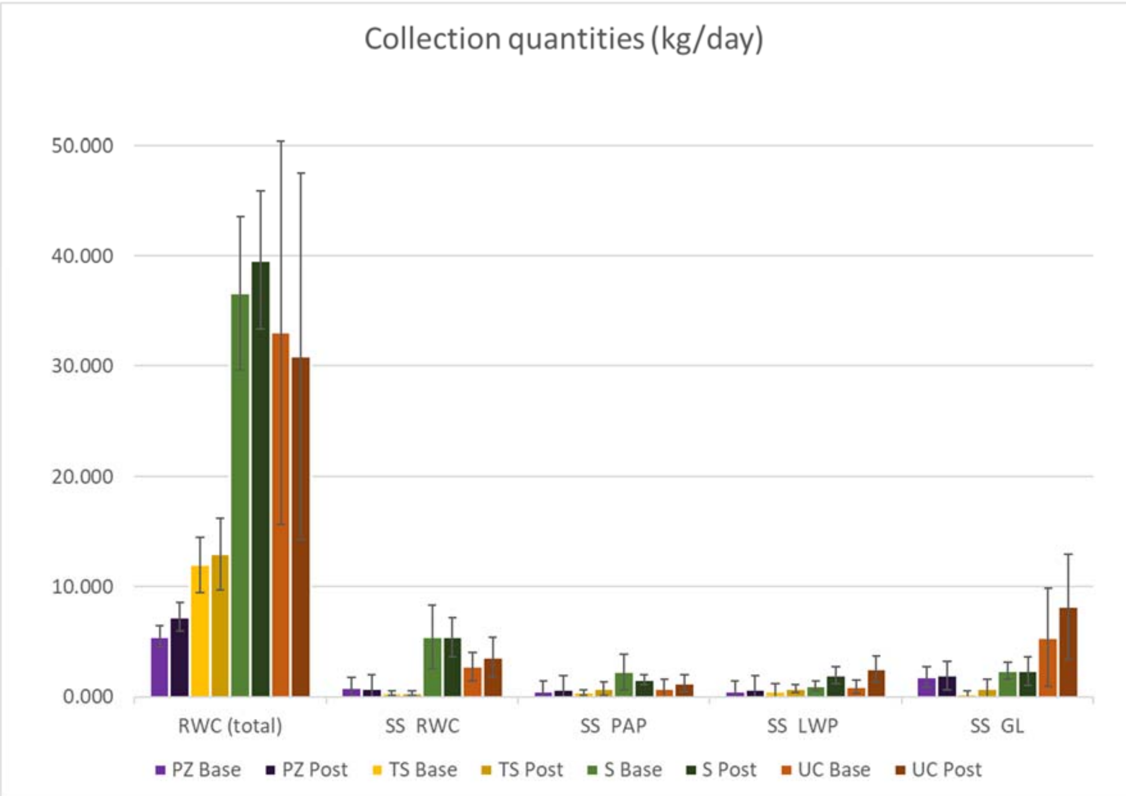

Figure S17 Waste amount collected per test location and week in kg per day, the standard deviation is shown as an error bar (RWC – residual waste container, SS – separation station, PAP – paper waste, LWP – lightweight packaging, GL – glass waste, PZ – pedestrian zone, TS – train station square, S – subway station square, UC – university campus square, Base – baseline waste audit (one week), Post – post waste audit (one week))

Table S5 Collection quantities

Test location	Collection fraction	Base				Post			
		kg/ week	Ø kg/ day	SD	RSD (%)	kg/ week	Ø kg/ day	SD	RSD (%)
PZ	RWC (total)	38.44	5.49	2.48	45%	50.76	7.25	2.92	40%
	SS RWC	6.17	0.88	0.55	62%	5.51	0.79	0.48	60%
	SS PAP	3.84	0.55	0.61	111%	4.79	0.68	0.56	81%
	SS LWP	3.59	0.51	0.56	110%	4.66	0.67	0.27	41%
	SS GL	12.86	1.84	2.03	110%	13.73	1.96	1.26	64%
	total CQ	**64.90**	**9.27**			**79.45**	**11.35**		
TS	RWC (total)	83.78	11.97	2.52	21%	90.62	12.95	3.28	25%
	SS RWC	2.63	0.38	0.18	48%	2.72	0.39	0.19	48%
	SS PAP	2.90	0.41	0.25	59%	5.30	0.76	0.63	83%
	SS LWP	3.92	0.56	0.63	112%	5.45	0.78	0.39	51%
	SS GL	2.08	0.30	0.30	100%	5.68	0.81	0.83	102%
	total CQ	**95.31**	**13.62**			**109.78**	**15.68**		
S	RWC (total)	256.29	36.61	6.99	19%	277.31	39.62	6.27	16%
	SS RWC	38.26	5.47	2.85	52%	38.09	5.44	1.76	32%
	SS PAP	15.97	2.28	1.60	70%	11.10	1.59	0.45	28%
	SS LWP	7.13	1.02	0.43	42%	13.79	1.97	0.75	38%
	SS GL	16.94	2.42	0.76	31%	16.51	2.36	1.32	56%
	total CQ	**334.59**	**47.80**			**356.81**	**50.97**		
UC	RWC (total)	231.36	33.05	17.41	53%	215.85	30.84	16.67	54%
	SS RWC	19.41	2.77	1.28	46%	24.93	3.56	1.82	51%
	SS PAP	5.33	0.76	0.86	113%	8.55	1.22	0.77	63%
	SS MET	2.06	0.29	0.23	79%	4.85	0.69	0.37	54%
	SS PL	4.48	0.64	0.38	60%	12.77	1.82	0.87	47%
	SS GLc	6.30	0.90	1.20	134%	14.98	2.14	2.01	94%
	SS GLw	31.53	4.50	3.57	79%	42.16	6.02	3.50	58%
	total CQ	**300.47**	**42.92**			**324.08**	**46.30**		
TOTAL	RWC (total)	609.88	87.13	17.96	20%	634.54	90.65	13.77	15%
	SS RWC	66.47	9.50	3.68	39%	71.25	10.18	1.41	14%
	SS PAP	28.04	4.01	1.74	43%	29.74	4.25	1.18	28%
	SS LWP	21.18	3.03	0.69	23%	41.51	5.93	1.38	23%
	SS GL	69.70	9.96	3.90	39%	93.06	13.29	3.44	26%
	total CQ	**795.27**	**114.66**			**870.11**	**124.30**		

2.2 Specific capture rates (CR_{sp})

The following Table S7 shows the results for separation efficiencies for all waste types of total waste (cumulated waste from all test locations) in the week before the intervention (CR_{sp} base), in the week after the intervention (CR_{sp} post), based on the change between before and after (ΔCR_{sp}, indicates effect of guidance intervention), and in total (CR_{sp} base + post, also presented in Table 2 of the main article).

