

Report

Spring 2015

Recycle and Reward Pilot Project Report

University of Dundee



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Zero Waste Scotland works with businesses, individuals, communities and local authorities to help them reduce waste, recycle more and use resources sustainably.

Find out more at zerowastescotland.org.uk

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1 Executive summary

Zero Waste Scotland supported a number of Recycle and Reward pilot projects in 2013. Each site has a separate report on its performance, and an overview report is also available.

The University of Dundee participated in the Recycle and Reward pilot project, funded by Zero Waste Scotland, to see how recycling facilities that offer rewards may affect recycling (specifically of drinks containers) on campus. The university installed seven Recycle and Reward machines across four locations on its main campus in February 2013. These automated machines provided a reward (money-off voucher) in exchange for returning empty drinks containers for recycling. The pilot project aimed to collect aluminium cans and PET plastic bottles, among other materials. SKM Enviros and Nicki Souter Associates (NSA) evaluated and monitored the pilot project, to assess independently the performance and public acceptability of the system. The period evaluated was between 20 February and the end of September 2013. The University of Dundee continued to supply scheme data on recycling to Zero Waste Scotland until December 2013, though sales data were no longer available. The machines were in addition to the existing recycling and general waste infrastructure on the campus.

Here is how the pilot project did overall.

- People returned 34,536 containers to the machines.
- This represents 13% of the containers estimated to have been sold on campus during the period. Some containers recycled may have been brought from elsewhere, and, conversely, this figure does not reflect containers recycled elsewhere.
- The proportion of drinks sold whose containers were returned via the machines fluctuated significantly over the pilot, from 6% to 37%.
- The quantities collected by the scheme were low, at 0.6 tonnes. That is about 13% of estimated can and bottle recycling on the campus overall.
- User surveying suggests that 16% had used the scheme at least once and 9% of respondents were regular users.
- About 85% of the total reward value was redeemed. This shows that the reward was worth claiming at the DUSA shop.
- Far more cans, relative to sales, were returned than bottles, perhaps because the reward for cans was higher (5p rather than 3p per unit). However, it seems (from the overall site recycling data) that more cans were consumed on site than bottles.
- Of those surveyed, 3% claimed to be recycling more bottles, and 5% claimed to be recycling more cans, as a result of the scheme.
- A large majority of respondents (93%) wanted to see the scheme continue, and would welcome schemes of this kind being more widespread in Scotland.
- Pilot performance remained broadly consistent in the autumn term. A further 17,779 containers were collected, with the proportions of cans and plastic bottles much the same as in the earlier period. Slightly more containers were collected per week than from March to September, which is unsurprising given the former period includes the summer break. The collection rate also appears a little higher than in the spring term (though this comparison is complicated by the exact timings of Easter, exams and so forth). In the absence of sales data, we cannot calculate a capture rate for the autumn term.

2 Pilot description

This section describes the pilot site at the University of Dundee's main campus, and the population it targeted. It then considers waste management systems in place before and during the pilot period, and then the detail of the Recycle and Reward scheme, including sections on

the communications and site resourcing requirements of the pilot. A final section describes any changes to them introduced during the pilot period.

2.1 Background and context

The University of Dundee has three campuses in different places: the main city centre campus (where the Recycle and Reward pilot took place); the Ninewells Medical School at Ninewells Hospital in Dundee; and the Fife campus in Kirkcaldy, around 30 miles south of Dundee. These last two campuses were not part of the pilot and are not covered in this report.

The main city centre campus ('the campus') is located to the south-west of the city centre, around 300m from the city's railway station. It covers an area of approximately 550m east to west by 330m north to south and is bounded by Perth Road to the south, South Tay Street to the east, Hawkhill to the north and Millers Wynd to the west. There are also two complexes of university-owned student accommodation off the main campus area. They were deemed to be sufficiently distinct and distant to be excluded from monitoring, though export of containers (especially resealable bottles) is quite credible.

The campus comprises over 50 buildings accommodating teaching and support functions (see Figure 1). There are two complexes of student accommodation (Belmont Tower Residence and Belmont Residences, which are adjacent and share waste management facilities); Heathfield Residences; university libraries; sports facilities; the Duncan of Jordanstone College of Art and Design; the dental school and hospital; and several science teaching and research buildings. The campus boundary is open for foot and road traffic to pass through, and both the nature of the scheme and the location meant that it was quite possible for people who had bought drinks containers off site, and indeed any passers-by, to access the scheme.

DUSA is housed in a building in the centre of the campus and hosts at least two bars, a café/restaurant and two nightclubs as well as DUSA's administrative offices. DUSA also manages cafeterias in the Matthew Building (part of the art college) and the library, two shops on campus and vending machines in many of the buildings across the site. There are also a large number of cafés and shops close to the campus.



Figure 1 Site map of University of Dundee city centre campus with Recycle and Reward recycling facilities marked

2.2 Waste management arrangements before the pilot

The university provides recycling facilities throughout its premises in a quite complex mix of infrastructure and service providers. Alongside the university there are three other organisations with responsibility for waste management on campus. The areas of responsibility are set out below.

The University of Dundee is responsible for waste and recyclables arising in its teaching and administrative buildings and general waste bins on the streets within the campus area.

Segregated recyclables (paper, plastic bottles and aluminium cans) from bins in communal areas of the teaching and administration buildings are collected daily and stored at the university's waste yard for collection. Mixed cans and plastic bottles are also collected from staff areas in the teaching buildings.

- The university has a contract with Dundee City Council to collect these materials weekly. Separate weight data are unavailable for the university, since the waste is collected on a wider round that includes other organisations.
- Materials collected through the Recycle and Reward machines were added to these recyclables before collection from the waste yard.

General waste from internal bins and from street bins on campus is collected daily and stored at the university's waste yard for collection. The university recently (beginning in November 2012) installed 10 solar-powered 'Big Belly bins' in areas where littering has been bad in the past. These bins compact waste and send a message to the waste team when they need to be emptied. Material from these is also stored at the waste yard for collection.

- Residual waste is uplifted by a private waste contractor for disposal. Some skip weights were available but not for the entire 2012 calendar year.

Other waste streams are not expected to be affected by this study and/or have not been included:

- segregated glass from the life science building laboratories;
- mixed recyclables from maintenance and refurbishment activities;
- paper and cardboard from university activities (e.g. office areas, maintenance etc.); and
- textile recycling bins in residence courtyards.

A further contractor manages cleaning, maintenance and waste services at two student residences (comprising seven blocks of flats) on site (as well as others off site, which have not been included in the pilot). Dundee City Council provide bins in separate bin stores in the courtyards of the student residences for general waste and segregated bins for recyclables (paper, cans, plastic bottles, clear glass, brown glass and green glass).

Dundee City Council also directly manages several Recycle on the Go (ROTG) banks at three locations on campus (as well as another close to, but outside, the campus boundary). They collect paper, cans and colour-segregated glass (clear, brown and green) at Belmont Tower, Bonar Hall and Duncan of Jordanstone College of Art and Design, Crawford Building.

We did not gather data on DUSA waste streams for this pilot because it does not manage aluminium cans or polyethylene terephthalate (PET) plastic bottles, other than those from its bars, where drinks are decanted. The bar staff use plastic mixer bottles and cans but retain them rather than pass them to student customers for disposal.

Figure 2 shows how the materials targeted by the Recycle and Reward scheme flow through the site. This is a site with very open boundaries (given its proximity to the city centre and other retail outlets) and multiple waste management routes. We could not monitor material flows onto the site, and information on the waste management depended on how it was recorded by the different parties involved. The information varied among routes, as described above.

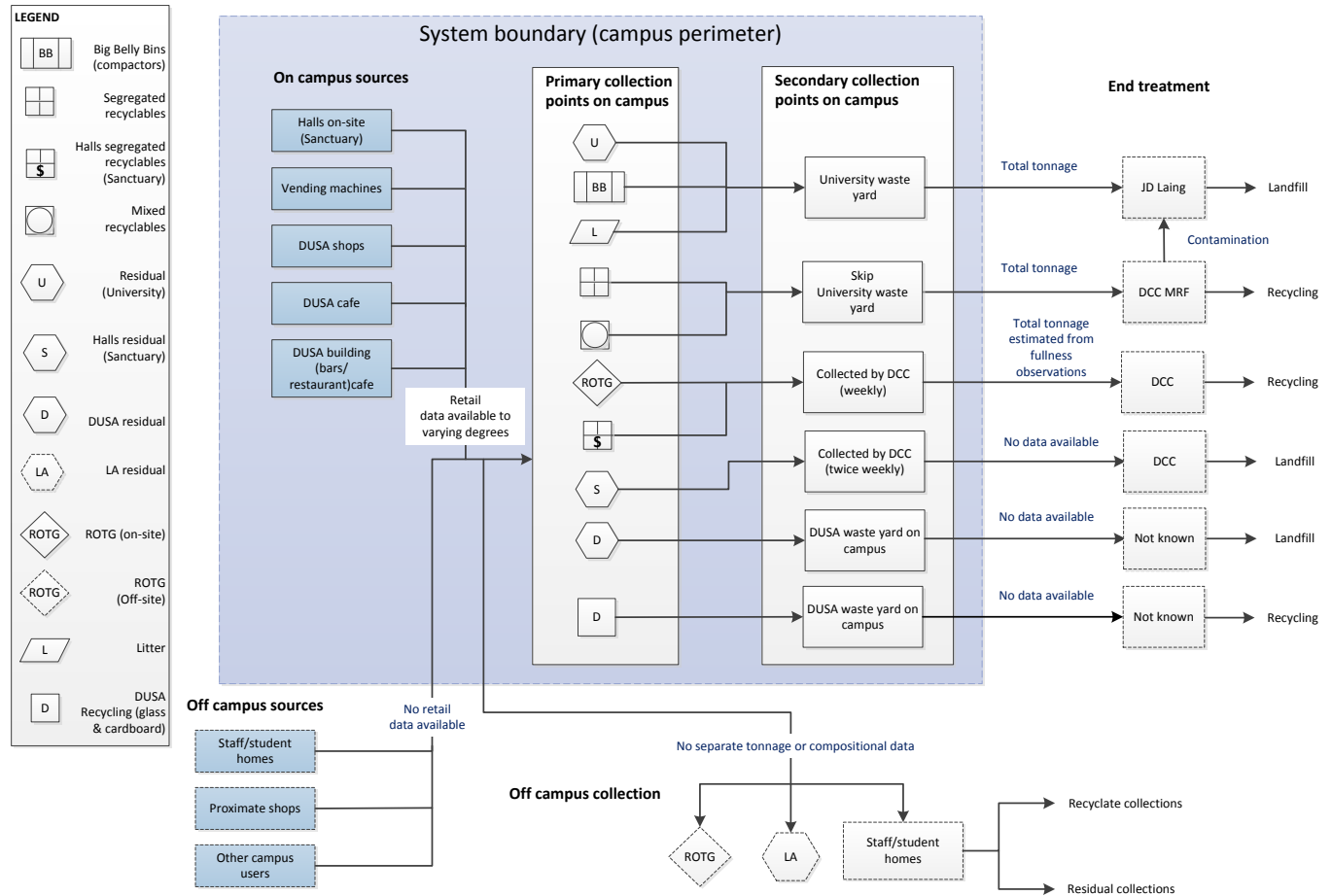


Figure 2 Flow of waste and waste data before pilot scheme

2.3 Target population

The University of Dundee is one of Dundee's largest employers, with over 3,000 staff. It has around 19,000 students, around 12,000 of whom are undergraduates and over 4,000 are distance learning students. From 2010/11 data, around 10,600 students are on the main campus and the remainder are in the College of Medicine, Dentistry and Nursing, which has sites at Ninewells and in Fife. It is thought that the Ninewells students and staff may occasionally visit the main campus. Dundee City has a population of around 145,570 (National Records of Scotland Mid 2011 Population Estimates Scotland).

2.4 Recycle and Reward approach

Seven Recycle and Reward machines were installed across the campus in four locations (Figure 1). Each machine accepts one material, so one for PET plastic bottles and another for aluminium cans were typically paired. The exception was at Belmont Tower, where only a PET plastic bottle machine was placed, to complement existing ROTG facilities that already accepted cans. All machines were Revendit Flex Interactive models, as shown in Figure 3.



Figure 3 Flex Interactive machine in situ (Belmont residences)

The machines were installed on 19 February and were operational from 20 February. The pilot was officially launched during the university's Green Week, 4–8 March 2013. The university organised a litter pick across campus on 5 March and the materials collected were put through the Recycle and Reward machines. It is also worth noting that Zero Waste Scotland also surveyed litter in the area around the Premier store on campus as a separate item of work.

The locations for the Recycle and Reward machines and the reasons for their siting are shown in Table 1. In selecting the most appropriate locations, health and safety considerations took priority, e.g. to ensure thoroughfares were not blocked in an emergency. In addition, the machines require a power supply and access to wifi to enable a telemetry link to a remote server in order to record container receipts and vouchers issued, and to let engineers monitor the status and operation of the equipment remotely.