Table S6 Specific capture rates

	CR_{sp} (base)					CR_{sp} (post)					ΔCR_{sp}					CRsp (base+post)				
Waste sorting fractions	TOT_CR(RWC)_pre	TOT_CR(SS_RW_rw)_pre	TOT_CR(PAP)_pre	TOT_CR(LWP)_pre	TOT_CR(GL)_pre	TOT_CR(RWC)_post	TOT_CR(SS_RW_rw)_post	TOT_CR(PAP)_post	TOT_CR(LWP_post	TOT_CR(GL)_post	TOT_CR(RWC)_diff	TOT_CR(SS_RW_rw)_diff	TOT_CR(PAP)_diff	TOT_CR(LWP)_diff	TOT_CR(GL)_diff	TOT_CR(RWC)	TOT_CR(SS_RW_rw	TOT_CR(PAP)	TOT_CR(LWP)	TOT_CR(GL)
1.1 ufw	**90.1%**	**8.7%**	0.1%	0.6%	0.4%	**74.8%**	**22.4%**	0.4%	2.1%	0.2%	**-15.3%**	**13.7%**	0.3%	1.5%	-0.2%	**82.9%**	**15.1%**	0.3%	1.3%	0.3%
1.2 fwu	**84.7%**	**10.1%**	1.9%	1.1%	2.2%	**86.4%**	**9.7%**	0.9%	2.5%	0.6%	**1.6%**	**-0.4%**	-1.0%	1.4%	-1.6%	**85.5%**	**9.9%**	1.4%	1.8%	1.4%
1.3 fwp	**80.3%**	**13.1%**	1.4%	2.7%	2.5%	**78.1%**	**9.2%**	1.3%	8.0%	3.4%	**-2.2%**	**-3.9%**	-0.1%	5.3%	0.9%	**79.0%**	**10.9%**	1.3%	5.7%	3.0%
1.4 hyg	**85.3%**	**9.0%**	2.1%	2.7%	0.9%	**83.9%**	**9.3%**	4.3%	2.1%	0.5%	**-1.4%**	**0.3%**	2.2%	-0.6%	-0.5%	**84.6%**	**9.2%**	3.2%	2.4%	0.7%
1.5 dog	**86.9%**	**11.0%**	0.0%	1.5%	0.7%	**84.8%**	**14.1%**	0.7%	0.0%	0.4%	**-2.1%**	**3.1%**	0.7%	-1.5%	-0.3%	**86.0%**	**12.4%**	0.3%	0.8%	0.5%
1.6 otw	**74.9%**	**20.1%**	0.2%	3.5%	1.3%	**76.4%**	**16.8%**	6.1%	0.7%	0.0%	**1.4%**	**-3.2%**	5.9%	-2.8%	-1.3%	**75.8%**	**18.2%**	3.5%	1.9%	0.5%
1.7 pco	**68.0%**	**2.4%**	26.7%	2.7%	0.2%	**72.1%**	**23.2%**	2.9%	1.7%	0.1%	**4.0%**	**20.8%**	-23.7%	-1.0%	-0.1%	**69.9%**	**11.9%**	15.9%	2.2%	0.2%
2.1 ppa	80.1%	10.8%	**6.9%**	1.0%	1.2%	74.1%	9.9%	**13.4%**	2.2%	0.4%	-6.0%	-0.9%	**6.5%**	1.2%	-0.8%	77.2%	10.4%	**10.0%**	1.6%	0.8%
2.2 pnp	75.3%	5.4%	**18.6%**	0.2%	0.5%	84.1%	5.6%	**9.6%**	0.4%	0.3%	8.8%	0.2%	**-9.0%**	0.3%	-0.2%	80.0%	5.5%	**13.8%**	0.3%	0.4%
3.1 pbb	76.1%	6.2%	0.4%	**16.0%**	1.4%	69.5%	5.0%	0.3%	**23.0%**	2.3%	-6.6%	-1.2%	-0.1%	**7.0%**	0.9%	72.4%	5.5%	0.3%	**19.9%**	1.9%
3.2 opp	81.5%	10.3%	1.2%	**6.3%**	0.7%	78.6%	10.3%	1.2%	**9.2%**	0.6%	-2.9%	-0.1%	0.1%	**2.9%**	-0.1%	79.9%	10.3%	1.2%	**7.9%**	0.7%
3.3 mbp	79.2%	6.1%	0.3%	**9.4%**	5.0%	76.0%	4.0%	0.5%	**17.1%**	2.3%	-3.2%	-2.1%	0.2%	**7.7%**	-2.6%	77.5%	5.0%	0.4%	**13.5%**	3.6%
3.4 omp	84.3%	8.7%	0.6%	**4.5%**	2.0%	78.5%	4.3%	1.1%	**14.3%**	1.8%	-5.8%	-4.3%	0.6%	**9.8%**	-0.2%	81.1%	6.3%	0.9%	**9.9%**	1.9%
3.5 cbc	67.7%	19.3%	10.7%	**1.9%**	0.5%	76.4%	17.1%	1.3%	**5.3%**	0.0%	8.7%	-2.2%	-9.4%	**3.4%**	-0.5%	72.3%	18.1%	5.7%	**3.7%**	0.2%
3.6 cpa	86.7%	9.1%	2.5%	**1.2%**	0.5%	79.7%	13.0%	5.1%	**2.1%**	0.1%	-7.0%	3.9%	2.7%	**0.9%**	-0.4%	82.8%	11.3%	3.9%	**1.7%**	0.3%
3.7 ccc	85.2%	9.8%	1.7%	**2.2%**	1.2%	78.4%	9.1%	4.6%	**6.6%**	1.3%	-6.7%	-0.7%	2.9%	**4.5%**	0.1%	82.3%	9.5%	2.9%	**4.1%**	1.3%
3.8 cpm	82.0%	3.9%	0.9%	**11.4%**	1.9%	76.8%	13.4%	0.8%	**9.0%**	0.0%	-5.2%	9.6%	0.0%	**-2.4%**	-1.9%	78.8%	9.7%	0.8%	**9.9%**	0.8%
3.9 olw	84.4%	11.7%	2.2%	**1.5%**	0.2%	73.2%	17.7%	5.7%	**3.4%**	0.1%	-11.2%	5.9%	3.5%	**1.9%**	-0.1%	77.7%	15.3%	4.2%	**2.6%**	0.1%
4.1 cgl	63.7%	7.8%	0.1%	2.5%	**25.9%**	68.7%	2.8%	0.5%	0.6%	**27.5%**	5.0%	-5.1%	0.4%	-1.8%	**1.5%**	66.4%	5.1%	0.3%	1.5%	**26.8%**
4.2 wgl	57.2%	2.6%	0.0%	0.0%	**40.1%**	40.0%	2.7%	0.6%	0.4%	**56.2%**	-17.2%	0.0%	0.6%	0.4%	**16.1%**	48.4%	2.7%	0.3%	0.2%	**48.4%**
5.1 prw	28.3%	2.6%	0.0%	0.0%	69.1%	71.7%	0.0%	0.0%	20.5%	7.8%	43.4%	-2.6%	0.0%	20.5%	-61.2%	64.3%	0.4%	0.0%	17.0%	18.3%
5.2 wbl	71.4%	3.1%	22.6%	3.0%	0.0%	92.3%	0.8%	0.0%	6.9%	0.0%	20.9%	-2.3%	-22.6%	3.9%	0.0%	88.1%	1.2%	4.5%	6.1%	0.0%
5.3 mnp	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
5.4 tex	92.2%	7.8%	0.0%	0.0%	0.0%	86.8%	11.8%	1.4%	0.0%	0.0%	-5.4%	4.0%	1.4%	0.0%	0.0%	89.7%	9.6%	0.6%	0.0%	0.0%
6 sor	89.7%	9.2%	0.1%	0.2%	0.7%	91.8%	5.1%	2.3%	0.5%	0.3%	2.1%	-4.1%	2.2%	0.3%	-0.4%	90.6%	7.5%	1.0%	0.3%	0.6%

2.3 Effects of the guidance intervention

The effects of the guidance intervention were evaluated based on changes in waste collection (separate collection rate ΔSCR), separation efficiency (capture rate ΔCR) and collection quality (contamination level ΔCL) between the baseline and the post-waste audit. Due to the small number of samples (n=7 per test location and audit week) and in order to minimise daily and location variations in waste volume and separation performance, the main interpretation of the results is based on the absolute change in total waste (waste cumulated from all test locations). Hence, the total weekly waste amount from the baseline week is compared with the total weekly waste from the post-week. These results are presented in Table S8 for individual test locations and in total.

Additionally, results were assessed based on individual daily values to demonstrate potential statistical significance. . Hence, seven values of the baseline week are compared with seven values of the post-week. The results of the data normality test (Shapiro-Wilk) and significance tests (parametric: paired t-test, non-parametric: permutation paired t-test, 2-sided) are presented in detail in the following chapters 2.3.1 - 2.3.5 and are summarised in Table S9, where significant results of permutation paired t-test are marked by “*”. For illustrative purposes, positively interpreted results are marked in green and negative results in red (e.g. increasing contamination level CL in separation fractions is interpreted as negative). The paired t-test is based on paired data points. Hence, if a container (collection fraction) was empty on a weekday, the respective data point in the other audit week had to be excluded as well (resulting in n=6, df=5 paired data points). Results described as significant refer to differences in daily performance rates when statistical tests suggest rejection of the null hypothesis, which assumes no differences between baseline and post-audit. The significance level was 5% for all statistical tests. Due to the high variations in daily waste separation performance, it is possible that results are inverse when compared to the absolute weekly differences (as reported in Table S8).

Table S7 Results of the guidance intervention given as absolute difference between weekly performance indicators before (baseline week) and after the intervention (post week).

	Pedestrian zone (PZ)	**Train station square (TS)**	**Subways station entrance (S)**	**University campus (UC)**	**TOTAL**
Residual waste (RWC)					
ΔSCR_RWC	4.65%	-5.35%	1.12%	-10.40%	-3.76%
ΔCR_(rw)RWC	0.40%	-0.89%	-2.83%	-10.62%	-4.41%
ΔCL_RWC	-0.66%	0.23%	3.79%	-0.16%	0.94%
Residual waste at separation station (SSRWC)					
ΔSCR_SSRWC	-2.56%	-0.28%	-0.76%	1.23%	-0.17%
ΔCR_(rw)SSRWC	-1.91%	-0.48%	3.39%	4.19%	2.36%
ΔCL_SSRWC	-11.67%	7.54%	-9.26%	-4.06%	-6.91%
Paper (PAP)					
ΔSCR_PAP	0.12%	1.78%	-1.66%	0.86%	-0.11%
ΔCR_(pap)PAP	0.50%	6.58%	-3.58%	0.49%	-1.02%
ΔCL_PAP	14.84%	-7.51%	-8.78%	24.61%	5.74%
Lightweight packaging (LWP)					
ΔSCR_LWP	0.32%	0.85%	1.73%	3.26%	2.11%
ΔCR_(lwp)LWP	6.76%	2.56%	3.47%	7.18%	4.98%
ΔCL_LWP	-9.04%	-8.54%	-1.28%	11.37%	-1.10%
Glass (GL)					
ΔSCR_GL	-2.53%	2.99%	-0.43%	5.04%	1.93%
ΔCR_(gl)GL	-16.23%	20.97%	-0.39%	19.17%	9.03%
ΔCL_GL	0.29%	-18.34%	-7.20%	-1.48%	-4.38%
total recyclables (pap + gl + lwp)					
ΔCR_(rec)SC	-1.01%	6.53%	0.00%	9.98%	4.56%

Table S9 Results of the guidance intervention given as mean difference between weekly performance indicator values before (baseline week) and after the intervention (post week).

	Pedestrian zone (PZ)	Train station square (TS)	Subways station entrance (S)	University campus (UC)	total
Residual waste (RWC)					
ΔSCR_RWC	-0.11%	-5.65%	0.46%	-4.59%	-3.94%
ΔCR_(rw)RWC	-2.02%	-1.72%	-3.13%	-8.05% *	-4.24%
ΔCL_RWC	-2.38%	0.40%	2.55%	2.56%	0.76%
Residual waste at separation station (SSRWC)					
ΔSCR_SSRWC	-2.7%	-0.3%	-0.16%	0.15%	0.05%
ΔCR_(rw)SSRWC	-2.6%	-0.9%	3.42%	2.34%	2.44% *
ΔCL_SSRWC	-14.7%	11.7%	-8.17%	-2.16%	-6.17%
Paper (PAP)					
ΔSCR_PAP	0.45%	2.18%	-1.29%	-0.12%	-0.13%
ΔCR_(pap)PAP	-0.58%	7.19%	-1.60%	5.55%	-0.19%
ΔCL_PAP	16.15%	-12.52%	-13.87%	13.41% *	2.10%
Lightweight packaging (LWP)					
ΔSCR_LWP	2.0%	1.21%	1.80%	3.27% *	1.85%
ΔCR_(lwp)LWP	8.7%	2.82%	3.58% *	6.62% *	4.65% *
ΔCL_LWP	-9.5%	6.52%	-2.49%	9.53%	1.06%
Glass (GL)					
ΔSCR_GL	0.36%	2.60%	-0.81%	1.30%	2.17% *
ΔCR_(gl)GL	-6.21%	13.13%	-0.51%	17.39%	7.64%
ΔCL_GL	1.31%	-38.41%	-6.19%	0.77%	-2.94%
Total recyclables (pap, gl lwp)					
ΔCR_(rec)SC					4.76% *

** indicates significant test results at significance level of 0.05.*

2.3.1 Test results PZ- pedestrian zone in Krems

PZ											
		Shapiro-Wilk (test for normal distribution of difference)			**Permutation paired t-test** (conf.level= 0.95, number of permutations = all possible permutations)			**Paired t-test** (without permutations)			
Test variables	df	W	p-value	Result	perm. p-value (2-sided)	Result (* = signifcant)	perm. mean of difference	p-value (2-sided)	Result (* = signifcant)	mean difference	SD of difference
ΔCQ_PZ_total	6	0.88803	0.2645	normal	0.125		-2.073631	0.1074		-2.079443	2.908085
RWC											
ΔSCR_RWC	6	0.82075	0.0653	normal	0.9766		0.00182805	0.9872		0.00114499	0.1816
ΔCR_(rw)RWC	6	0.96141	0.8307	normal	0.7344		0.01955548	0.7523		0.02017907	0.1616
ΔCL_RWC	6	0.94287	0.6647	normal	0.6172		0.024057	0.6321		0.02382861	0.1250
SSRWC											
ΔSCR_SSRWC	6	0.93517	0.5957	normal	0.07812		0.02674818	0.0918		0.02715211	0.0358
ΔCR_(rw)SSRWC	6	0.95208	0.7485	normal	0.4922		0.02565792	0.5063		0.02633324	0.0986
ΔCL_SSRWC	6	0.96172	0.8333	normal	0.2344		0.1494154	0.2590		0.1470054	0.3120
PAP											
ΔSCR_PAP	6	0.97717	0.9447	normal	0.9062		-0.005501	0.8950		-0.00447	0.0859
ΔCR_(pap)PAP	6	0.94684	0.7008	normal	0.9766		0.00349251	0.9606		0.00575632	0.2954
ΔCL_PAP	6	0.82544	0.0724	normal	0.4688		-0.1603566	0.4192		-0.1614637	0.4926
LWP											
ΔSCR_LWP	6	0.93641	0.6066	normal	0.3594		-0.0197687	0.3488		-0.0202016	0.0526
ΔCR_(lwp)LWP	6	0.92065	0.4744	normal	0.2344		-0.0861607	0.1799		-0.0865107	0.1508
ΔCL_LWP	6	0.91575	0.4371	normal	0.2891		0.09295702	0.2953		0.09484697	0.2189
GL											
ΔSCR_GL	6	0.8958	0.3063	normal	0.9844		-0.0042221	0.9647		-0.0036255	0.2082
ΔCR_(gl)GL	6	0.91329	0.4191	normal	0.7109		0.06492191	0.6645		0.06209371	0.3603
ΔCL_GL	6	0.68291	0.002406	not normal	0.8203		-0.0124805	0.6929		-0.0131034	0.0836

2.3.2 Test results TS - train station square in Krems

TS											
		Shapiro-Wilk (test for normal distribution of difference)			**Permutation paired t-test** (conf.level= 0.95, number of permutations = all possible permutations)			**Paired t-test** (without permutations)			
Test variables	df	W	p-value	Result	perm. p-value (2-sided)	Result (* = signifcant)	perm. mean of difference	p-value (2-sided)	Result (* = signifcant)	mean difference	SD of difference
ΔCQ_TS_total	6	0.87501	0.2052	normal	0.04688	*	-2.040153	0.08577		-2.066171	2.661426
RWC											
ΔSCR_RWC	6	0.66181	0.001399	not normal	0.3047		0.05611177	0.2657		0.05652704	0.1219
ΔCR_(rw)RWC	6	0.76566	0.01844	not normal	0.7656		0.01733333	0.7058		0.01722024	0.1150
ΔCL_RWC	6	0.9394	0.6052	normal	0.9453		-0.0045651	0.9166		-0.0039677	0.0891
SSRWC											
ΔSCR_SSRWC	6	0.66181	0.001399	not normal	0.5703		0.00313141	0.5875		0.00329365	0.0152
ΔCR_(rw)SSRWC	6	0.87831	0.2191	normal	0.5		0.00876199	0.5244		0.00868572	0.0340
ΔCL_SSRWC	6	0.92265	0.4517	normal	0.4531		-0.1173316	0.4536		-0.1170437	0.3581
PAP											
ΔSCR_PAP	6	0.69748	0.003479	not normal	0.4688		-0.0221448	0.3916		-0.0217793	0.0624
ΔCR_(pap)PAP	6	0.8522	0.1287	normal	0.3594		-0.0718862	0.2729		-0.0719205	0.1577
ΔCL_PAP	6	0.94167	0.6276	normal	0.2656		0.1275709	0.3049		0.1252353	0.2748
LWP											
ΔSCR_LWP	6	0.86914	0.1824	normal	0.4844		-0.0119043	0.6560		-0.0120661	0.0681
ΔCR_(lwp)LWP	6	0.845	0.1106	normal	0.1797		-0.0282442	0.1657		-0.0281556	0.0472
ΔCL_LWP	6	0.89497	0.2601	normal	0.6562		-0.0675054	0.6238		-0.0652266	0.3103
GL											
ΔSCR_GL	6	0.94041	0.6424	normal	0.1719		-0.0258417	0.2069		-0.0259753	0.0486
ΔCR_(gl)GL	5	0.88226	0.2796	normal	0.375		-0.1122111	0.3355		-0.1313378	0.3020
ΔCL_GL	5	0.96624	0.8701	normal	0.1406		0.401651	0.0889		0.3840648	0.4078