Location	Machines/material accepted	Reasons for site selection
Dalhousie Building* – ground floor (mainly teaching rooms and lecture halls)	1 for PET bottles 1 for aluminium cans	High footfall High visibility next to vending machines Vending machines are a source of target materials
Matthew Building (part of Duncan of Jordanstone College of Art and Design) – ground floor	1 for PET bottles 1 for aluminium cans	High footfall Location used as breakout area by students High visibility next to vending machines Vending machines are a source of target materials
Students' Union Building – external under walkway linking buildings	1 for PET bottles 1 for aluminium cans	High footfall – main thoroughfare for students travelling across campus Close to nightclub exit door Close to Premier shop (open till 10:00) Historic litter problem
Belmont Tower – external under overhanging upper storey, next to existing Recycling on the Go banks	1 for PET bottles	High footfall Close to Premier shop Historic litter problem Next to recycling banks for other materials

Table 1 Recycle and Reward facility locations

Note

**In the original project plan, facilities for PET plastic bottle and aluminium cans were to be located next to the café at the main entrance of the library, but they were installed in the Dalhousie Building instead. This was because there was some concern about noise and the library is also very close to the Students' Union Building and Belmont Tower, where Recycle and Reward machines were already located.*

The reward for recycling was a voucher (worth 5p per aluminium can, 3p per PET plastic bottle) redeemable against purchases only at the on-campus Premier Store run by DUSA in the Students' Union. One voucher was given per use of the machine, so there could be many containers per voucher, with the voucher having a variable value.

The Belmont Tower and Students' Union machines were in the central and busiest area of the campus. Both were outside the buildings so could be used at all times by anyone. They were also both close to the Premier Store where vouchers could be redeemed. All other recycling facilities remained available throughout the pilot.

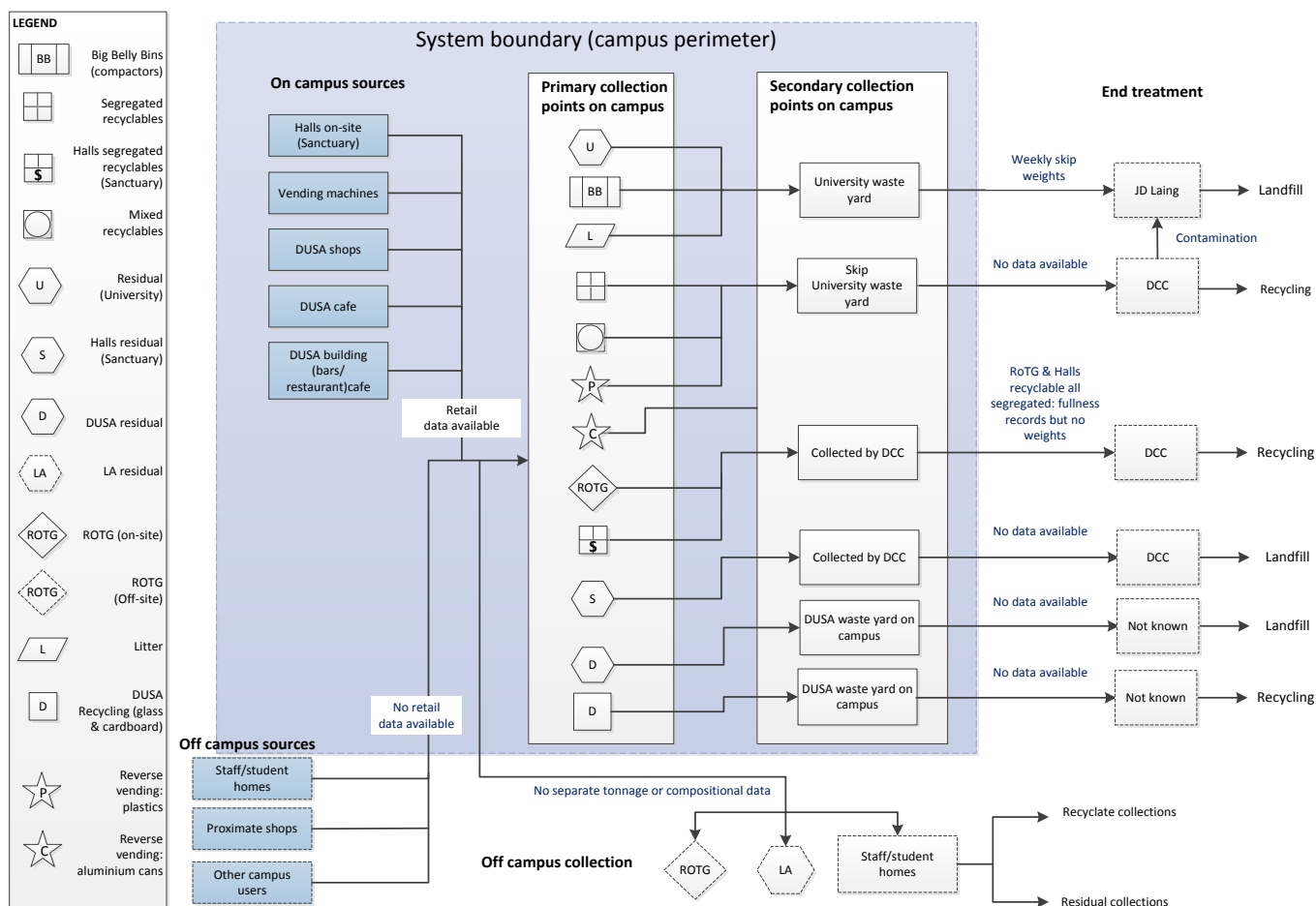


Figure 4 Flow of waste and waste data after pilot scheme began

2.5 Promoting the scheme

Zero Waste Scotland provided communications support and resources to help the University of Dundee develop a communications plan and timetable of activities during the pilot project, covering the launch in March and relaunch during freshers' week. Zero Waste Scotland approved the plan, and the supporting materials.

The communications strategy used many forms of media to get the message across to campus users – 'you are never very far from a Recycle and Reward machine' – and also to make them aware of incentives, to increase the likelihood that they would make the effort to recycle. A key goal was to encourage students to develop good habits whilst they were enrolled at the university, in the hope that they would have them for life.

The University of Dundee used a variety of media streams:

- dedicated emails;
- weekly electronic newsletter (Hermes) – goes out to over 22,000 staff and students;
- Facebook;
- Twitter;
- posters;
- press releases on university website;
- local radio, newspapers, and television (STV) – the university has a very active press office with good links to D.C. Thomson publishers and local radio stations;
- training sessions; and

- lectures.

2.5.1 *Staff engagement*

DUSA, the Premier shop's general manager and staff, and estates staff had a key role coordinating between the project and the students. They were all provided with face-to-face training about the project, how to use the equipment and how to redeem rewards, so that they could respond to student and staff enquiries. Training took place before the Recycle and Reward machines were installed and also during the installation process on 18 February 2013. The environment and sustainability officer and estates staff carried out staff training, supported by the equipment supplier and its team of service engineers. A refresher training session also took place during freshers' week and the week before, to coincide with the intake of new students.

A detailed briefing note was emailed to all key staff to ensure they knew the background to the project and had sufficient information to respond to customer enquiries. It also gave contact details for further information. This was also issued again during freshers' week.

2.5.2 *Media and public relations*

A programme of media/public relations (PR) opportunities continued throughout the duration of the project. The main target medium was the local press, although PR angles were extended to maximise regional coverage, including an article in *The Scotsman*, published on 27 February, announcing the launch date of the scheme. The formal launch of the Recycle and Reward project took place on 4 March 2013, during the university's Green Week. The launch week's activities included green quizzes, training sessions and Zero Waste Scotland volunteer demonstrations of how to use the machines at the university. It also included a demonstration of the benefits of recycling the materials and types of products that could be manufactured from recycled packaging materials. A relaunch during freshers' week, in September, provided similar activities to those used in Green Week. Student TV featured the project during freshers' week and was broadcast on plasma screens throughout the campus.

2.5.3 *Marketing communications*

2.5.3.1 **Flyers**

A6 promotional flyers were produced and distributed at key locations, including the Premier shop, high student use areas (such as breakout areas) and teaching buildings. The flyers detailed the location of the Recycle and Reward machines, the materials that could be recycled and the rewards. These highlighted three key messages: benefit yourself and the environment; turn your recycling into rewards; and landfill or pocketful? Flyers for each theme were distributed in turn, beginning two weeks before the launch and continuing thereafter on an ongoing basis.

2.5.3.2 **Posters**

Promotional posters were distributed throughout DUSA and the campus (A0 and A3 sizes), during a seven-week period before and after the launch of the project on 4 March 2013 and again during a two-week period to coincide with freshers' week. Portable document format (PDF) files of the posters were also emailed to all school secretaries to inform staff and students. Key messages included locations of the Recycle and Reward machines, the rewards and how to claim them.

2.5.3.3 **Signage**

All Recycle and Reward machines were identifiable by the use of approved branding, messages and graphics, which were fitted to the three panels, which were visible to the staff and students using the machines.

2.5.3.4 E-mails – Hermes

The university has an internal newsletter, Hermes, which is sent to over 22,000 staff and students. Features describing the project were included in the Hermes newsletter for two consecutive weeks before the launch of the project and then on an ongoing basis. The newsletter was also used to encourage students to redeem any vouchers they had collected over the summer term, in the week before the campus closed for undergraduate students on 6 May 2013. Similarly, the newsletter was translated into Italian, to coincide with the residency of summer school students living on campus in June and July, so that overseas students could take part in the project.

2.5.3.5 Social media

The primary social media routes were University of Dundee Facebook, Twitter and MyDundee (virtual learning environment), with regular messages issued from the week before the launch and then on an ongoing basis throughout the project. Increased activity took place during freshers' week, to inform new students about the location of the Recycle and Reward machines, the rewards available and how to collect them.

2.5.4 Freshers' week

It was clear from the outset of the project that communications would be important during freshers' week, as around 2,000 new students would be introduced to the scheme, most of whom would be unfamiliar with the concept. The university identified that a priority would be to get the new intake using the scheme. The main communications included a relaunch, using similar activities and materials to those designed for the initial launch of the project in March. In addition, four new communication channels were introduced. A full-page advertisement was placed in *The Fridge*, a magazine aimed at all freshers attending the university. Plasma screen advertisements were placed across the campus. New directional signage was placed on three large window panels in the Students' Union Building, to direct students to the nearest Recycle and Reward machines. Point-of-sale information (shelf talkers) was introduced in the Premier shop, to inform students that the drinks containers bought there could be recycled using the machines on campus and they could redeem the vouchers in the store.

2.6 Changes during the pilot period

The operation of this pilot site was not static, and there were some operational changes over the pilot period that may have affected its performance, both the user experience and the number of containers collected. Promotional activity varied, for example, with peaks at the start of the pilot and during freshers' week in September as noted above.

In particular, the machines required frequent visits from a service engineer, because of a number of recurring problems, which resulted in the machines being unable to accept containers, or failing to print out vouchers for materials put in the machines. These operational problems were significantly reduced in early August 2013 following a visit and diagnostic report by the equipment manufacturer. Performance of the machines improved over subsequent months but, overall, the equipment needed more servicing than the other pilot projects.

3 Study method

The overview report on the pilots gives greater detail on the method selected and the reasons for this. This section focuses on how this was applied in this specific location, first describing the approach to data collection on performance, and then the approach taken to the social research (obtaining user, non-user and staff feedback at the site). A final section considers challenges encountered in practice, and how far this affects the conclusions that can be drawn about pilot performance.

3.1 Performance data collection

Quantitative data were gathered in various ways, described below. Although some of the desirable waste data for the site as a whole were not available, there was a high level of engagement from staff of the university and Revendit (supplier of the Recycle and Reward machines), who provided sales and redemptions data to compare with the machine returns data. See section 4.

3.1.1 *Machine throughput*

All of the Recycle and Reward machines installed included unit counters to collect data on total units inserted. The university's Environment and Sustainability Officer (ESO) read these counters weekly where practicable (every Friday) during the pilot period. These data were then returned to SKM in a basic spreadsheet. In addition, data were collected remotely from the equipment provider by telemetry and then forwarded to SKM once a week by the machine supplier.

These data were available disaggregated by machine and by material type at each location. Throughout the data collection period, manual and telemetry data were sense-checked separately as they were submitted, and cross-referenced and compared to ensure general consensus in results. The data were read on different days of the week so there was always some difference between the two datasets for a given time period. Where Revendit did not have telemetry data because of technical issues with wifi, for example, the ESO was still able to provide manual readings. It is worth noting that there was no complete dataset with figures for all machines for all weeks from either source, so cross-checking and interpolation had to be done on several occasions.

The total number of rewards issued was calculated based on the number of units inserted.

3.1.2 *Waste and recycling data*

Baseline data (before the pilot) were made available for the segregated recyclable materials collected by Dundee City Council from the student residences. This was done weekly and by container 'fullness' on collection rather than by weight (see section 3.2 on data limitations). A single record for average fullness of the ROTG banks over four to six weeks in December 2012 and January 2013 was provided but 2012 (baseline) data for the pilot period (March to September) were unavailable. The university provided weight data based on skip weights from JD Laing for the university's residual waste collected from the waste yard (weekly tonnages except for May–July 2012). Estimated annual tonnages of segregated recyclables (plastic bottles, aluminium and steel cans, and paper and cardboard) from the teaching and administration buildings were also provided by the university waste manager.

During the pilot period, Dundee City Council provided weekly or twice-weekly fullness observations of the ROTG banks and student residences' segregated recyclables. The university waste manager provided tonnages for weekly residual waste skips uplifted from the waste yard by the waste contractor.