2.3.3 Test results S - forecourt of a subway station entrance in Vienna

S											
		Shapiro-Wilk (test for normal distribution of difference)			**Permutation paired t-test** (conf.level= 0.95, number of permutations = all possible permutations)			**Paired t-test** (without permutations)			
Test variables	df	W	p-value	Result	perm. p-value (2-sided)	Result (* = signifcant)	perm. mean of difference	p-value (2-sided)	Result (* = signifcant)	mean difference	SD of difference
ΔCQ_S_total	6	0.90655	0.3725	normal	0.6641		-3.136954	0.5921		-3.174543	14.84496
RWC											
ΔSCR_RWC	6	0.96558	0.8649	normal	0.6797		-0.0044624	0.7466		-0.0046056	0.0360
ΔCR_(rw)RWC	6	0.85396	0.1335	normal	0.25		0.03146025	0.2747		0.03128147	0.0689
ΔCL_RWC	6	0.95117	0.723	normal	0.3359		-0.0252413	0.4721		-0.0254904	0.0814
SSRWC											
ΔSCR_SSRWC	6	0.84967	0.122	normal	0.8984		0.00129928	0.9412		0.00157022	0.0540
ΔCR_(rw)SSRWC	6	0.93741	0.6155	normal	0.1562		-0.0341673	0.1325		-0.0342436	0.0689
ΔCL_SSRWC	6	0.90457	0.3174	normal	0.0625		0.08235094	0.0770		0.08174494	0.0940
PAP											
ΔSCR_PAP	6	0.97056	0.9024	normal	0.08594		0.01297306	0.0907		0.0129435	0.0170
ΔCR_(pap)PAP	6	0.95639	0.7872	normal	0.5625		0.01546793	0.6196		0.01597908	0.0808
ΔCL_PAP	6	0.86484	0.1341	normal	0.3438		0.139481	0.3692		0.1387188	0.3524
LWP											
ΔSCR_LWP	6	0.88353	0.2426	normal	0.0625		-0.0179036	0.0663		-0.0180312	0.0213
ΔCR_(lwp)LWP	6	0.97239	0.9151	normal	0.0234	*	-0.0358373	0.0399	*	-0.0358491	0.0363
ΔCL_LWP	6	0.77237	0.01439	not normal	0.8047		0.02837855	0.8232		0.02491425	0.2658
GL											
ΔSCR_GL	6	0.89431	0.2979	normal	0.5234		0.00791987	0.4940		0.0081231	0.0295
ΔCR_(gl)GL	6	0.98384	0.976	normal	0.9453		0.00419189	0.9418		0.0051264	0.1781
ΔCL_GL	6	0.95968	0.8071	normal	0.6797		0.06044975	0.7153		0.06194187	0.3982

2.3.4 Test results UC - square at the business university campus in Vienna

UC											
		Shapiro-Wilk (test for normal distribution of difference)			**Permutation paired t-test** (conf.level= 0.95, number of permutations = all possible permutations)			**Paired t-test** (without permutations)			
Test variables	df	W	p-value	Result	perm. p-value (2-sided)	Result (* = signifcant)	perm. mean of difference	p-value (2-sided)	Result (* = signifcant)	mean difference	SD of difference
ΔCQ_UC_total	6	0.96888	0.8903	normal	0.7422		-3.541919	0.7344		-3.372171	25.10047
RWC											
ΔSCR_RWC	6	0.8058	0.0467	not normal	0.6797		0.04754068	0.6762		0.04590615	0.2768
ΔCR_(rw)RWC	6	0.8376	0.0943	normal	0.04688	*	0.08114223	0.08086		0.08047749	0.1016
ΔCL_RWC	6	0.9800	0.9597	normal	0.5312		-0.0256	0.5701		-0.0256137	0.1128
SSRWC											
ΔSCR_SSRWC	6	0.9251	0.5096	normal	0.9141		0.00181723	0.9355		-0.0015272	0.0479
ΔCR_(rw)SSRWC	6	0.9110	0.4027	normal	0.4297		-0.0234	0.4351		-0.0233701	0.0739
ΔCL_SSRWC	6	0.9159	0.4384	normal	0.4922		0.02111941	0.5017		0.02157963	0.0799
PAP											
ΔSCR_PAP	6	0.7679	0.0194	not normal	0.9453		0.00149602	0.9242		0.00123745	0.0330
ΔCR_(pap)PAP	5	0.9832	0.9665	normal	0.1406		-0.0589	0.138		-0.0554636	0.0770
ΔCL_PAP	5	0.9221	0.5207	normal	0.03125	*	-0.1341	0.02187	*	-0.1341423	0.1001
LWP											
ΔSCR_LWP	6	0.91375	0.4224	normal	2.20E-16	*	-0.0325	0.0057	*	-0.0327	0.0206
ΔCR_(lwp)LWP	6	0.93766	0.6178	normal	2.20E-16	*	-0.0657	0.0047	*	-0.0662	0.0401
ΔCL_LWP	6	0.98732	0.9872	normal	0.1953		-0.0942	0.2349		-0.0953308	0.1911
GL											
ΔSCR_GL	6	0.83318	0.08575	normal	0.8984		-0.0114367	0.8711		-0.0129627	0.2025
ΔCR_(gl)GL	5	0.85677	0.1783	normal	0.2656		-0.1678	0.2179		-0.173906	0.3024
ΔCL_GL	5	0.0563	0.3252	normal	0.625		-0.0082	0.8103		-0.0076629	0.0742

2.3.5 Test results TOTAL (cumulated waste from all test locations)

TOTAL											
		Shapiro-Wilk (test for normal distribution of difference)			**Permutation paired t-test** (conf.level= 0.95, number of permutations = all possible permutations)			**Paired t-test** (without permutations)			
Test variables	df	W	p-value	Result	perm. p-value (2-sided)	Result (* = signifcant)	perm. mean of difference	p-value (2-sided)	Result (* = signifcant)	mean difference	SD of difference
ΔCQ_TOTAL	27	0.91781	0.03063	not normal	0.326		-2.647961	0.3174		-2.673082	13.88565
RWC											
ΔSCR_RWC	6	0.94795	0.711	normal	0.125		0.03901655	0.0753		0.03935354	0.0485
ΔCR_(rw)RWC	6	0.94042	0.6426	normal	0.1172		0.04199396	0.1003		0.04237235	0.0578
ΔCL_RWC	6	0.94816	0.7129	normal	0.8438		-0.008253263	0.8167		-0.0076127	0.0832
SSRWC								noch nachtr			
ΔSCR_SSRWC	6	0.79387	0.03561	not normal	0.9688		-0.000714444	0.9653		-0.0004947	0.0288
ΔCR_(rw)SSRWC	6	0.9338	0.5836	normal	0.01562	*	-0.02441004	0.0185	*	-0.024388	0.0201
ΔCL_SSRWC	6	0.94056	0.6438	normal	0.1484		0.06190039	0.1156		0.06167393	0.0888
PAP								noch nachtr			
ΔSCR_PAP	6	0.90854	0.3858	normal	0.7266		0.001279117	0.7133		0.00129133	0.0089
ΔCR_(pap)PAP	6	0.6193	0.0004574	not normal	0.9766		0.001867624	0.9025		0.00190719	0.0395
ΔCL_PAP	6	0.82118	0.0659	normal	0.6406		-0.02045339	0.7971		-0.021038	0.2071
LWP								noch nachtr			
ΔSCR_LWP	6	0.89908	0.3254	normal	0.08594		-0.01847347	0.0462	*	-0.0184617	0.0195
ΔCR_(lwp)LWP	6	0.90552	0.3658	normal	0.0234	*	-0.04647434	0.0094	*	-0.0465305	0.0327
ΔCL_LWP	6	0.92721	0.5274	normal	0.7656		-0.01093231	0.8303		-0.0106017	0.1253
GL								noch nachtr			
ΔSCR_GL	6	0.88332	0.2416	normal	0.04688	*	-0.02183082	0.0405	*	-0.0216885	0.0221
ΔCR_(gl)GL	6	0.93175	0.5658	normal	0.1875		-0.07744063	0.1848		-0.0764437	0.1350
ΔCL_GL	6	0.88491	0.2491	normal	0.2109		0.02895563	0.2769		0.02939157	0.0650
total recyclables (pap + gl + lwp)											
ΔCR_(rec)SC	6	0.91273	0.4151	normal	0.03125	*	-0.0481	0.02187	*	-0.0476	0.0410

2.4 Specific effects from intervention

In the context of the experimental setting, a change in separation efficiency ($\Delta CR = CR_{post} - CR_{base}$) or in contamination ($\Delta CL = CR_{post} - CR_{base}$) before and after the intervention provides an indication of the impact of the intervention. These can either refer to the sum of target waste (total effect indicated by ΔCR and ΔCL), as described in the main article, or to specific subfractions (specific effects indicated by changes in specific capture rate $\Delta CR_{sp}(a_x)A$ and specific contamination level $\Delta CL_{sp}(a_x)A$), for a more differentiated analysis. The following specific effects can be described;

- ***Repelling effect*** is described by a decreasing capture of a specific waste in the RWCs after the intervention (-ΔCR(*a*)RWC). If this effect is larger than > 6%, it will be discussed in the following.
- **A direct *positive capture effect*** results, if a "repelled" recyclable (-$\Delta CR(a_{rec})$RWC) is then disposed of correctly at the SS, resulting in an increasing capture in the target SC (+$\Delta CR(a_{rec})$SC). All repelling effects greater than 6%, where the majority (> 65%)[4] is disposed of correctly in the target container, therefore resulting in at least +3.6% $\Delta CR(a_{rec})$SC increase, are discussed in the following.
- If the capture of recyclables in the target SC (+$\Delta CR(a_{rec})$SC) increases > 6% due to a general improvement in separation, including transfer from other SCs (where no guidance stickers were applied) the effect is described as an **indirect positive effect**.
- An increase of recyclables in the RWCs (+$\Delta CR(a_{rec})$RWC) may demonstrate an undesired ***attraction effect,*** which may be due to misunderstanding of the guidance stickers. If this effect is larger than > 6%, it will be discussed in the following.

As the different capture effects described above refer to shifts within the specific waste fractions, which can make up a very small proportion in terms of quantity, it is important to consider problematic effects (contaminations) in relation to the total waste mass.

- **Contamination effects** arise if the "repelled" waste from RWCs is transferred to the wrong SC, causing contamination. This problematic effect can be described on the basis of the largest source of contamination increase per SC (sub-fraction that contributes most to the total increase of CL in separation container +ΔCL(a)SC), which mainly originates from "repelled" waste from the RWCs.

For a better evaluation and interpretation of the results, the results per waste fraction and the different effects are analysed more closely. Specific effects are also summarised in Table S10 based on changes in specific separation efficiencies (see specific capture rates in Table S7) and specific contaminations (see Tables S11-S15).

The results indicated that the forwarding stickers showed a **repelling effect (> 6%)**, and therefore a potential (general) impact, on white glass packaging (ΔCR_{sp}(wgl)RWC -17.2%), unavoidable food waste (ΔCR_{sp}(ufw)RWC -15.3%), other lightweight packaging (mainly wooden cutlery) (ΔCR_{sp}(*olw*)RWC -11.2%), pcc composite packaging and coated pcc packaging (ΔCR_{sp}(cpa)RWC -7.0%), coated cardboard cups (ΔCR_{sp}(ccc)RWC -6.7%), plastic beverage bottles (ΔCR_{sp}(pbb)RWC -6.6%) and paper packaging (ΔCR_{sp}(ppa)RWC -6.0%). In contrast undesired **attraction effects (> 6%)** occurred for paper non-packaging (e.g. newspapers) (ΔCR_{sp}(pnp)RWC + 8.8%) and beverage carton (ΔCR_{sp}(cbc)RWC + 8.7%).

Repelling effects ***resulted in positive effects*** for white glass (CR_{sp}(wgl)GL + 16.1%, correct: 94%), plastic bottles (ΔCR_{sp}(pbb)LWP + 7.0%, correct: 106%), coated cardboard cups (CR_{sp}(ccc)LWP + 4.5%, correct: 67%) paper packaging (ΔCR_{sp}(ppa)PAP + 6.5%, correct: 108%) and "indifferent" for

[4] The share can be > 100% if additional waste from other SCs was transferred

unavoidable food waste (ΔCR_{sp}(*ufw*)SSRWC +13.7%, correct: 90%) as the majority was disposed of correctly in the respective target SC. Metal beverage cans and other metal packaging showed a **positive indirect effect** (CRsp(mbp)LWP + 7.7%, CRsp(omp)LWP + 9.8%).

Problematic effects, occurred from packaged avoidable food waste (incl. beverages) in GL and LWP (ΔCL_{sp}(fwp)LWP + 8.3%, ΔCL_{sp}(fwp)GL + 0.81%) and from hygienic paper in PAP (ΔCL_{sp}(hyg)PAP + 4%), as the largest sources for contamination increase which was transferred for most parts from RWCs. The attraction of non-packaging paper created a problematic effect as this waste had the largest negative impact on increasing recyclables in RWC (CL_{sp}(pnp)RWC + 2.3%).

Table S10 Specific effects of guidance intervention

Effect type	Waste type (subfraction) and effect size
***Repelling effect** (> 6%)*	• white glass packaging (ΔCRsp(wgl)RWC -17.2%), • unavoidable food waste (ΔCRsp(ufw)RWC -15.3%), • other lightweight packaging (mainly wooden cutlery) (ΔCRsp(olw)RWC -11.2%), • pcc composite packaging and coated pcc packaging (ΔCRsp(cpa)RWC -7.0%), • coated cardboard cups (ΔCRsp(ccc)RWC -6.7%), • plastic beverage bottles (ΔCRsp(pbb)RWC -6.6%) • paper packaging (ΔCRsp(ppa)RWC -6.0%),
Undesireed Attraction effect *(> 6%)*	• paper non-packaging (e.g. newspapers) (ΔCRsp(pnp)RWC + 8.8%) • beverage carton (ΔCR_{sp}(cbc)RWC + 8.7%). • *slight effects (> 5%) for coloured glass packaging (ΔCR_{sp}(cgl)RWC + 5.2%)*
Direct Positive capture effect *majority (> 65%) of waste is disposed of correctly*	• white glass (CR_{sp}(wgl)GL + 16.1%, correct: 94%) • plastic bottles (ΔCR_{sp}(pbb)LWP + 7.0%, correct: 106%) • paper packaging (ΔCR_{sp}(ppa)PAP + 6.5%, correct: 108%) • coated cardboard cups (CR_{sp}(ccc)LWP + 4.5%, correct: 67%) • *"indifferent" for unavoidable food waste (ΔCR_{sp}(ufw)SSRWC +13.7%, correct: 90%) as the majority was disposed of correctly in the respective target SC*
Indirect Positive capture effect *Correct capture increase (> 6%)*	• metal beverage cans (CRsp(mbp)LWP + 7.7%, • other metal packaging (CRsp(omp)LWP + 9.8%)
Contamination effects *largest negative contributor*	• packaged avoidable food waste (incl. beverages) in GL and LWP (ΔCL_{sp}(fwp)LWP + 8.3%, ΔCL_{sp}(fwp)GL + 0.81%) • hygienic paper in PAP (ΔCL_{sp}(hyg)PAP + 4%) • non-packaging paper in RWC (CL_{sp}(pnp)RWC + 2.3%)

The results suggest that the intervention was particularly successful in increasing the capture of "high-valued" materials such as clear glass bottles and "well-established" waste items such as plastic bottles and metal beverage packaging. Notably, however, the capture of "less-established" items such as coated cardboard cups also improved. On the other hand, the intervention proved detrimental to improving the separation efficiency of paper non-packaging waste, resulting in a negative contamination effect by increasing specific contaminations in RWC. The intervention neither substantially improved the capture of other recyclables such as other plastic packaging (cups, films etc.) nor beverage cartons. This may be due to a suboptimal design of the guide stickers, which only depicted certain types of waste and may have been too small to be easily recognised (see Figure 2 in the main article). Moreover, red was used as the main colour to attract attention which is, however, also the colour code associated with paper waste in Austria, potentially causing the unwanted contamination effect in RWC from paper non-packaging.

The intervention further potentially caused contamination effects from the increased transfer of packaged food waste into GL and LWP and hygienic paper into PAP. This may relate to a general misinterpretation of material (e.g. mistaking hygienic paper as recyclable) or to a suboptimal design of guidance stickers, as no indication of the available collection fractions at the target (SS) was included (only “Waste Separation” 25 seconds, see Figure 2). Additionally, the separation station did not provide an organic waste separation option although most people are used to separating their organic waste from household collection. Both, the problematic effect of packaged food waste (includes packaging with high residual contents), and the repelling effect of unavoidable food waste from the RWCs may be related to pedestrians being used to separating organic waste in their households and considering it as recyclable in the public context as well, or due to an increased awareness on packaging recycling (induced by the guidance stickers), resulting in a misconception that also packaging with food residues should be disposed of in the SCs. In an attempt to separate biogenic waste and/or packaging, the waste is taken to the separation station, but there is no appropriate SC present. To prevent frustration over the non-availability of separation options and higher contaminations in the SCs, it might be important to clearly indicate the separation fractions offered at the target point (SS) on the guidance stickers (e.g. “Sort paper, glass and lightweight packaging → 25 seconds”). Qualitative instructions on the LWP separation station signage (“packaging only please!”) might have been insufficient and may need to be more precise (e.g. “No food residues or spoiled packaging. Empty packaging before disposal!”) (see separation station signage in chapter 1.4).

It is also interesting to note that a positive effect was observed for white glass, while coloured glass was not significantly affected by the intervention. This may be due to the fact that coloured bottles are more commonly used for alcoholic beverages, which leads to less awareness.

Overall, the intervention showed desired effects for four and a half (if white glass is considered) of the seven waste items depicted (white glass, plastic bottles, paper cups, paper packaging, metal drinks cans), while the intervention proved ineffective or detrimental for two depicted waste items (coloured glass and paper non-packaging). Apart from shortcomings in the design of the stickers, the differences in effectiveness for different types of waste could be due to a different established 'separation norm' (e.g. well established for plastic bottles and metal cans), ease of material identification (e.g. misinterpretation of tissue paper as recyclable), the perceived material value (e.g. high for glass bottles), or to different consumption patterns. When designing guidance signage, it is advisable to avoid using established separation colours (e.g. red for paper in Austria) as the main colour and potentially include a notice on the separation fractions provided at the destination (separation station) in cases where the collection fractions provided deviate from the common collection system (in the case of this study, no separate bin for organic waste). Finding the right balance between providing enough essential information on labels without overwhelming consumers is a challenge in this respect.

2.5 Waste composition and specific contaminations (CL_{sp})

In the following chapters 2.5.1-2.5.5 the composition and contamination level results (after waste sorting) of total waste (cumulated waste from all locations) in the week before (base) and after the intervention (post) are presented for each collection fraction/ separation container (RWC, SSRWC, GL, PAP, LWP). The change in contaminations between the two audit weeks (ΔCL_{sp}) are shown as well. The respective target fractions of collection are marked in bold. The other fractions are considered as contamination. More details on the sorting fractions can be found in the sorting catalogue in Table S5.