The recyclates from the Recycle and Reward machines were added to segregated recyclables from the university's teaching and administration buildings before collection. Unfortunately, weight or volume data were not separately available for these materials, because they are collected from the waste yard as part of a round, so weighbridge data would include waste collected from other organisations.

3.1.3 *Litter monitoring*

Separately from this study, Zero Waste Scotland implemented a litter study in the area around the Premier store, where there are benches and a picnic area with very high footfall and a historic litter problem. This was linked to the installation of the Big Belly solar-powered compacting litter bins, but

was timed to coincide with the introduction of the Recycle and Reward scheme, to ascertain if an impact on litter could be discerned (see section 4.7 on the pilot's impact on litter).

3.1.4 *Retail and rewards data*

Recycle and Reward machine returns data can be compared with the sales data to gain some understanding of the 'capture' of relevant containers sold on site. DUSA provided pre-pilot sales data for target containers based on actual sales in the two campus shops during one term-time week, an estimated figure for weekly term-time vending machine sales and an estimate of expected sales (from shops and vending machines) during holiday periods.

The DUSA retail services manager provided monthly sales data for the pilot period in three- to four-month batches and included a breakdown by material for the two shops and the café in the Matthew Building (art college) and a combined estimated figure for vending sales. It should be noted that the art college café was closed from June to August (i.e. in the middle of the pilot). Sales from the library café have not been included but DUSA staff indicated that this was expected to be no more than 5% of the total sales figures.

The redemption of rewards from the machines can also be tracked. Data on rewards claimed were based on invoices raised by DUSA and presented to the university approximately twice a month, with an extra invoice in May, when the exams and art college degree show meant the Premier store was very busy.

In assessing the capture rate at Dundee University, it is important to remember the open nature of the scheme, and of the site. Containers bought off site could be placed in the machines, and received a reward. Conversely, containers bought on site may be consumed off site. There is no way to take these 'imports' and 'exports' into account, with some site feedback suggesting flows were significant. However, the social research goes some way to exploring the possible impact of this.

3.2 Social research – quantitative survey and observations

The methods used to appraise the attitudes, behaviour and experience of people using the Recycle and Rewards machines at the University of Dundee were:

- observational analysis (two days);
- quantitative face-to-face surveys (target 250); and
- focus groups (two: one user and one non-user group).

Greater detail on the methodologies employed across all sites is available in the appendix, and the overview report. This section highlights considerations that are unique to this site.

The social research at Dundee University was carried out between 16 and 26 September, i.e. early in the 2013/14 academic year, during the second and third week of teaching. It is possible that newer students may therefore have been relatively unfamiliar with the scheme.

Additional insight into the Dundee pilot was also obtained from the university's annual environmental survey (run online at the end of the 2012/13 academic year), which included some questions on the pilot. Zero Waste Scotland staff also visited the pilot frequently throughout the period, and are familiar with several of the operational issues encountered, and input from the university's ESO was also invaluable.

3.2.1 *Observational analysis*

Trained NSA engagement officers carried out the observational analysis on Friday 20 and Thursday 26 September between 09:30 and 17:30 at each of the four areas where the machines were located.

At each location, an average of three hours of observations were carried out and recorded using standardised recording sheets. Relatively few people were seen using the machine during this period, which is at odds with the usage data for the same time period (which was not exceptionally low). Thus the observations at this location provide some insight, but insufficient data to draw conclusions in isolation (discussed further below).

3.2.2 Quantitative survey

Two NSA engagement officers carried out the quantitative survey over five days (16–20 September) between 10:00 and 18:00. The engagement officers approached students and staff at each of the areas on campus where the machines were located; at the Student Union next to the campus shop, in the art college next to the other vending machines, outside the Belmont Tower building and in the Dalhousie Building near the main entrance (the machines in the Dalhousie Building are next to vending machines down a corridor off the main foyer). Males and females of various ages were canvassed to take part in the survey. All students, staff and visitors using the machines at the time of surveying were also approached to take part in the survey.

The target of 250 surveys was met, with a total of 255 surveys carried out at the University of Dundee as detailed in Tables 2, 3 and 4. A brief overview of the respondent profile is below.

Age	Male	Female	Total
Under 18	4	2	6
18–29	110	109	219
30–44	8	16	24
45–59	1	5	6
Total	123	132	255

Table 2 Age and gender profile of participants

Personnel	Number
Staff	9
Undergraduates	212
Postgraduates	34
Total	255

Table 3 Staff/student profile of participants

The overall profile of the surveyed population is summarised in Table 4.

Participants	Number	%
Surveyed	255	100
Non-users	214	84
Users (of which):	41	16
Regular users	22	9
Regular users plastic	11	4
Regular users cans	17	7

Table 4 Survey profile

In 2011/12, University of Dundee's male to female student ratio was 40:60, with staff to student ratios of ~1:14 (just academic staff) and ~1:6.3 (all staff), all staff being around 14% of the combined student plus staff population. The student population comprised approximately 63% undergraduate, 32% taught postgraduate and 5% research postgraduate students, according to statistics from The Complete University Guide (www.thecompleteuniversityguide.co.uk). Assuming these data had not changed significantly for the 2012/13 academic year, female students (52% of participants), postgraduates (14%) and staff (3.5%) were all under-represented in the survey, relative to the whole university population. The population of the main campus may differ slightly from the overall population, but the difference is not expected to be significant.

3.2.3 Focus groups

One focus group was conducted among those who had used the Recycle and Reward scheme at Dundee University more than once (defined as users). One group was conducted among those who had never used the scheme or who had used it once or twice but said they would not use it again (defined as non-users; this also included lapsed users).

Each group included both men and women from a spread of year groups. To ensure good group dynamics, no participants were chosen who rejected the idea of recycling or were active members of environmental groups.

Two focus groups were conducted with students at the university on 24 September 2013. The first focus group, for users, took place between 17:30 and 19:00; the second, for non-users, took place between 19:30 and 21:00.

There were seven participants in the user focus group: five women and two men; three first-year undergraduates, three second-year undergraduates and one fourth-year undergraduate.

There were seven participants in the non-user group: four women and three men; two first-year undergraduates, two second-year undergraduates and three postgraduate students.

3.2.4 *In-depth interviews*

The external monitoring team did not conduct in-depth interviews with staff at this site, since Zero Waste Scotland was regularly on site throughout the pilot, and was also in close contact with the ESO. Zero Waste Scotland has provided input to this report to cover the experiences of the university staff.

3.2.5 *University of Dundee student survey*

The university's annual survey of environmental performance was not part of strand B (see appendix), as it was undertaken by the university itself, but can also give some insight into how the scheme was perceived and used among the university population.

Dundee University distributed an online survey targeting 18,000 students and 4,500 staff on 15 May 2013, and it was live until 31 May 2013. It had a response rate of 3.4%, 765 individuals completing the survey. A common target response rate for this type of survey is 1%. This survey is unlikely to be representative of the whole population, but does provide a large number of responses. In contrast to the strand B work, it was undertaken at the end of the academic year in which the machines were installed. As it was about environmental performance, it may disproportionately attract those with an interest in the subject; indeed very many respondents claimed to recycle commonly in general (though this is also seen in the wider population when questions of this type are asked). It is not possible to compare it in this regard with the strand B survey, which did not ask about general recycling behaviour. The response pattern was quite different from that seen in strand B, with 353 staff responses and 412 student responses.

However, overall the two surveys' responses differ far less than we might expect given these factors, and are broadly in agreement. It is not possible to state if this reflects consistent views between the two survey points, or if the methodological differences have had the effect of cancelling out any genuine change between the two survey points.

3.3 Challenges encountered during the fieldwork

We encountered a number of challenges in delivering the planned monitoring at this complex and comparatively open site. These are detailed in this section, including any implications for what can be concluded from this pilot.

The most significant issue was that the complex nature of the waste management operations at this site imposed some limitations on our understanding of wider material flows. These constraints included the following:

- Recyclable materials from the student residences and the ROTG banks are collected as part of a wider waste round, and no direct weight data are available. (Weighbridge data would be available but include waste collected from other organisations as well.) The weight data have therefore been estimated, based on container 'fullness' observations made by council staff at the time of collection or on the day before collection. This 'fullness' figure provides a volume estimate, and a weight was then calculated using Waste & Resources Action Programme density factors.
- Recyclables from the Recycle and Reward machines were added to segregated recyclables from the university's teaching and administration buildings (see section 3.1.2). No weight or fullness/volume data were available for this material, as it is collected on a round. We can, however, estimate the weight information for the recyclables from the machines in isolation, based on the number of containers counted, with a reasonable level of accuracy.
- Building-by-building data on residual waste on campus are not available, because of how this is collected and bulked centrally. The residual waste data from JD Laing therefore provide only total campus-wide tonnages.

These restrictions mean that our understanding of wider material flows on campus is limited in some key respects.

Moreover, the material diverted by the machines comprises light-weight plastics and aluminium. Even without the uncertainties around total waste weights identified above, the material being collected by the Recycle and Reward machines is lighter than the collected waste in general. The impact on the other waste and recycling streams is therefore very difficult to distinguish, especially given the challenges in measuring overall flows.

Baseline sales data for each container type in 2012 were unavailable by month, although yearly totals were available. We have estimated monthly data based on the number of weeks of term time and holiday during a particular month, but that does not reflect variations based on specific events on campus (exams, freshers' week, conferences etc.) or changes in student behaviour through the year. For this reason, we cannot assess changes in sales from 2012 to 2013 (in the pilot scheme) quantitatively, although we sought qualitative feedback from the campus sales outlets.

The pilot period vending machine data were available only for the machines not selling Coca-Cola. DUSA estimated the total vending sales by assuming that the Coca-Cola sales were double other sales, plus a further 10%. These numbers were therefore likely to be very rough.

The Recycle and Reward machines used in the Dundee pilot recorded units of bottles and cans and not the number of units inserted per transaction. This limits our understanding of how people are using the machines, although we examined redeemed vouchers (which show the number of units per transaction) from the Premier store to help fill this data gap. The machine data were provided weekly.

On the data side, much of the pilot project monitoring was over the quieter summer recess period, which is not representative of the university in full operation, so this may reflect lower than normal sales, recycling and waste. That said, the university remained open and functional, with students attending for summer schools or resits, and the university facilities were in use for conferences and similar events. The data can be easily split between term time and non-term time, and the dates of key events (e.g. exams, freshers' week) are known. Zero Waste Scotland continued to gather data from this scheme until December 2013.

The timing of the pilot also meant that the social research was carried out early in the academic year, during the second and third weeks of teaching for 2013/14; this meant there may have not been much time for new students to become aware of the machines. The survey recorded only students' undergraduate or postgraduate status, so it was not possible to take account of any 'fresher' bias. The scheme's quantitative data do not suggest that more containers were returned overall than during term time earlier in the year. It is, however, notable that sales on campus were much higher in September

than at any other point during the pilot, so the percentage recycled does appear to have been low. Zero Waste Scotland continued to monitor the scheme's performance for the duration of the autumn term. It seems likely that any effect of surveying early in the academic year would be to understate awareness of the scheme.

Within the 255 responses to the survey, actual users were in a minority, and thus provide a smaller sub-group for analysis. Thus, while analysis of this data is valuable, some subgroup conclusions need to be interpreted more cautiously. The university's online survey provides an alternative perspective on student and staff views of the scheme, but the methodology (and timing) means that it is not directly comparable.

Only four people were observed using the Recycle and Reward machines over the two-day observation period; this was surprising, as the usage data for the weeks in question were not exceptionally low. The machine telemetry does not show the time of day when machines are used, but, based on another university site, where these data are available, it was expected that daytime observation would catch users at appropriate times. Following the observations, it was suggested by university staff that use might be higher at the art college in the evening, and this may also apply to the machines at the Students' Union and the Belmont Tower students' accommodation. Further observational analysis would be required to verify this. From the machine data we do know that the four sites across campus see very different levels of use. As observations were equally split across the four machine locations, this may have reduced the volume of transactions observed.

4 Pilot performance and operation

The following sections contain detailed quantitative and qualitative analyses of the scheme's performance. Sections 4.1 and 4.2 compare the machine data with the reported recycling behaviours from the social research, which are broadly complementary. Section 4.3 considers the rewards issued and claimed in more detail, while sections 4.4 and 4.5 focus on people's familiarity with the machines and how often they use them. Finally, sections 4.6 to 4.10 explore the potential wider implications of the pilot. This includes consideration of possible impacts on litter, net waste on site, any boost to sales on site and improvements in recyclate quality. Finally we consider operational aspects of the pilot, focusing on machine reliability (both actual and perceived) and staffing implications.

4.1 Overview

Overall machine throughput data in terms of returns and rewards are shown in Table 5, with estimated weights for cans (~14g per can) and bottles (~22g each) based on SKM measured data from other pilots.

Throughput	Data category	Students' Union	Belmont Residence	Dalhousie Building	Matthew Building	Total
Sales	Total DUSA shop sales – cans (units/kg)*					81,654 units 1,143kg
	Total DUSA shop sales – PET (units/kg)*					137,580 units 3,026kg
	Total DUSA sales including vending (units)**					264,416
Returns (units)	Total cans (units)	11,332	–	1,363	7,913	20,608 (25%)
	Total PET bottles (units)	4,807	2,303	1,608	5,210	13,928 (10%)
	Total units (cans and PET bottles)					34,536 (13%)
Returns (weight)	Total cans (kg)	164.3		19.8	114.7	298.8
	Total PET bottles (kg)	103.4	49.5	34.6	112.0	299.5
Rewards	Total rewards issued (vouchers)	16,139	2,303	2,971	13,123	34,536
	Total rewards issued (£)	710.81	69.09	116.39	551.95	1448.24
	Total rewards claimed (£)					1,227.5 (~85%)

Table 5 Summary of sales, returns and rewards, 20 February to 27 September 2013

Notes

*Shop sales data are for March to September and the data for cans and PET bottles are from the two DUSA shops on campus and the Matthew Building café only.

**Vending sales data are based on partial sales from some machines, extrapolated for all machines. The figure is approximate but only ~17% of total DUSA sales. Vending data are not broken down by material.

Over 34,500 units were returned to the machines out of an estimated 264,000 sales of relevant containers on site. On this basis the capture rate (percentage of target items returned as a proportion of DUSA sales) was 13% overall but varied considerably over time. It was 9% in March (despite the fact that a litter pick was organised in March and the materials placed in the machines) and peaked at 37% during August. As much as 40% more items were returned in September than in August but the DUSA sales increased by 826% as the new term started, so the capture rate dropped to 6%. The overall capture rate by material was 25% of cans and 10% of plastic bottles.

Given that there are ~22,000 students and staff in term time, the 34,500 returns represent just over 1.5 containers per student/staff member over the whole pilot period of seven months. Out of term, the population is not known but will still be several thousand, hence lowering the average population across the pilot. Assuming an average of 10,000 would imply ~3.5 containers per person across the whole pilot period. This low absolute usage rate is also reflected by the survey work, which showed that only 9% of those surveyed were regular users.

It has to be noted, however, that only a very small proportion of survey participants stated that they bought all of their bottled and canned drinks on campus; the vast majority bought only some of their drinks on campus. The overall recycling data for can and plastic bottles on the campus (including ROTG and student residences) indicate that more bottles and cans are bought off campus and consumed on site than are bought on campus and consumed off site. In turn this may mean that the capture rate of 13% overall is higher than the 'real' capture rate, i.e. in proportion to the empty plastic bottles and cans collected in the general refuse on campus (an unknown quantity).

This is supported by the social research, albeit with a small survey sample. Of the people who regularly recycled their cans using the machines (17 people; 7% of the total sampled population), only two bought all of their cans on campus, one bought none on campus and 14 bought some on campus and some off campus (e.g. in nearby shops). Of the people who regularly recycled their plastic bottles (11 people; 4% of the total sampled population), one bought all of their bottles on campus and one bought none on campus, leaving nine who bought some on campus and some off campus.

The sections below give an indication of the possible reasons for the performance levels observed.

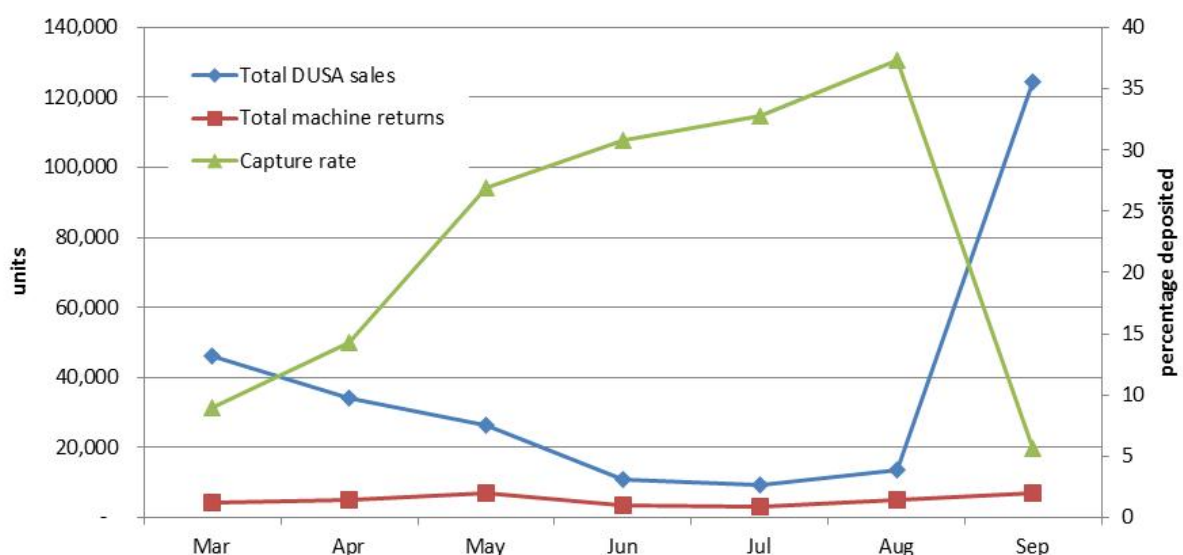


Figure 5 Monthly unit sales, machine returns and capture rate (% returned)

Zero Waste Scotland continued to collect data from this site from September to December 2013. Data covered the machines' performance, but were no longer linked to sales data. Nonetheless, analysis of the data suggests that the machines saw similar use to term time in the formal monitoring period. Figure 6 shows the data from March to December, with the Zero Waste Scotland data in paler shades.

The proportion of cans to plastic containers was consistent across all the time periods, with slightly more containers per week in the autumn term. The consistent high performance in September supports the case that promotion of the scheme encouraged use. However, without sales data for the rest of the autumn period it is unclear how exceptional this really is, or whether increased consumption is the main driver.

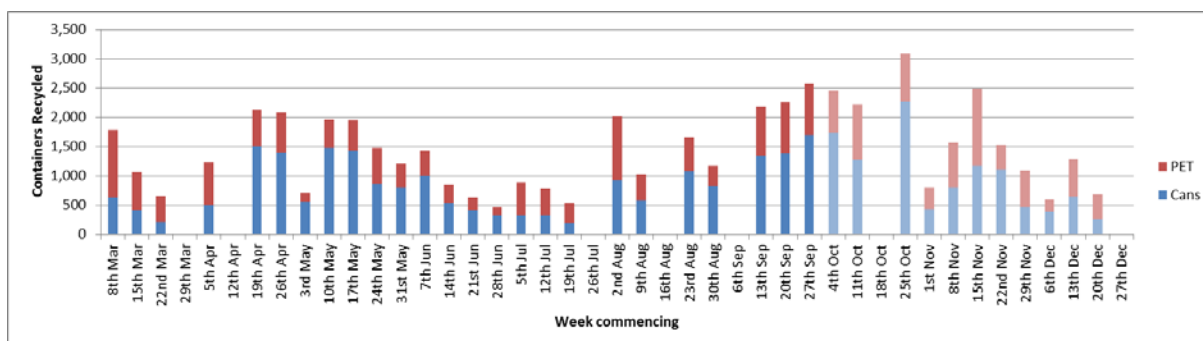


Figure 6 Weekly returns from March to December

4.2 Social research insight into items recycled

Two thirds of the users surveyed claimed they recycled cans, and just over half said they recycled PET plastic bottles. There not enough observational data to back this up, but it certainly reflects the pattern, if not the exact percentage, of containers returned to the machines. These responses should perhaps be treated cautiously, as recycling behaviour may be overclaimed in face to face surveying.

The strand B survey of a total sampled population of 255 people (users and non-users) indicated that:

- 9% (23 people) of the total sampled population had recycled plastic bottles in the machines;
- 3% (33% of the 9%; eight people) claimed they now recycled more bottles on campus since the machines had been introduced; and
- 2% (five people) of the total sampled population claimed that they now recycled all or almost all of the plastic bottles they bought on campus.

Before the machines were introduced, the repeat users (4% of the total sampled population; 10 people) had disposed of their plastic bottles in the following ways:

- put their bottles in a residual waste bin on campus (36%);
- recycled their bottles elsewhere (45%); and
- reused them by refilling them (18%).

For aluminium cans the survey results indicated that:

- 11% (28) of the total sampled population had recycled cans in the machines;
- 5% (13 people) claimed they now recycled more cans on campus since the machines were introduced; and
- 4% (10 people) of the total sampled population claimed they now recycled all or almost all of the cans they bought on campus.

Before the machines were introduced, the repeat users (7% of the total sampled population; 18 people) had disposed of their cans in the following ways:

- put their cans in a residual waste bin on campus (47%); and
- recycled their cans elsewhere (47%).

These results indicate that 3% of the survey population (19% of users) recycled more plastic bottles since the machines were introduced, and 5% of the survey population (31% of users) recycled more cans. This has to be taken in the context of only 16% using the machines at all.

The university survey showed that 42% of users recycled both materials in the machines, 40% only PET plastic bottles and 16% only aluminium cans. Of all those surveyed, these figures are 8%, 7%, and 3% respectively.

The university survey saw 72% of users claiming the machines meant they were recycling more (13% of all those surveyed). This difference in the two surveys may reflect the fact that this survey was carried out at the end of the academic year (with an established student population); the higher proportion of staff responses (though it is unclear why they would respond so differently); or the fact that there is a bias towards those who are more environmentally minded in the way this survey was conducted (though this might also be expected to mean they were already better recyclers than average to begin with). Counterintuitively, the university survey also saw many non-users state that they thought the machines would lead to them recycling more. It is hard to know how to interpret this response.

Generally the machine data and survey data seem to match reasonably well. The size of the university population suggests a theoretical maximum figure for people using the scheme. Looking at weekly returns through the machines in the light of that figure provides a further sense check on the likelihood that the survey responses are representative of the whole university population.

4.3 Rewards issued and claimed

The rewards issued are based on the manual readings taken directly from the machine and supplemented with the telemetry data where required. Overall, 85% of rewards (by value) were redeemed. Figure 7 shows the variation that would broadly be expected as students come and go to and from the university.

The university was in session and teaching at the start of the pilot period until 29 March, followed by a three-week vacation, with students returning for exams from 22 April to 24 May. The last week of the holiday and the exam period saw increased use of the machines, with the exception of the week ending 3 May, when the art degree show was on and the machines in the Matthew Building were not always accessible. Machine use remained relatively high throughout May's exam period and then dropped when the student population left for the summer. There was a small increase again in resit week (5 July).

Students checked into the university accommodation during the weekend of 30 and 31 August and teaching restarted on 9 September. Machine use at the start of the new term in September was generally higher than the period after the first week of the pilot. This is encouraging given that final-year students would have been replaced with new first-year students, who would not be as familiar with the pilot scheme.

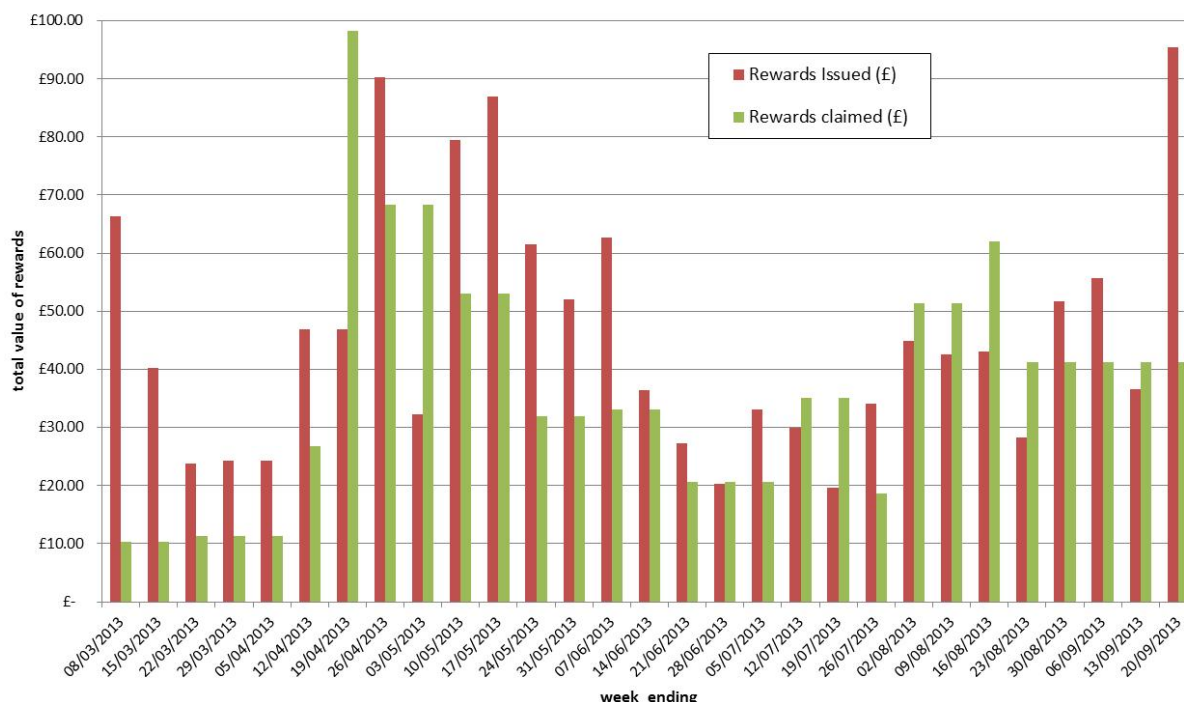


Figure 7 Weekly rewards issued and redeemed from 4 March to 27 September 2013

It appears from Figure 7 that there was a long lag in voucher redemptions at the start of the pilot, with some vouchers from March not being redeemed until mid-April. Thereafter, redemptions fluctuate, sometimes being larger than that week's issues and sometimes smaller. This could indicate a wide variety of behaviours, including some hoarding.