Specific variations are apparent to previous analysis. For example, a substantially lower percentage of dog feces (dog) was generated in the residual waste in this study in public hot spots (1 – 1.2 %) compared to the entire city area of Krems (18%) (Kladnik et al., 2024).

2.5.1 RWC

Table S 11 Waste composition and contaminations in surrounding residual waste containers (RWC) based on total volume of waste from combined test locations (total)

Waste sorting fraction	RWC total (base)			RWC total (post)				RWC total (base+post)		
	kg	%	CL_{sp}	kg	%	CL_{sp}	ΔCL_{sp}	kg	%	CL_{sp}
1.1 ufw	**50.88**	**8.27%**		**37.12**	**5.89%**			**88.00**	**7.07%**	
1.2 fwu	**28.76**	**4.67%**		**27.61**	**4.38%**			**56.37**	**4.53%**	
1.3 fwp	**51.20**	**8.32%**		**66.60**	**10.58%**			**117.80**	**9.46%**	
1.4 hyg	**45.05**	**7.32%**		**45.21**	**7.18%**			**90.26**	**7.25%**	
1.5 dog	**6.32**	**1.03%**		**4.96**	**0.79%**			**11.28**	**0.91%**	
1.6 otw	**5.23**	**0.85%**		**7.09**	**1.13%**			**12.32**	**0.99%**	
1.7 pco	**5.30**	**0.86%**		**4.71**	**0.75%**			**10.02**	**0.80%**	
2.1 ppa	67.33	10.94%	11.26%	59.14	9.39%	9.58%	-1.55%	126.47	10.16%	10.41%
2.2 pnp	57.02	9.27%	9.54%	72.90	11.58%	11.80%	2.31%	129.92	10.43%	10.69%
3.1 pbb	27.24	4.43%	4.56%	32.20	5.11%	5.21%	0.69%	59.44	4.77%	4.89%
3.2 opp	37.78	6.14%	6.32%	45.68	7.25%	7.40%	1.11%	83.46	6.70%	6.87%
3.3 mbp	30.43	4.95%	5.09%	33.82	5.37%	5.48%	0.42%	64.25	5.16%	5.29%
3.4 omp	3.76	0.61%	0.63%	4.27	0.68%	0.69%	0.07%	8.04	0.65%	0.66%
3.5 cbc	7.11	1.16%	1.19%	9.18	1.46%	1.49%	0.30%	16.29	1.31%	1.34%
3.6 cpa	23.33	3.79%	3.90%	26.23	4.16%	4.25%	0.37%	49.56	3.98%	4.08%
3.7 ccc	22.86	3.71%	3.82%	15.81	2.51%	2.56%	-1.21%	38.66	3.11%	3.18%
3.8 cpm	0.63	0.10%	0.11%	0.94	0.15%	0.15%	0.05%	1.57	0.13%	0.13%
3.9 olw	4.47	0.73%	0.75%	5.74	0.91%	0.93%	0.19%	10.21	0.82%	0.84%
4.1 cgl	49.01	7.90%	8.20%	62.64	9.95%	10.14%	1.98%	111.27	8.94%	9.15%
4.2 wgl	58.38	6.34%	9.76%	43.21	6.86%	7.00%	-2.63%	101.59	6.60%	6.76%
5.1 prw	0.15	3.23%	3.33%	1.84	0.29%	0.30%	0.27%	1.99	1.75%	1.79%
5.2 wbl	0.60	0.10%	0.10%	3.10	0.49%	0.50%	0.39%	3.70	0.30%	0.30%
5.3 mnp	5.44	0.88%	0.91%	0.18	0.03%	0.03%	-0.85%	5.62	0.45%	0.46%
5.4 tex	9.59	1.56%	1.60%	7.39	1.17%	1.20%	-0.38%	16.98	1.36%	1.40%
6 sor	17.46	2.84%		12.19	1.94%			29.65	2.38%	
	615.32	100.00%	100.00%	629.77	100.00%	100.00%		1245.09	100.00%	100.00%

2.5.2 SSRWC

Table S 82 Waste composition and contaminations in residual waste container at separation station (SSRWC)

Waste sorting fraction	**SSRWC total (base)**			**SSRWC total (post)**				**SSRWC total (base+post)**		
	kg	%	CL_{sp}	kg	%	CL_{sp}	ΔCL_{sp}	kg	%	CL_{sp}
1.1 ufw	**4.93**	**7.47%**		**11.13**	**15.71%**			**16.06**	**11.74%**	
1.2 fwu	**3.43**	**5.21%**		**3.10**	**4.38%**			**6.53**	**4.78%**	
1.3 fwp	**8.39**	**12.73%**		**7.86**	**11.10%**			**16.25**	**11.88%**	
1.4 hyg	**4.77**	**7.24%**		**5.01**	**7.08%**			**9.78**	**7.15%**	
1.5 dog	**0.80**	**1.21%**		**0.82**	**1.16%**			**1.62**	**1.19%**	
1.6 otw	**1.40**	**2.13%**		**1.56**	**2.21%**			**2.97**	**2.17%**	
1.7 pco	**0.19**	**0.28%**		**1.52**	**2.14%**			**1.70**	**1.24%**	
2.1 ppa	9.10	13.81%	14.19%	7.91	11.16%	11.27%	-2.92%	17.01	12.44%	12.66%
2.2 pnp	4.06	6.16%	6.33%	4.82	6.80%	6.87%	0.54%	8.88	6.49%	6.61%
3.1 pbb	2.21	3.35%	3.45%	2.30	3.24%	3.28%	-0.17%	4.51	3.30%	3.36%
3.2 opp	4.79	7.27%	7.47%	5.97	8.42%	8.50%	1.04%	10.76	7.87%	8.01%
3.3 mbp	2.36	3.58%	3.68%	1.79	2.52%	2.55%	-1.13%	4.15	3.03%	3.09%
3.4 omp	0.39	0.59%	0.60%	0.24	0.33%	0.34%	-0.27%	0.62	0.45%	0.46%
3.5 cbc	2.02	3.07%	3.16%	2.05	2.90%	2.92%	-0.23%	4.08	2.98%	3.04%
3.6 cpa	2.46	3.73%	3.84%	4.29	6.06%	6.11%	2.28%	6.75	4.94%	5.03%
3.7 ccc	2.63	3.99%	4.10%	1.82	2.57%	2.60%	-1.50%	4.45	3.26%	3.32%
3.8 cpm	0.03	0.05%	0.05%	0.16	0.23%	0.23%	0.19%	0.19	0.14%	0.14%
3.9 olw	0.62	0.94%	0.97%	1.39	1.96%	1.98%	1.01%	2.01	1.47%	1.50%
4.1 cgl	6.01	9.12%	9.37%	2.51	3.54%	3.58%	-5.80%	8.52	6.23%	6.34%
4.2 wgl	2.68	4.07%	4.18%	2.89	4.08%	4.12%	-0.07%	5.57	4.07%	4.15%
5.1 prw	0.01	0.02%	0.02%	0.00	0.00%	0.00%	-0.02%	0.01	0.01%	0.01%
5.2 wbl	0.03	0.04%	0.04%	0.03	0.04%	0.04%	0.00%	0.05	0.04%	0.04%
5.3 mnp	0.00	0.00%	0.00%	0.00	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
5.4 tex	0.81	1.24%	1.27%	1.01	1.42%	1.44%	0.17%	1.82	1.33%	1.36%
6 sor	1.79	2.72%		0.67	0.95%			2.46	1.80%	
	65.90	100.00%	100.00%	70.87	100.00%	100.00%		136.77	100.00%	100.00%