An analysis of the vouchers redeemed at the Premier store over a 16-day period (from 14 to 29 May) (see Table 6) showed that, of the 129 vouchers redeemed over that period, those issued by the cans machines at the Matthew Building and the Student Union were for the greatest average number of items per transaction, and that cans were returned in greater average multiples (28) than bottles (nine). As many as 64% of can vouchers were for multiples of 10 or more cans while 32% of bottle vouchers were for multiples of 10 or more bottles.

Of the bottle machines, the one located near the Belmont Residences had the highest average number of bottles per transaction/voucher, which may be because students from the residence brought a number of collected bottles from home. That said, multiple units were returned at all machines, implying a degree of collection rather than just inserting a single container recently emptied. One transaction at the Students' Union was for 203 cans, while another at the Belmont Residence was for 96 bottles, showing a great deal of stockpiling in both cases (Table 6).

It should be remembered that vouchers were worth 5p per aluminium can and 3p per PET bottle, so returning 10 cans would be worth 50p and 10 bottles 30p. This may have affected the balance between can and bottle returns to the machines; cans outnumbered bottles overall by almost 3:1. In this context, however, it is interesting to note that the overall recycling data indicate that more cans are consumed on site than bottles, even though more bottles are sold on site than cans.

Location/material	No. of items returned	No. of vouchers redeemed	Average no. of items returned per voucher redeemed	No. (%) of vouchers redeemed for single item	No. (%) of vouchers redeemed for ≥ 10 items	Max. no. of items per voucher
Student Union cans	1,287	45	28	8 (18)	30 (67)	203
Student Union bottles	280	29	10	7 (24)	11 (38)	57
Belmont Residences bottles	175	11	16	3 (27)	5 (45)	96
Dalhousie Building cans	97	6	16	2 (33)	2 (33)	50
Dalhousie Building bottles	94	17	6	4 (24)	3 (18)	19
Matthew Building cans	377	13	29	2 (15)	9 (69)	81
Matthew Building bottles	61	8	8	4 (50)	2 (25)	36
Cans – all locations	1,761	64	28	12 (19)	41 (64)	203
Bottles – all locations	610	65	9	18 (28)	21 (32)	96

Table 6 Breakdown of source machine for vouchers redeemed between 14 and 29 May

4.4 Awareness of the machines and their correct use

Two thirds of those surveyed on behalf of Zero Waste Scotland were aware of the Recycle and Reward machines on campus (closely matching the 70% of those surveyed online by the university). Of those interviewed face to face, 43% were aware that the machines accepted aluminium cans and 39% knew they accepted PET plastic bottles. The university survey gave slightly higher figures (52% and 54% respectively), which may be because those who completed that survey were more environmentally engaged individuals. It is worth noting that the actual machine returns were biased towards cans.

Although far more plastic bottles were sold on site than cans, the overall recycling data suggest that more cans were consumed on site; see section 4.6 for further discussion. Glass was incorrectly mentioned as an accepted material by 3% of the respondents in the social research (this was higher in the university survey, at 9%). Just 2% of users in the pilot project survey considered that not understanding what could be recycled was a problem.

Of those surveyed in our social research, 23% were aware of activity carried out to promote the Recycle and Reward machines on campus, a very similar percentage to that seen in the university survey (21%). Awareness of these promotional activities was higher among the users; 56% of users compared with 16% of non-users noticed promotions. The most common forms of communications recalled were posters (88%), word of mouth (14%) and email (5%).

From the focus group findings, two of the challenges identified were:

- Not knowing which types of plastic bottles were accepted. Milk bottles had been brought in from home (including from the student accommodation on campus) and were not accepted, which frustrated users. The equipment is not designed to accept plastic milk bottles, which are made of high-density polyethylene (HDPE) rather than PET plastic – though schemes could be set up to allow this if appropriate. Images of milk bottles were not used in any of the graphics on the machines or in promotional material, specifically to communicate this message.
- Not knowing where the machines were. See section 5.4 for a discussion on machine location.

Of those surveyed for the social research, only 16% had used the Recycle and Reward machines on campus, far fewer than the ~67% that claimed to be aware of the machines. In the university survey, 18% claimed to have used the machines (26% of those who claimed to know about them). Figure 8 shows how often people in the social research funded by Zero Waste Scotland said they used them. Around 9% of all those surveyed (users and non-users) stated that they were regular users (once a month or more) and under 4% were very regular users (several times a week or daily). However, there was a high number of first-time users, probably because the survey took place near the start of the academic year.

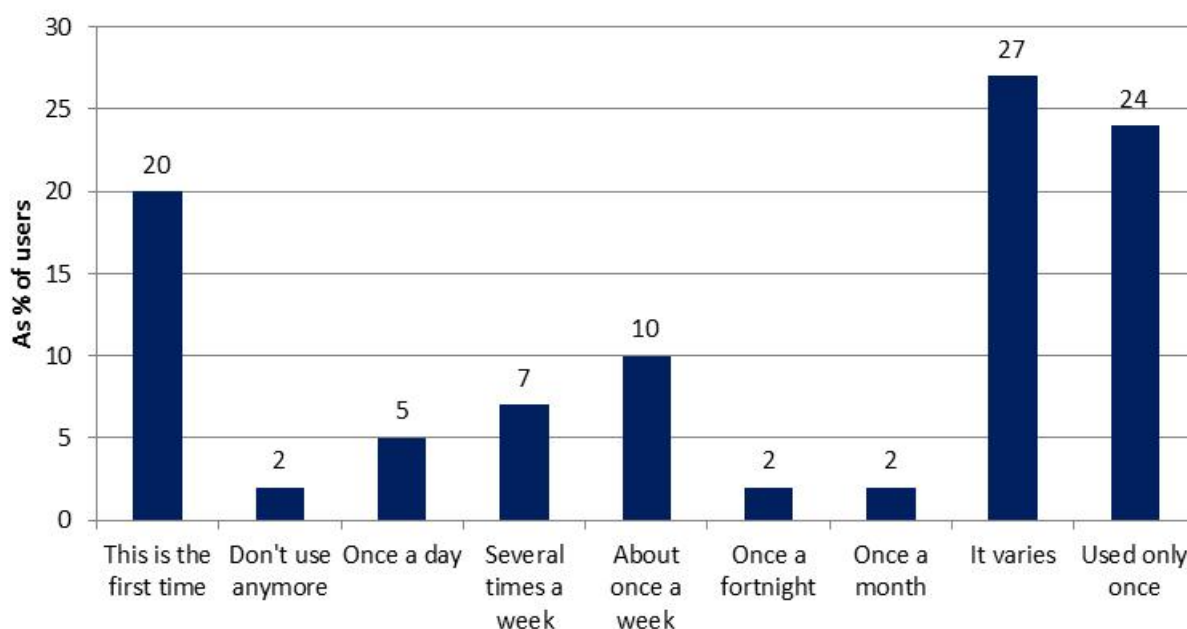


Figure 8 Regularity of Recycle and Reward machine use (% of users)

In the survey work undertaken, 54% of the users were male and 46% were female; 2% were staff, 80% undergraduates and 17% postgraduate students (the total is not 100 because of rounding). Based on the proportions of students and staff described in section 3.2.2, these data suggest that postgraduates and male students are disproportionately likely to use the machines. The postgraduate bias is likely to be because the pilot was mostly undertaken out of term time.

From the focus groups, two usage models emerged:

- students recycled the empty drinks containers consumed on site (bought on campus or elsewhere, see section 4.8); and
- a small minority brought drinks containers from home to the machines for recycling.

The latter model was presumably encouraged by the location of a machine at a university residence building on campus (outside the building and next to the ROTG banks). Both a desire to recycle and the reward motivated users to bringing multiple items from home. Students reported that the reward was insufficient in itself for them to make the effort; rather it was a welcome bonus for recycling (see section 5.1 for further information on motivation). The extent to which university cleaning and maintenance staff use the scheme (e.g. grouping items collected around the campus to place in the machines) is not known. Anecdotally, from the university survey, this may be happening to at least some extent. The large number of units placed in several transactions may support this (see section 4.3).

4.5 Impact on litter

In the Zero Waste Scotland-funded survey work only 3% of respondents noted reducing litter as a benefit of the Recycle and Reward scheme. However, when asked directly about the impact on littering, 94% of the sampled population said they felt the introduction of the Recycle and Reward machines had reduced litter levels at the university. In the focus groups, however, the campus was seen as fairly litter-free before the scheme and so the impact was seen as minimal. This view is inconsistent with the views of the staff on site, who noted that the area around the Union was often quite badly littered (specifically at the weekends); hence the introduction of the Big Belly bins as one part of a solution.

Zero Waste Scotland commissioned a separate study looking at litter in three areas on campus: around the Students' Union, Dalhousie Building and Matthew Building. This was not explicitly part of the Recycle and Reward pilot, and was undertaken as a more exploratory piece of work by Zero Waste Scotland's litter programme. However, the sampling was timed to be undertaken both before and after the Recycle and Reward machines were installed. The sampled areas are busy and included the Big Belly bins and the Recycle and Reward machines. Waste, including litter and material in waste bins and recycling bins, was collected and analysed in February (three days' accumulation) and March (one day's accumulation) 2013.

The report showed that PET bottles and aluminium cans made up 13% of the weight of litter in February but 14% in March. The weight of recyclable materials including paper, card, plastic bottles, cans and glass went up although the diversion rate (recyclables captured by recycling schemes) also went up. Zero Waste Scotland concluded that the sample period was not sufficient to show significant variation in litter levels, as background variation was too poorly understood. It was also very early in the pilot period so the effects on recycling behaviour may not have been captured.

4.6 Impact on overall waste

As already identified, given the complexity and volumes of the waste flows on the site, discerning the impact of the scheme, in tonnage terms, was always likely to be challenging. While the quality of the data is too poor to draw firm conclusions about the impact of the Recycle and Reward scheme, a number of observations can be made.

Figure 9 shows the residual waste arising from the university's teaching and support buildings (i.e. not including waste from the student residences) in 2012 (blue) and 2013 (red) based on skip weights from the contractor. Data were not available for May to July 2012. Over the five study months for which there are comparable data, the residual waste reduced by 1.88 tonnes (1.2%) in 2013, although there is quite a lot of variation from month to month, as the figure shows. Given natural variation, it is not possible to conclude that the reduction seen is a genuine trend rather than a random fluctuation. No data were available for the residual waste collected from the student residences for either 2012 or 2013.

Comparable data for all the recyclates collected from the student residences were available (estimated volumes converted to weights) for only two months of the pilot period (April and May) and showed a 2.35-tonne (7.7%) reduction in 2013. The data for cans over these two months showed a reduction of 0.01 tonnes or 2.1% (0.46 tonnes in 2013 compared with 0.47 tonnes in 2012) while the plastic bottles reduced from 0.5 tonnes in 2012 to 0.39 tonnes in 2013 (a 22% reduction). No comparable data for the ROTG banks for 2012 were available.

Approximately 1.22 tonnes of cans were collected in the ROTG banks on campus between April and September and 1.72 tonnes of cans were collected at the student residences. Hence ~2.94 tonnes of cans were collected via the ROTG banks and the student residence bins. There are no ROTG banks for plastic bottles on campus but 1.20 tonnes of plastic bottles were collected at the student residences alone between April and September 2013. By way of comparison, the weight of empty packaging from all of the DUSA sales over the monitoring period would be ~1.14 tonnes of cans and ~3.03 tonnes of plastic bottles. This suggests that far more cans (2.94 tonnes vs 1.14 tonnes) are consumed on site than bought there, while the opposite seems to be true for bottles. However, the data are incomplete.

In comparison, 0.293 tonnes of cans were placed in the Recycle and Reward machines during the period from March to September, around 10% of the amount placed in the ROTG banks and residence bins alone during April to September. Some 0.305 tonnes of plastic bottles were put into the Recycle and Reward machines during March to September, around 25% as much as placed in the student residence bins alone during April to September. The machines therefore took 9% of the cans and ~20% of the plastic bottles sent for recycling (i.e. excluding any that might be in the residual waste), which is broadly the opposite of the capture rate by DUSA sales (~25% of cans and ~10% of plastic bottles).

Taking both materials together, over the pilot period (March to September 2013), the Recycle and Reward machines collected ~0.6 tonnes of recyclables while other recycling facilities collected ~4.14 tonnes (excluding the quantities collected from the recycling bins in public areas of the university's teaching and administrative buildings, estimated at 0.5 tonnes in 2012). Hence, around 13% of the target container waste that was recycled went through the machines, and 87% through the other recycling facilities.

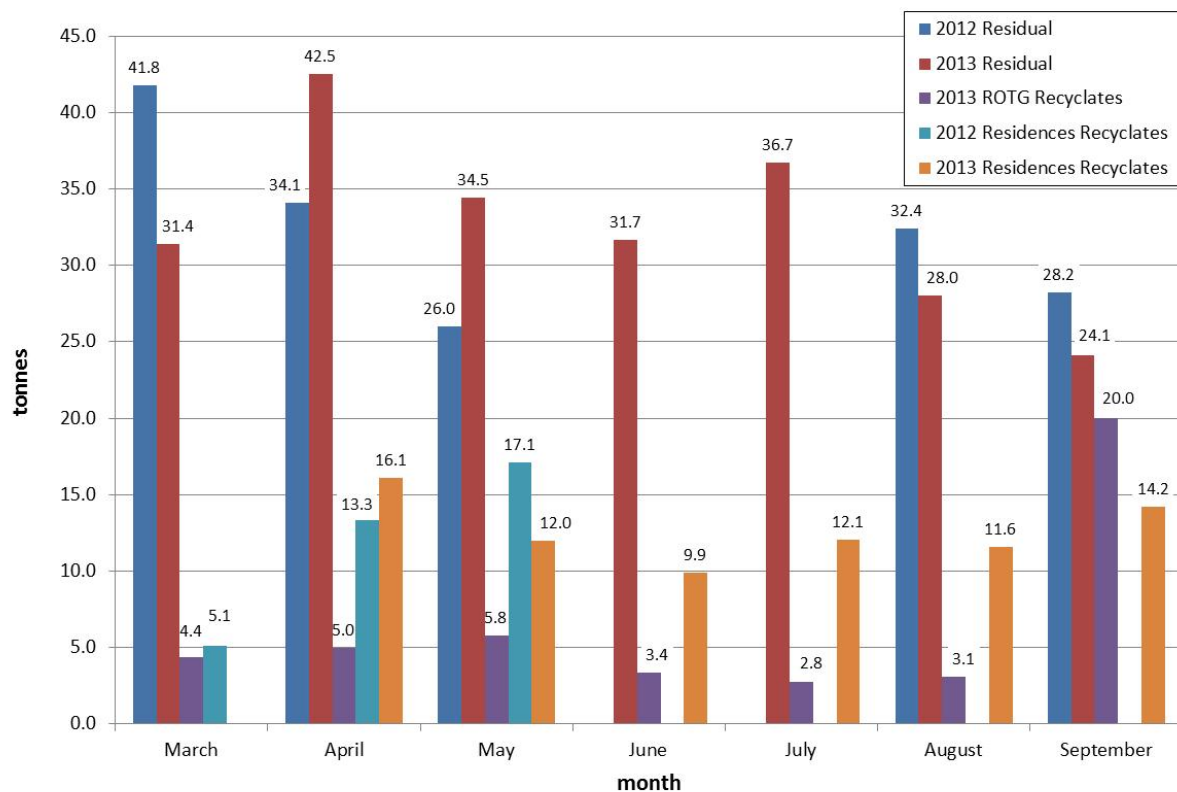


Figure 9 Comparison of waste and recyclate collected in 2012 and 2013

4.7 Impact on container sales

Sales data were available for the pilot period, but there were no comparable baseline monthly data for before the pilot. There was no reported change in purchasing behaviour amongst the regular users of the machines as a result of the machines being introduced at the university.

4.8 Impact on material quality

Each of the machines installed at the University of Dundee was set up to accept only one container type: PET bottles or aluminium cans (they were set up in banks so a typical recycling point could deal with different containers). The machines are designed to accept only items fitting the weight/size/shape criteria of the accepted material. No comprehensive data are available regarding any contaminants found in the machines, although site observations indicated that contamination levels were very low.

Some users reported that items they attempted to insert were rejected. It is not possible to say whether these rejections were 'correct' (i.e. the machine refusing to accept an item that would contaminate the quality) or 'incorrect' (i.e. the machine failing to recognise a legitimate item). Rejections are discussed further in the next section.

The recyclate from the machines was dealt with alongside the rest of the university's recyclate. It is therefore not possible to assess if the recyclate value is higher than that from other sources on campus, although, in sufficient quantities, a pure recyclate stream will be of higher value than a contaminated one.

4.9 Operational factors

This section considers the machines' technical reliability, and also how reliable the users and staff thought them. It also considers the resources the scheme required; specifically where these diverged from initial expectations.

4.9.1 *Machine reliability*

Machine reliability was an ongoing problem for most of the monitoring period covered in this report, although it improved significantly in August, following several site visits by technicians. Had this issue been identified and resolved sooner, reliability across the pilot period would have been improved.

For most of the pilot period one or more machines were out of operation for at least some time. In the first couple of weeks some of this may have been down to higher than expected use, reflecting the effectiveness of the launch and pre-pilot promotion campaign. Some issues could be resolved by university staff once they were alerted to the issue but others required the intervention of a technician.

Of the users we surveyed, 7% claimed the machine would not accept the plastic bottles they were attempting to recycle. This may of course represent the machine functioning correctly and refusing incorrect items (it is not possible to tell from the available data). However, it seems highly likely that rejections do influence user perceptions of reliability regardless. Users surveyed also suggested that they had encountered machines that were full or broken and were out of operation (20%), a concern also noted in the university survey. Some 2% of users we surveyed said they had experienced the machine not issuing a voucher. Overall, just over three quarters (76%) of the users considered the machines reliable. The focus groups suggested that perceived unreliability could discourage use.

4.9.2 *Resourcing implications*

No additional staff were employed to implement the pilot. The university's ESO was fully engaged and very enthusiastic in promoting it. She undertook to record the weekly manual data readings from all the machines and used this opportunity to identify any operational issues that needed to be addressed (and, if possible, fix them). She was also the driving force behind the publicity campaign surrounding the launch of the pilot and the ongoing promotion of it through the various channels noted above.

Although no additional staff were employed, the ESO had to dedicate a lot of extra time to the pilot, which was onerous given her already busy schedule. The shop staff (sales and redemptions data), the university waste team, Dundee City Council and volunteers during Green Week also undertook additional work. This additional effort is largely, in our estimation, down to the pilot itself and the need to gather data for Zero Waste Scotland's monitoring. Day-to-day activities would largely revolve around ensuring that the machines were operating correctly and being emptied as necessary. That said, machine reliability problems added considerably to the ESO's workload during the pilot with repeated callouts to maintenance staff.

5 Public reactions to the pilot

In assessing public reactions, this section considers the views of only the target population for the scheme (which was also the target population for the social research) plus any staff or site insight into the pilot. This section first considers user and non-user views in isolation, before discussing the extent to which the rewards themselves were seen as appropriate more generally. It then discusses the legacy of the system: the extent to which users and the site wish to see it continue, and whether or not it will. A final section summarises the perceived benefits of the scheme and also highlights any questions raised about the scheme, and user suggestions for changes.

5.1 User views and motivation

The majority of users (76%) liked the Recycle and Reward machines, rating both overall satisfaction and ease of use highly or very highly. Most of them rated the operating instructions as easy or very easy to follow (85%). The university’s survey also showed high levels of satisfaction with the ease of use. However, the users are a small group (only 16% overall in the social research survey). Most of the users in the focus groups continued to use the machines because they found them convenient and easy to use, with the rewards seen as a bonus for recycling, which they supported anyway.

The physical presence and novelty value of the machines, along with a desire to recycle, were the primary motivations noted by students and staff to use the machines, as shown in Figure 10. In our survey, 54% of users said that they were motivated to use the machine because they saw it or just to try it. In the university survey, the environmental benefits, the reward and the novelty value were the three most stated reasons, in that order.

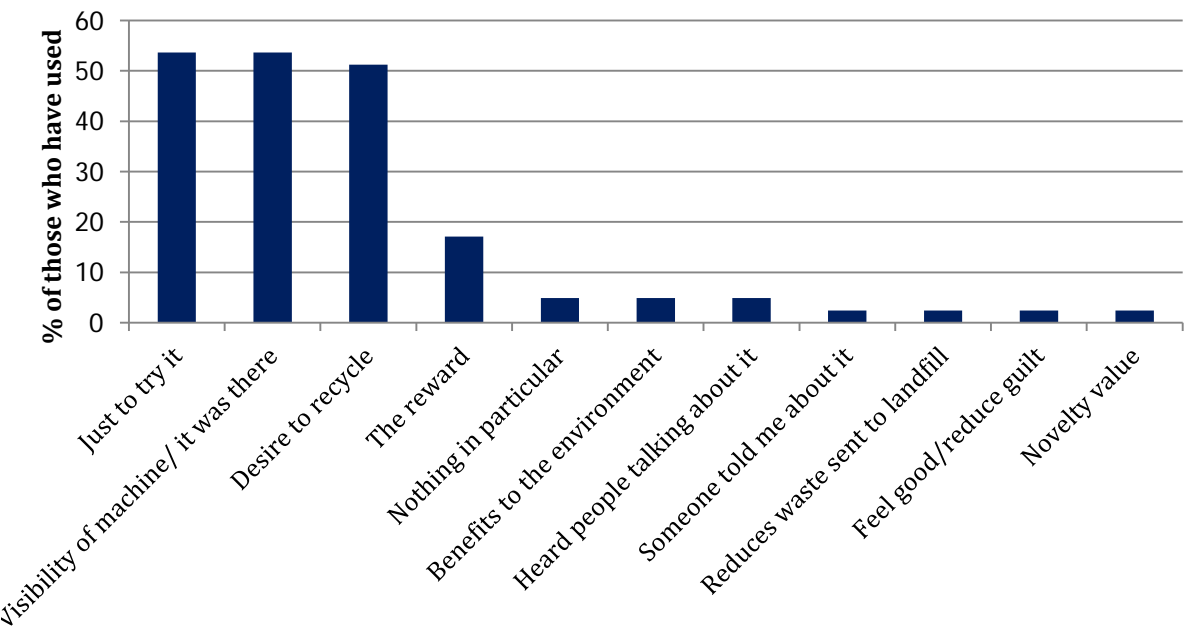


Figure 10 Motivation to use the Recycle and Reward machines

The focus group research reinforced these findings.

- Users had tried the scheme initially for a number of reasons: they considered recycling a good thing and wanted to recycle on campus; they ‘might as well’ be rewarded for it; and they were intrigued to try the machines.
- The machines were a ‘welcome bonus for recycling’ and the presence of the machines had motivated them to recycle, sometimes bringing multiple items from the student accommodation.
- Almost all users and non-users had first come across the scheme by seeing one of the machines. A few had heard about it from friends.

Interestingly, however, the data seem to show that the financial reward has far more of an impact than these responses would suggest. First, ~85% of the total reward value was redeemed (although not necessarily 85% of the vouchers, each potentially having a different value, dependent on the numbers of items returned). Of the bottles and cans sold by DUSA in the two campus shops and the art college café, bottles outsell cans by 1.8:1. However, for every bottle, 1.5 cans were returned (in spite of there being one more machine accepting bottles), and, for every bottle reward redeemed, 2.9 can rewards were claimed. This suggests that the level of reward is significant, the 5p reward being a greater incentive for recycling than the 3p reward. (The figures cover only three months; however, similar

sales and return ratios apply for the whole pilot period: 0.59 cans sold per bottle sold and 1.49 cans returned per bottle returned.) Another factor, however, is the number of cans vs plastic bottles consumed on site. The estimated data for the other recycling facilities suggest that more cans than bottles were consumed on site, although the data are incomplete (see section 5.3).

Cans are also smaller so may be easier to store than bottles, although they cannot be crushed and still accepted by the machines. In addition, confusion about which types of plastic bottle would be accepted by the machine and rejection of some unacceptable bottles (e.g. milk bottles) may have put people off returning more bottles.

See section 5.5 for further discussion on the appropriateness of rewards.

5.2 Non-user views

The majority of students and staff surveyed (84%) did not use the Recycle and Reward machines. The primary reason they gave was that they were not aware of the machines (42%), although 67% overall claimed to be aware of the machines (a 9% mismatch). This perhaps indicates a desire to appear informed, or the sequencing of the questions. Such a discrepancy is not unusual in a social survey of this type. Other reasons recorded for non-use are shown in Figure 11.

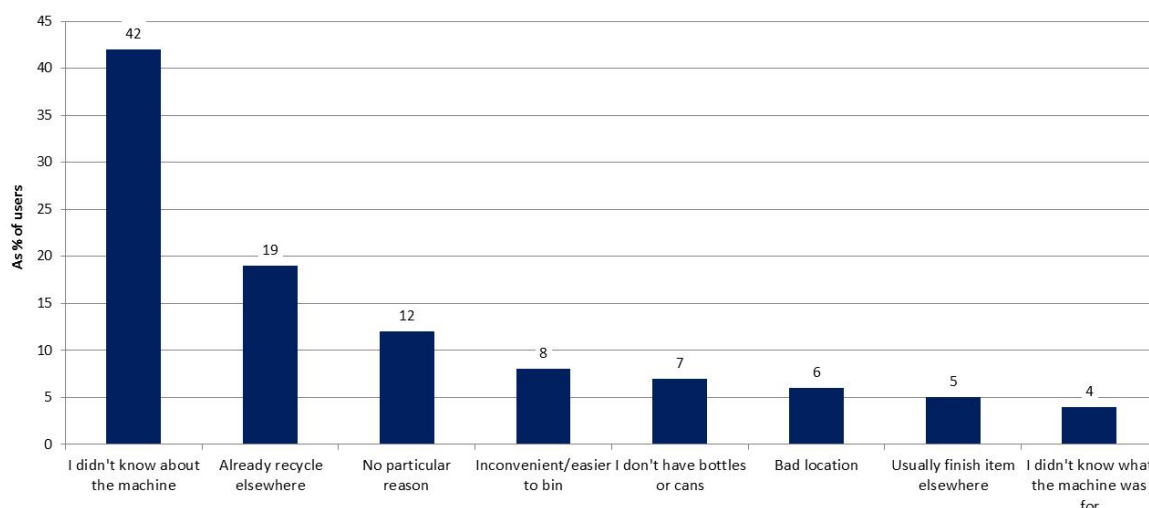


Figure 11 Reasons for not using the Recycle and Reward machines

During the non-user focus groups the following reasons for not participating in the Recycle and Reward scheme were also noted.