2.5.3 PAP

Table S 93 Waste composition and contaminations in paper containers

Waste sorting fraction	PAP total (base)			PAP total (post)				PAP total (base+post)		
	kg	%	CL_{sp}	kg	%	CL_{sp}	ΔCL_{sp}	kg	%	CL_{sp}
1.1 ufw	0.08	0.30%	0.30%	0.20	0.69%	0.70%	0.40%	0.29	0.50%	0.50%
1.2 fwu	0.64	2.28%	2.28%	0.28	0.93%	0.94%	-1.34%	0.92	1.59%	1.60%
1.3 fwp	0.88	3.14%	3.14%	1.10	3.73%	3.77%	0.63%	1.98	3.44%	3.46%
1.4 hyg	1.09	3.88%	3.88%	2.30	7.80%	7.88%	4.00%	3.39	5.89%	5.92%
1.5 dog	0.00	0.00%	0.00%	0.04	0.15%	0.15%	0.15%	0.04	0.07%	0.08%
1.6 otw	0.01	0.05%	0.05%	0.56	1.91%	1.93%	1.88%	0.58	1.00%	1.01%
1.7 pco	2.08	7.41%	7.41%	0.19	0.65%	0.66%	-6.75%	2.27	3.94%	3.97%
2.1 ppa	**5.77**	**20.56%**		**10.67**	**36.14%**			**16.45**	**28.54%**	
2.2 pnp	**14.08**	**50.11%**		**8.32**	**28.18%**			**22.40**	**38.87%**	
3.1 pbb	0.13	0.48%	0.48%	0.14	0.48%	0.48%	0.01%	0.28	0.48%	0.48%
3.2 opp	0.54	1.91%	1.91%	0.72	2.42%	2.45%	0.54%	1.25	2.17%	2.19%
3.3 mbp	0.13	0.45%	0.45%	0.21	0.72%	0.73%	0.28%	0.34	0.59%	0.59%
3.4 omp	0.02	0.09%	0.09%	0.06	0.21%	0.21%	0.12%	0.09	0.15%	0.15%
3.5 cbc	1.12	4.00%	4.01%	0.15	0.52%	0.53%	-3.48%	1.28	2.22%	2.23%
3.6 cpa	0.66	2.36%	2.36%	1.69	5.71%	5.77%	3.41%	2.35	4.08%	4.10%
3.7 ccc	0.45	1.59%	1.59%	0.92	3.11%	3.14%	1.55%	1.36	2.37%	2.38%
3.8 cpm	0.01	0.02%	0.02%	0.01	0.03%	0.03%	0.01%	0.02	0.03%	0.03%
3.9 olw	0.11	0.41%	0.41%	0.44	1.50%	1.52%	1.11%	0.56	0.97%	0.97%
4.1 cgl	0.05	0.19%	0.19%	0.41	1.40%	1.41%	1.22%	0.47	0.81%	0.81%
4.2 wgl	0.01	0.02%	0.02%	0.67	2.28%	2.31%	2.29%	0.68	1.18%	1.19%
5.1 prw	0.00	0.00%	0.00%	0.00	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
5.2 wbl	0.19	0.68%	0.68%	0.00	0.00%	0.00%	-0.68%	0.19	0.33%	0.33%
5.3 mnp	0.00	0.00%	0.00%	0.00	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
5.4 tex	0.00	0.00%	0.00%	0.12	0.40%	0.40%	0.40%	0.12	0.20%	0.20%
6 sor	0.02	0.09%		0.31	1.04%			0.33	0.58%	
	28.09	100.00%	100.00%	29.53	100.00%	100.00%		57.62	100.00%	100.00%

2.5.4 LWP

Table S 104 Waste composition and contaminations in lightweight packaging containers (LWP)

Waste sorting fraction	LWP total (base)			LWP total (post)				LWP total (base+post)		
	kg	%	CL_{sp}	kg	%	CL_{sp}	ΔCL_{sp}	kg	%	CL_{sp}
1.1 ufw	0.35	1.64%	1.64%	1.05	2.54%	2.54%	0.90%	1.40	2.23%	2.24%
1.2 fwu	0.38	1.79%	1.80%	0.79	1.91%	1.91%	0.12%	1.17	1.87%	1.87%
1.3 fwp	1.71	8.12%	8.14%	6.80	16.43%	16.45%	8.31%	8.51	13.62%	13.65%
1.4 hyg	1.41	6.69%	6.71%	1.13	2.73%	2.73%	-3.97%	2.54	4.07%	4.07%
1.5 dog	0.11	0.51%	0.51%	0.00	0.00%	0.00%	-0.51%	0.11	0.17%	0.17%
1.6 otw	0.24	1.16%	1.16%	0.07	0.16%	0.16%	-1.00%	0.31	0.50%	0.50%
1.7 pco	0.21	0.99%	0.99%	0.11	0.27%	0.27%	-0.72%	0.32	0.51%	0.51%
2.1 ppa	0.82	3.92%	3.92%	1.74	4.20%	4.21%	0.28%	2.56	4.11%	4.11%
2.2 pnp	0.14	0.67%	0.67%	0.39	0.94%	0.94%	0.27%	0.53	0.85%	0.85%
3.1 pbb	**5.71**	**27.13%**		**10.65**	**25.74%**			**16.36**	**26.21%**	
3.2 opp	**2.94**	**13.95%**		**5.36**	**12.96%**			**8.30**	**13.30%**	
3.3 mbp	**3.61**	**17.14%**		**7.62**	**18.41%**			**11.23**	**17.98%**	
3.4 omp	**0.20**	**0.96%**		**0.78**	**1.88%**			**0.98**	**1.57%**	
3.5 cbc	**0.20**	**0.93%**		**0.63**	**1.53%**			**0.83**	**1.33%**	
3.6 cpa	**0.33**	**1.56%**		**0.68**	**1.65%**			**1.01**	**1.62%**	
3.7 ccc	**0.58**	**2.75%**		**1.34**	**3.24%**			**1.92**	**3.07%**	
3.8 cpm	**0.09**	**0.42%**		**0.11**	**0.26%**			**0.20**	**0.32%**	
3.9 olw	**0.08**	**0.38%**		**0.27**	**0.64%**			**0.35**	**0.55%**	
4.1 cgl	1.89	8.98%	9.00%	0.57	1.38%	1.38%	-7.61%	2.46	3.94%	3.95%
4.2 wgl	0.00	0.00%	0.00%	0.47	1.13%	1.13%	1.13%	0.47	0.75%	0.75%
5.1 prw	0.00	0.00%	0.00%	0.53	1.27%	1.27%	1.27%	0.53	0.84%	0.84%
5.2 wbl	0.03	0.12%	0.12%	0.23	0.56%	0.56%	0.44%	0.26	0.41%	0.41%
5.3 mnp	0.00	0.00%	0.00%	0.00	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
5.4 tex	0.00	0.00%	0.00%	0.00	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
6 sor	0.04	0.21%		0.06	0.16%			0.11	0.17%	
	21.06	100.00%	34.66%	41.37	100.00%	33.56%		62.43	100.00%	33.93%

2.5.5 GL

Table S 115 Waste composition and contaminations in glass containers (GL)

Waste sorting fraction	GL total (base)			GL total (post)				GL total (base+post)		
	kg	%	CL_{sp}	kg	%	CL_{sp}	ΔCL_{sp}	kg	%	CL_{sp}
1.1 ufw	0.25	0.35%	0.35%	0.11	0.12%	0.12%	-0.23%	0.36	0.22%	0.22%
1.2 fwu	0.73	1.06%	1.06%	0.20	0.21%	0.21%	-0.85%	0.93	0.57%	0.57%
1.3 fwp	1.62	2.34%	2.34%	2.92	3.15%	3.15%	0.81%	4.54	2.80%	2.80%
1.4 hyg	0.50	0.72%	0.72%	0.24	0.26%	0.26%	-0.45%	0.74	0.46%	0.46%
1.5 dog	0.05	0.07%	0.07%	0.02	0.02%	0.02%	-0.05%	0.07	0.04%	0.04%
1.6 otw	0.09	0.13%	0.13%	0.00	0.00%	0.00%	-0.13%	0.09	0.05%	0.05%
1.7 pco	0.02	0.03%	0.03%	0.01	0.01%	0.01%	-0.02%	0.02	0.01%	0.01%
2.1 ppa	1.01	1.46%	1.46%	0.34	0.37%	0.37%	-1.09%	1.35	0.83%	0.83%
2.2 pnp	0.39	0.56%	0.56%	0.24	0.26%	0.26%	-0.30%	0.63	0.39%	0.39%
3.1 pbb	0.49	0.71%	0.71%	1.05	1.13%	1.13%	0.41%	1.54	0.95%	0.95%
3.2 opp	0.32	0.47%	0.47%	0.37	0.40%	0.40%	-0.07%	0.70	0.43%	0.43%
3.3 mbp	1.91	2.75%	2.75%	1.04	1.12%	1.12%	-1.63%	2.95	1.82%	1.82%
3.4 omp	0.09	0.13%	0.13%	0.10	0.10%	0.10%	-0.02%	0.18	0.11%	0.11%
3.5 cbc	0.05	0.07%	0.07%	0.00	0.00%	0.00%	-0.07%	0.05	0.03%	0.03%
3.6 cpa	0.13	0.19%	0.19%	0.02	0.02%	0.02%	-0.16%	0.15	0.09%	0.09%
3.7 ccc	0.33	0.47%	0.47%	0.27	0.29%	0.29%	-0.18%	0.59	0.37%	0.37%
3.8 cpm	0.02	0.02%	0.02%	0.00	0.00%	0.00%	-0.02%	0.02	0.01%	0.01%
3.9 olw	0.01	0.01%	0.01%	0.01	0.01%	0.01%	-0.01%	0.02	0.01%	0.01%
4.1 cgl	**19.93**	**28.74%**		**25.03**	**26.94%**			**44.96**	**27.71%**	
4.2 wgl	**40.93**	**59.02%**		**60.68**	**65.32%**			**101.61**	**62.63%**	
5.1 prw	0.36	0.52%	0.53%	0.20	0.22%	0.22%	-0.31%	0.57	0.35%	0.35%
5.2 wbl	0.00	0.00%	0.00%	0.00	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
5.3 mnp	0.00	0.00%	0.00%	0.00	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
5.4 tex	0.00	0.00%	0.00%	0.00	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
6 sor	0.14	0.20%		0.04	0.05%			0.18	0.11%	
	69.35	100.00%	100.00%	92.89	100.00%	100.00%		162.24	100.00%	100.00%

2.6 Test location differences

Previous location analyses were conducted to create the most favourable setting conditions (e.g. optimal waste bin visibility and short walking distances to the separation station) and ensure an optimal field test set-up (see chapter 1.1).