- The location of some of the machines was perceived as inconvenient. People felt the machines were not near where they spent their time and/or where they were likely to discard drinks containers. A suggestion during the focus groups was for the machines to be relocated in front of the Students' Union (though it is worth noting that this was ruled out originally on health and safety grounds).
- Recycling drinks containers at university was not a priority for them and they would not go out of their way to do it.
- The machines were perceived as unreliable. Some had tried it once and it didn't work, which one focus group attendee had found 'embarrassing and annoying'. The group did not highlight this but a reasonable conclusion might be that getting the scheme right from the start may be helpful in forming new habits.

The primary changes that might encourage non-users to use the machines were greater awareness, knowledge and understanding of what the machines were for, and more promotion and advertising to support this (56%); and locating the machines in more suitable areas (42%). Other suggestions were:

- a better or alternative reward (9%);
- if they used the packaging materials (bottles and cans) the machines accepted (6%); and
- if there had been more assistance to use the machines (2%).

However, 82% of the non-users surveyed indicated that, now they knew more about the machines and their operation, they would consider using them.

5.3 Appropriateness of the rewards

In the social research survey, 82% of all respondents indicated that the rewards were appropriate. In the university survey, the figure was 72%. Users were generally more enthusiastic about rewards for recycling than non-users and believed that their purpose was to encourage more students to recycle and to increase the recycling rate on campus. Some respondents felt that a reward for recycling was unnecessary and that it was easier just to recycle using normal recycling containers. In the university survey, a couple of comments highlighted the fact the reward on offer is smaller than in European schemes overseas (though as such schemes are typically deposit schemes, different financial considerations apply).

Surprisingly, given the above, the majority of users (71%) said that they had not redeemed the vouchers. Data are not available showing the number of vouchers redeemed throughout the pilot, but the total value of the vouchers redeemed during the pilot period was 85% of the total value of vouchers issued. This suggests that the survey data are not representative overall; that higher-value vouchers (for returning multiple items) are more likely to be redeemed than low-value ones; and/or that people placing cans in the machines (a slightly higher-value reward) are more likely to redeem their vouchers than those returning bottles.

Of those who had redeemed vouchers, approximately half said that they saved the vouchers up before redeeming them. Others used them either straight away or the next time they bought something in the campus shop. Some had used their vouchers individually for money off items, while others were collecting the vouchers until they had enough to buy an item outright. Most of the vouchers redeemed between 14 and 29 May had been issued during that period, although one voucher had been issued in the week commencing 11 March, four in the week commencing 1 April and three in the week commencing 29 April.

During the focus groups a number of reasons were given for not redeeming vouchers: concern over annoying shop staff by handing over vouchers at busy times; the vouchers expiring before they were redeemed (they were valid for three months from the date of issue); and that dispensing paper vouchers clashed with the concept of recycling and waste minimisation. Although the level of rewards was considered 'acceptable' by most, they were also considered insufficient to motivate most users and all non-users to actively go out of their way to recycle using the machines. This may be inconsistent with the data (see section 5.1) showing that a higher redemption value (cans compared with bottles) could motivate users. There are, however, other possible explanations.

People suggested alternative rewards, such as using the student matriculation card as a loyalty card and adding points to the card at the machine each time materials were recycled. This was considered an improvement and appealing to both users and non-users because it removed the waste paper as well as alleviating any slight concerns about losing the vouchers; it also seemed more contemporary in being 'hi-tech'. Respondents in each group took the concept further by suggesting the rewards could be reclaimed in more campus outlets than the shop, e.g. for printing and photocopying, thus

increasing their overall value. The appropriateness of the reward may have as much to do with the convenience of keeping/claiming it as with the financial value.

Students also responded positively to the concept of donating the reward to charity, indicating that it could be worth more to others than to them and that there would be an additional feel-good factor in donating.

5.4 Legacy of the Recycle and Reward scheme

Most survey participants (93%) were clear that they would like the Recycle and Reward scheme to continue in the university, and 88% were keen to see similar schemes become more widespread across Scotland. This seems inconsistent with the relatively low number of users (16%), although greater awareness and more convenient machine locations might increase use. As noted earlier, 82% of the non-users said that they would consider using the machines now that they were better informed.

5.5 Other observations

The main benefits of the Recycle and Reward scheme described during the survey work were that it generally improved the quality of the environment, reduced waste to landfill and reduced pollution (42% in total). Other benefits identified were that it enhanced the corporate reputation of the university as an environmentally responsible organisation (14%), (potentially) increased sales in the businesses involved (6%), gave a monetary reward to the user (4%) and reduced litter (3%).

Among more negative observations, a small number of university survey respondents, and some in the non-user focus group, suggested the machines were 'flashy' or 'overcomplicated', and queried their benefit over normal recycling bins. While it was suggested that the visual impact of the machines would increase awareness of the need to recycle and the sense that recycling was being taken seriously, these non-users seemed to need more reassurance on this and on any other benefits of the machines (e.g. the greater capacity provided as the machines compacted the items). The other query raised about the scheme was the environmental impact of the machines. Both focus groups mentioned continued power use, materials used in their construction etc. This could remain a rationale for some non-users to reject the scheme. In the university survey, seven respondents (1%) queried the energy consumption of the machines.

The main suggestion for change concerned location. Although the machines were deliberately located in high-footfall areas, people reported that they did not know all of the available machines on site. While no one user needs to know all the machines, clearly people are less likely to use them if they are not obvious. Lack of awareness of the machines was in fact the reason that 42% of non-users surveyed gave for not using them (see section 5.2). Careful consideration was given to the best locations for the pilot machines. However, with a limited number of units, and with certain practical constraints (such as health and safety, need for a power source and wifi, access and space issues, and exposure to the elements), locations may not have been ideal for users. Both users and non-users stated that the machines were 'hidden' or 'out of the way'. A number of people believed that there was no obvious rationale for their placement. Only those who had brought items from home went out of their way to find a machine and use it. Others who used a machine did so only when it was convenient, i.e. close by and encountered in passing on a normal route. Certainly the machines at the Students' Union, while the most well-used, were away from the main thoroughfare at the front of the building and other machines were amongst other recycling bins, potentially reducing their impact.

It was suggested that the machines could be relocated to make them more visible, convenient and accessible to a wider student audience, e.g. perhaps at main crossroads on the campus. These sentiments were also supported by the university survey, which included a wide range of suggestions for alternative locations. Closing the gap between user expectations and convenience and practical

aspects of machine location may not be straightforward, but has certainly been highlighted as an issue to be aware of in future schemes.

Convenience may also link to reward redemption, although this was not raised by the survey or focus group respondents. Only a few machines were particularly close to the single redemption point. That said, university staff noted that some students had stockpiled vouchers for subsequent redemption. Some students, depending on their personal circumstances and attitudes, may be more motivated than others to take advantage of the price reduction offered by the vouchers.

6 Conclusions

Just over 34,400 containers were recycled via the Recycle and Reward machines during the pilot period, with the ebb and flow of university life reflected in the weekly data. This represents 13% of the containers estimated to have been sold on campus during the period. (Some containers recycled may have been brought from elsewhere, and, conversely, this figure does not reflect containers recycled via other routes). Further monitoring in the autumn term showed continued use, and no significant changes in behaviour, though fewer contextual data (e.g. sales information) were available for detailed analysis.

The overall capture rate (by sales) via the machines fluctuated significantly over the pilot, from 6% to 37%. This improved steadily after launch, but dropped sharply with the new academic year in September (although container returns increased, sales increased by a far greater amount).

User surveying suggests that, while 16% of respondents had used the machines, only 9% of respondents were regular users of the scheme, with a further 7% having used it at some point. Some 3% claimed to be recycling more bottles, and 5% claimed to be recycling more cans, as a result of the scheme.

The actual weights collected by the scheme were low, at ~0.6 tonnes, reflecting both the relatively low capture rate noted above and the low weight of the targeted materials. Around 13% of the target container waste that was recycled went through the machines, and 87% through the other recycling facilities. The machine capture rates for materials arising in the various recycling streams (i.e. excluding any that might be in the residual waste) are therefore 9% for cans and ~20% for plastic bottles, broadly the opposite of the capture rate by DUSA sales (~25% of cans and ~10% of plastic bottles).

Given the difficulties in obtaining comprehensive tonnage data for all waste and recyclate streams across the campus, and the likely natural variation within those figures, it was not possible to identify the impact of the scheme on overall waste and recycling levels.

High down-time rates for most of the pilot may have affected the use and data obtained. The machines at Belmont Towers (PET bottles) and at the Dalhousie Building, in particular, were out of use for long periods when they were awaiting parts. This will have affected not only the numbers of items returned but also users' confidence and the likelihood that they would bring items to the machines.

The pilot was time-intensive for staff at the University of Dundee, especially the ESO. Many of these demands were linked to data requirements for the pilot, rather than scheme management. However, machine reliability was a recurring issue at this site, requiring staff time and frequent technician visits until the root cause of the problem was eventually identified. The small amounts collected, combined with the fact that this was a pilot, meant that, while material quality was high, there were no changes to how recyclate was handled on site, or the value obtained from it.

The machines were popular with 76% of users, who rated both overall satisfaction and ease of use highly. Non-users tended to cite lack of awareness and relatively inconvenient locations for the machines as reasons for non-use, and users also believed the locations could be better. The novelty of the scheme and a desire to recycle were the most frequently cited reasons for using the machine, with the reward mentioned less frequently. The benefits of the scheme that were mentioned most often were environmental. Unprompted, 3% suggested it had had an effect on litter, although other evidence suggested that this was not the case.

Of those surveyed, 71% claimed they had not redeemed their reward voucher, but approximately 85% of rewards by value had been redeemed. It seems likely, though it cannot be proven, that part of this discrepancy is because people are more likely to redeem higher-value vouchers (e.g. for multiple containers). Some of these multiple-container returns may have been made by staff (e.g. cleaners or catering staff).

The reward level was generally considered appropriate, somewhat in contrast to the redemption behaviour claimed above. It is interesting to note that cans were recycled more than bottles, despite more bottles than cans being sold on site. The higher reward for cans (5p) than bottles (3p) may have motivated different behaviour, though other factors could also contribute. In particular, it appears (from the data for the other site recycling facilities) that more cans than bottles were consumed on site.

Suggestions for different rewards included alternatives to paper vouchers (such as using student matriculation cards as loyalty cards) and allowing redemption at a greater range of outlets and for other university services.

A large majority of respondents (93%) wanted to see the scheme continue, and would welcome schemes of this kind being more widespread in Scotland.

7 Glossary of terms

- Capture rate: the proportion of targeted containers that are recycled through the system.
 - Collection: the return of containers to the reverse vending machine.
 - Deposit: the 10p charge placed on an in-scheme container.
 - In-scheme: a container that was sold within the university with a deposit charged.
 - Non-user: person who has not used the Recycle and Reward scheme, or has used it but does not intend to again.
 - PET: polyethylene terephthalate.
 - Reverse vending: accepting an item for recycling in a machine that issues a reward or other incentive.
 - Shelf talker: card or sign attached to a shelf to highlight a product or promotion.
 - Transaction: a visit to the reverse vending machine by a user placing one or more collected containers in the machine.
 - Units/containers: the aluminium cans, PET plastic bottles or cups.
 - User: person who has used the Recycle and Reward scheme more than once.
-

Appendix: monitoring methodology

The monitoring and evaluation work for the pilots was led by SKM Enviro (SKM), working in partnership with Nicki Souter Associates (NSA). At the educational sites, Zero Waste Scotland undertook additional data collection outside the trial period, so a complete dataset could be obtained for the autumn term.

The range and number of data collected varied somewhat by site, reflecting constraints on what sites knew, and the cost-effectiveness of obtaining certain types of data in some contexts. As the pilots progressed, the balance of monitoring was adapted to concentrate on those sites which would be most likely to provide useful learning. This particularly affected strand B, where it was felt that, firstly, concentrating some resources on key sites could help offset some of the limitations on the strand A data and, secondly, some sites were experiencing relatively low footfall and would be far less cost-effective to target in data collection terms.

Data collected and methods employed included the following. Some differences between sites are highlighted here, whilst the approach for specific sites is in tabular form below.

Strand A

Baseline retail sales data for the site – some sites had only annual data, others monthly and some only partial data. In one case (HebCelt) there were no historic data, and in another (Troon HWRC) no sales data were collected either before or during the trial, as the target area was too broad.

Pilot period retail data – all sites but Troon HWRC provided these data. Typically data were either weekly or monthly depending on the sales systems and number of outlets that were relevant to the site.

Baseline waste management data for the site – some sites had monthly data and one site (Dundee) sought to estimate weekly information. However, several sites had no baseline data. All sites struggled to provide detailed waste information (e.g. the composition of drinks containers by stream, or weights rather than volume-based estimates).

These are common challenges in trials of this type, and could be comprehensively tackled only by a year-long resource intensive pre-pilot monitoring period. In an attempt to improve understanding, in two cases (Heriot-Watt and the North Ayrshire schools) waste compositional analysis was undertaken before and during the trial. Site visits in all cases where it was appropriate also included visual estimates of container fill rates and contamination, and discussion with site staff to understand collection frequency, but, while this improved our understanding of material flows, it was insufficiently sensitive in itself to highlight change over the trial period.

Waste management data during the pilot period was available for all sites, but granularity and quality varied. Most sites knew their overall waste arisings and some knew recyclates within that. In two cases (as noted above) compositional analysis was undertaken to try to understand residual composition. Sites provided data from a mix of volume-based measures, weight information, and site and waste contractor information.

Returns data from the recycle and reward machine(s) and/or manual data during the trial period were collected. Where both were available they were sense-checked against each other. Typically the manual data were preferred in those cases where there was a contradiction (for example, switching the power on and off was found to have led to the machine resetting the count at one site).

Machines recorded transaction data in different levels of detail (daily, weekly or by individual transaction). Most machines recorded data by container type; in one case the machine collected

mixed plastics and cans in a single receptacle and in this case the split of material was estimated during site visits.

The level of analysis that these data could be subjected to varied according to the format obtained.

Downtime data during the pilot period – some machines also provided telemetry data when they were offline (either for servicing or emptying, or because of a problem), and some sites provided these data. However, it was not always clear at all sites how long machines were down for.

Redemption rates during the trial period – the machines identified how many vouchers were issued (where this differed from the number of containers returned, e.g. where some containers did not attract a reward, or rewards were given to charity). Voucher redemption data were collected from the retail outlets either monthly or weekly. The level of analysis that these data could be subjected to varied according to the format obtained, and how closely they matched the machine data in time periods covered.

Site visits were conducted to understand waste management practice, to help gather baseline data and to build a relationship with the sites to facilitate the overall monitoring. SKM staff originally proposed to visit each site (with the exception of HebCelt, which it was sensible to visit only during the pilot) at least twice (once before the pilot and once during it). However, for some sites the number of visits was increased, where it was felt this would enable the collection of better baseline data, addressing some of the gaps in pre-existing records.

Although not formally part of the monitoring process recorded here, all sites (except HebCelt, though other Zero Waste Scotland staff were present) received multiple visits from the Zero Waste Scotland project manager. Especially during the early trial period, these were often weekly for some of the bigger sites. Zero Waste Scotland staff were also available to troubleshoot problems remotely (by phone and email) and this also means we obtained data on much of the learning around set-up and installation. These visits were therefore invaluable both in delivering the pilots and also in providing insight into how they were functioning on the ground, and what was and was not working well. Visits included an assessment of reliability, and material quality, on several occasions. Zero Waste Scotland also made several other visits to sites to assess communications and scheme performance; these included informal ‘mystery shopper’-style use of the machines. NSA also visited all sites where they conducted fieldwork at least once, and provided feedback on how well the scheme was functioning at the time of their visits.

Throughout the pilot period SKM, NSA and Zero Waste Scotland liaised closely on issues encountered.

In some cases, site visits included visual (including photographic) inspection of residual bins, recycling bins or the recyclate collected from the machines. In a few cases, site waste management staff were able to supplement data gathered this way independently of a visit from the monitoring team.

Strand B

Focus groups were concentrated on the university sites, which saw relatively high levels of use, and an audience that was accessible for this form of research. Despite the variation in scheme design, these three institutions are of course broadly similar in function, so it was also felt cross-site comparison would add most value to focus groups conducted in these contexts.

Face-to-face (and online) surveying was concentrated on the university sites and HebCelt, as these saw the highest footfall and were thus most appropriate for an in-situ survey technique. Thanks to patterns of use at these sites, an in-situ technique also has a good chance of reaching a

representative set of users, and (albeit to a somewhat lesser extent) relevant non-users (i.e. those who use the public areas targeted, but not the scheme). The samples obtained in these cases do allow for quantitative analysis.

At Dundee, an online survey to students managed by the university also asked about reactions to the Recycle and Reward scheme, and the results were kindly shared with Zero Waste Scotland. These provide an interesting perspective, as the respondent base and time period differ somewhat from the external monitoring undertaken.

At the Ikea stores and Troon Household Waste Recycling Centre an interviewer was placed on site for a day in each case, but, as expected, relatively few interviews were obtained because of the lower footfall. The responses obtained here provide customer insight, but are too small to be analysed quantitatively.

In the school context it was felt that an online survey was a cost-effective alternative to face-to-face surveying (all students can be contacted in this way, and can be encouraged to participate by staff). Numbers were relatively small, but can be considered quantitatively (with caution).

An online survey was made available at Whitmuir (using its customer database), as it was felt that on site surveying would yield too few users to be worthwhile. Very little feedback was obtained via this route (which is also a somewhat selective sampling method, as not all customers are on the database – though regular customers, which the scheme expected to target primarily, were).

Observations were also concentrated on sites where footfall was highest, but were employed to some extent at all sites except Marr (as Zero Waste Scotland considered the schools in North Ayrshire to provide sufficient insight) and Whitmuir (where machine use was very low). The extent to which the observations can be analysed quantitatively is dependent on the number of transactions actually observed in each case.

Insight from formal observations is supplemented by the insight gained during site visits by SKM, NSA and Zero Waste Scotland throughout the trial period, and feedback from site staff (about both what they have observed, and what customers have told them). This provides a useful perspective, in conjunction with other sources, both on changing behaviour over time (in particular the extent to which the observed periods at the universities may have been atypical, as they were near the start of term) and on behaviour outwith the monitoring period (for example, use by cleaning staff at some sites particularly in the early morning).

In-depth interviews were carried out by NSA at a smaller number of sites. These sites were selected by Zero Waste Scotland on the basis that they would provide most additional insight. The interviews targeted a range of site staff including management, cleaning and retail staff. The excluded sites were those where Zero Waste Scotland had had particularly extensive contact throughout the trial period, and it was felt staff insight and reactions were already well understood. Zero Waste Scotland has fed into the reporting process in all cases.

General

Although presented as strands A and B in research design, with SKM undertaking the fieldwork and analysis for strand A and NSA doing so for strand B, the final reporting and analysis for all cases, and the overview report, have been led by SKM, working closely with both NSA and Zero Waste Scotland. Throughout the process, the project team across the three organisations met regularly to exchange information and insight, and, particularly in terms of insight into site management and scheme performance, all three organisations gained insight from their respective site visits. The reporting should thus be seen as an integrated report, drawing on both technical data and analysis, and quantitative and qualitative social research.

Key challenges in interpretation and analysis are highlighted in the main report at section 2.4, and where appropriate when presenting specific findings. Table A1 shows the detail of monitoring across sites, including variation.

	Pilot Project	Hard' Performance Data - baseline (pre-pilot)			Hard' Performance Data - during pilot							Strand B				Other information	
		Baseline retail data	Baseline waste management data	RVM data manual record	RVM data telemetry	Retail data	Voucher data	Waste Management data	Machine downtime	Site visits	Other in depth analysis	Focus Groups	Depth interview (days)	Observational analysis (days)	Face-to-face surveys (total number)	Site Specific data limitations	Other supporting information
Universities	GCU	Supplied approximately weekly by the General Manager of Catering Services	Supplied as monthly data by the Sustainability Coordinator	Supplied approximately weekly by the General Manager of Catering Services	Machine supplier provided data approximately weekly.	Supplied approximately weekly by the General Manager of Catering Services	Supplied approximately weekly by the General Manager of Catering Services	Supplied monthly by the Sustainability Coordinator	Limited data from machine supplier (machine ID but not date/duration)	5	Photographic/ observational bin audits (6:5 by SKM staff; 1 by GCU staff)	2	0	3	250	Early weeks recorded as a total value. No machine downtime data provided by GCU. Procurement of drinks containers based on existing process rather than sensitive to current patterns.	
	HWU	Comparable data not available	Annual data available	N/A	Machine supplier provided weekly; data available at an hourly level	Supplied weekly by the Hospitality Services Manager and Student Union Manager	Supplied weekly by the Hospitality Services Manager and Student Union Manager	Unavailable so waste compositional analyses undertaken	Machine supplier provided weekly	3	2 waste compositional analyses (prior and during trial)	3	1	2.5	500	The data provided by Hospitality Services of units sold in retail outlets was initially understood to be PET bottles only as no cans were sold in retail outlets. However it became apparent in the latter stages of the trial that a small quantity of cans is indeed sold in retail outlets. This has led to an unidentifiable but small number of cans sales being reported as PET bottle sales	
	UoD	Provided by DUSA based on actual sales in the two campus shops during one term-time week, an estimated figure for weekly term-time vending machine sales, and an estimate for expected sales (from shops and vending machines) during holiday periods.	Estimated weekly data on segregated recyclables provided by University based on container fullness rather than weight; estimated annual tonnages of segregated recyclables from teaching and admin buildings supplied by University waste manager; also monthly residual data excluding May to July 012	Supplied approximately weekly by the Environment and Sustainability Officer	Machine supplier provided data approximately weekly.	Supplied monthly by the Environment and Sustainability Officer/DUSA Shop and Vending Manager	Environment and Sustainability Officer provided data on the total amount invoiced by DUSA (variable frequency)	Data on for recycling from RotG banks, Halls of Residence supplied monthly by Dundee City Council; University Waste Manager supplied weekly data on University residual waste	Supplied approximately weekly by the Environment and Sustainability Officer; limited data from machine supplier (machine ID but not date/duration)	1	N/A	2	0	3	250		
HWRC	Troon	N/A	No data available	Total units data provided weekly by Council staff; data on bottle/can split only provided as overall ratio provided at end of trial	N/A	N/A	Monthly data provided by HWRC staff at end of trial	Material collected in combination with other recyclates so no data available	No data	2	N/A	0	1	1	1 day		
Schools	Marr College	Baseline vending sales data was available from DC7 Ltd but not from the school canteen	No data available	Weekly data provided by the community policeman	N/A	Weekly data supplied by canteen staff and monthly data for the vending machine was provided by DC7 Ltd	Data provided by the community policeman and the eco-committee	Only estimated data available	No data	2	N/A	0	1	0	50		
	NAC Schools	Monthly data supplied by each school's canteen staff	No data available	Janitor from each school provided a weekly record excluding summer holiday period	N/A	Monthly data supplied by each school's canteen staff	Monthly data supplied by each school's canteen staff	Only estimated data available so waste compositional analyses undertaken	Janitor from each school provided a weekly record excluding summer holiday period	3	2 waste compositional analyses (prior and during trial)	0	0	1	50 per school		
Retail	IKEA Edinburgh	Monthly data for Britvic vending machine sales only	Very little data available; initial visual inspection/weighting of recyclables to provide indicative daily data undertaken by SKM staff but access limited latterly	N/A	Daily data provided by machine supplier	Approximately four weekly provision of relevant items sold in the restaurant and the Swedish Food Market by sustainability staff; data for store sales have been provided for PET and glass bottles	Approximately four weekly provision of relevant items sold in the restaurant and the Swedish Food Market by sustainability staff	Some data on recyclables for a proportion of the trial period only	No data provided	4	Granular level telemetry data analysis	0	1	2	1 day per store		
	IKEA Glasgow	Monthly data for Britvic vending machine sales only	Monthly average residual waste data estimated based on volumes provided by store	N/A	Daily data provided by machine supplier	Approximately four weekly provision of relevant items sold in the restaurant and the Swedish Food Market by sustainability staff; data for store sales have been provided for PET and glass bottles	Approximately four weekly provision of relevant items sold in the restaurant and the Swedish Food Market by sustainability staff	Weekly residual data provided	No data provided	1	Granular level telemetry data analysis	0	1	2	1 day per store		
	Whitmuir	2012 unit sales provided for same period as pilot	Very little data available; initial visual inspection/estimation by volume of recycle and residual bins to provide indicative daily data undertaken by SKM staff; not possible to estimate fullness of glass banks (opaque)	N/A	Machine supplier provided at a weekly level	Weekly data provided by WO staff every few weeks	Machine supplier provided data on issued at a weekly level; weekly data on total redemptions provided by WO staff every few weeks	Weekly observations by WO staff of bags in the dry recyclables storage shed and residual bins where practicable	Machine supplier provided at a weekly level	1	N/A	0	1	0	Online - no target	Machine downtime data conflicting with staff experience due to issues with the quality of barcode stickers applied causing difficulty in machine reading	
Festival	HebCelt	None available	General waste and organics only for the 2012 festival	N/A	Machine supplier provided at a daily level	Hebcelt (beer cups; via Caroline) and 4 other vendors (bottles and cans); Based on stock purchased and left at end	Festival and machine supplier provided data on vouchers issued for prize winners	Council provided weighbridge data; supporting waste data gathered by SKM/Hebcelt team during festival via waste analyses	Manual observations only	Staff on-site the duration of entire festival	General waste analysis from litter pick / general waste	0	0	2	100		

Table A1 Breakdown of monitoring activity undertaken at each site



Zero Waste Scotland works with businesses, communities, individuals and local authorities to help them reduce waste, recycle more and use resources sustainably.

Find out more at **zerowastescotland.org.uk**
or call freephone **0808 100 2040**