However, the results (especially separation efficiencies) of the different test locations are not directly comparable as the setting conditions of waste bins vary between test locations, most importantly concerning the ratio of RWCs to SS and the average walking distances to the SS (see table S1). Moreover, the bin design and external factors such as foot traffic, clientele (e.g. socio-demographic differences), consumption patterns, traffic conditions and patterns of stay are highly specific in each test location.

Nevertheless, the collected metrics; waste composition and separate collection performance at a standardized level (see following section), allow for a comparison between locations, providing implications on the influence of setting conditions (average walking distance) and external factors (degree of urbanization) on the share of recyclables and waste separation behaviour. Since weather conditions were generally favourable and rather stable across locations (see chapter 1.3 weather record), the potential impact of adverse weather conditions (e.g., heavy rain or cold temperatures) could not be assessed.

For a crude comparison between separate collection performance in the locations, the results were standardized with respect to proportion of RWCs / SS, including only the six closest RWCs to the SS. A comparison of the standardised separate collection rate (see $SCR_{stand,}$ Figure S18) and generated waste composition in the test locations (see Figure S19) shows that although more recyclables are generated in Vienna (sum of recyclables in UC = 77%, S = 68%, PZ = 65%, TS = 58%), the Kremser sites, especially the pedestrian zone, shows better overall separate collection on this standardised basis (total SCR_{stand} PZ = 30.1%, TS = 23.3%, UC = 21.3%, S = 13.1%). This provides implications that separate waste collection works better in less urbanized locations, which is consistent with studies on household collection (Baud & Milota, 2017; Feil et al., 2017; Schuch et al., 2023). However, results showed that the separation quality is not generally better in the small city locations. With the exception of contaminations in glass, which is highest in S (GL=32%), contamination levels in separation containers were highest at the train station square TS in Krems (PAP = 50%, LWP = 58%, GL= 15%, see Figure 3 in main article). Furthermore, the comparison of different test sites suggests that separate collection performance is not clearly correlated to the walking distance from the residual waste bins to the separation station, as in the PZ, which showed thebest separate collection performance (see SCR_{stand}, Figure S18), the SS had the highest average distance referring to the six nearest surrounding RWCs (PZ: 83m, S: 33m, UC: 22m, TS: 14m).

Implications from the differences in test locations may be summarised as follows:

- More recyclables are generated in public spots of more urbanised/ larger city
- Separate collection performance is better in less urbanised/ smaller city
- Separate collection performance is not directly related to the average walking distance to the separation station
- Separation quality varies by location and is not clearly linked to the degree of urbanisation

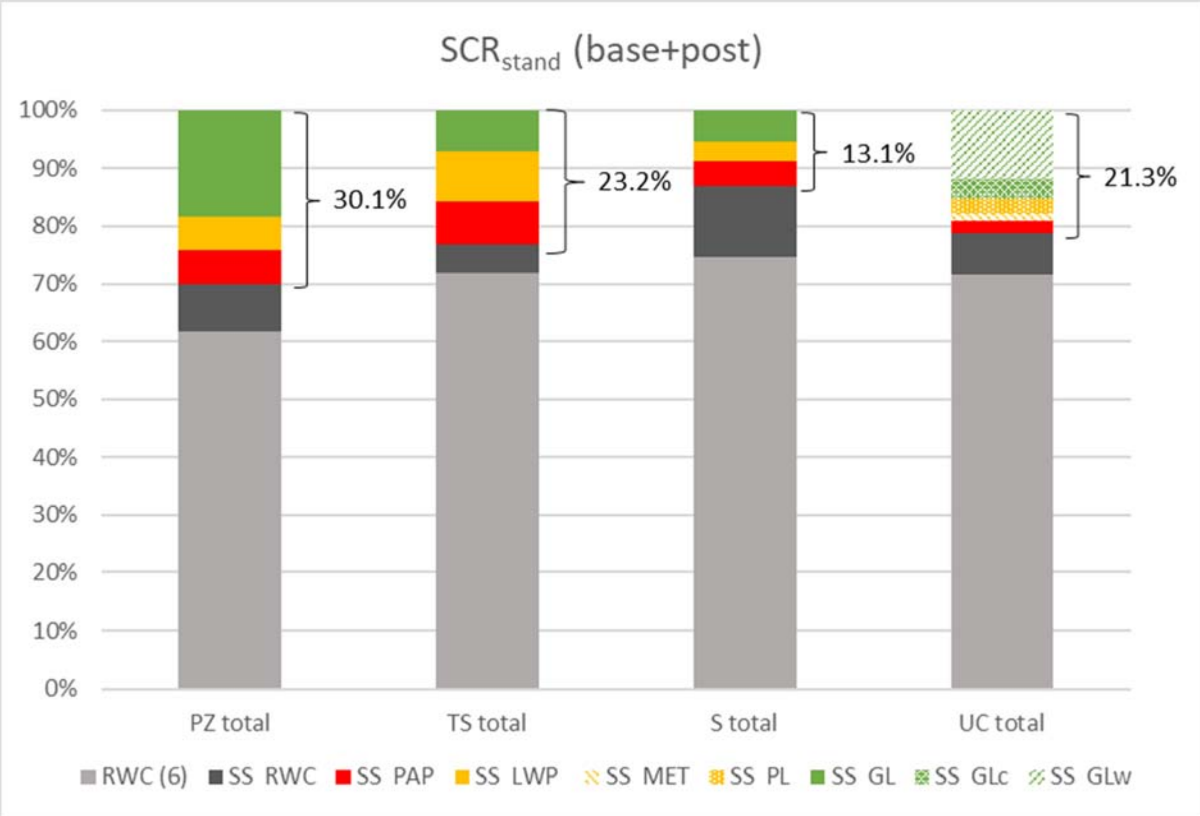

Figure S18 standardized SCRs including six closest surrounding RWCs based on results from both audit weeks (base + post) for each test location

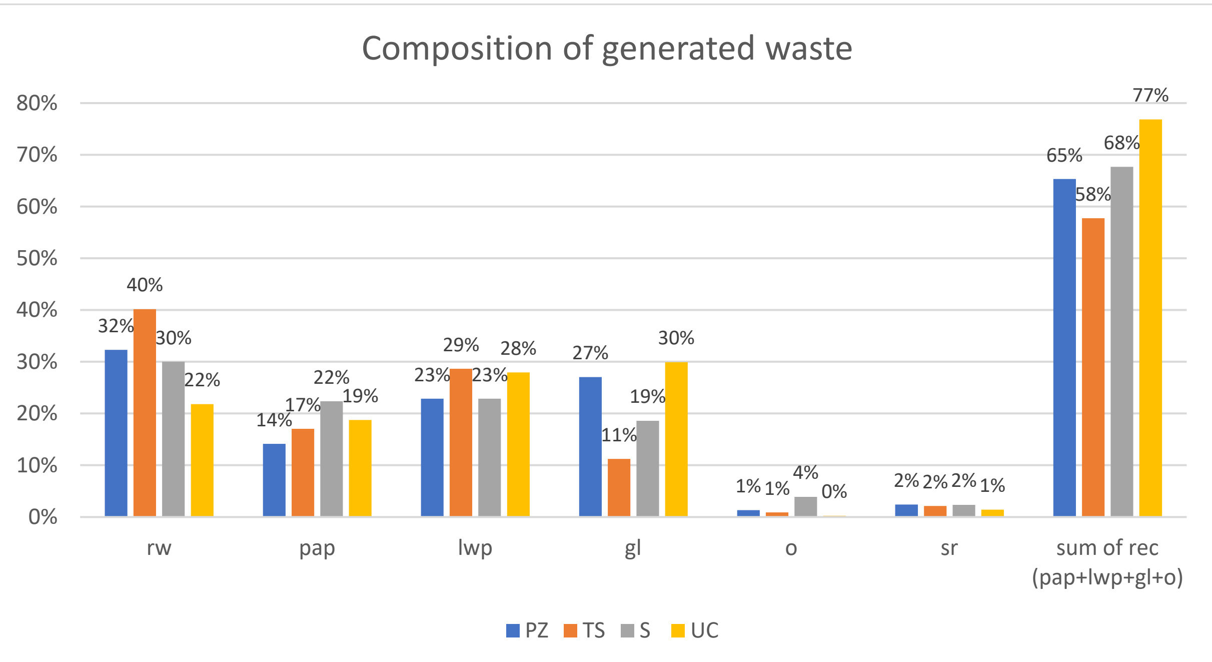

Figure S19 Composition of generated waste (independent of collection container) based on total collected waste (base + post) and five main waste fractions for each test location; rw = Residual waste target fractions, lwp = Lightweight Packaging target fractions, pap = Paper, Cardboard, Corrugated board (PCC) target fractions, gl = Glass packaging target fractions, o = Other collection points target factions

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