

# Report

Spring 2015

## Recycle and Reward Pilot Project Report Heriot-Watt University



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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](http://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.

This case study details the results of the Recycle and Reward pilot undertaken at Heriot-Watt University's Riccarton Campus. This pilot was based on a deposit return system with single use drinks containers. In this type of system a small, fully-refundable monetary deposit is charged for each drink container sold on site and when the container is returned for recycling, the deposit is refunded.

The pilot used four machines placed in different parts of the Edinburgh Campus. The period covered by this report is from 6 May 2013 to 26 September 2013, with operational data relating to normal use available from 10 May. The pilot covered four weeks of term time either side of 16 weeks of exams and summer holidays, when summer schools and other activities took place on the campus. This meant that there were changes to the student population during the pilot period. The pilot continued beyond September, with the university continuing to provide data direct to Zero Waste Scotland until December 2013.

While the pilot was a "closed" site in so far as it was within the campus, it was not truly isolated. There was the very real possibility for people to bring in drinks containers purchased outside the campus, and (to a lesser extent) recycle containers from the campus off site. Deposits of 10p were added to every targeted container sold on campus (polyethylene terephthalate, or PET, plastic bottles and aluminium cans), and vouchers (redeemable at campus retail outlets) were issued for each return to a machine of these items. An option to donate the deposit to charity when an item was returned was introduced in July 2013.

In terms of overall pilot performance:

- From 10 May to 26 September 2013, 97,552 target containers were sold.
  - A total of 41,000 containers were recycled through the machines, 37,000 from Heriot-Watt University sales and 4,000 (~11%) from outside the university campus.
  - The machines captured 37% of the containers estimated to have been sold on campus during the period. More may have been recycled in the general recycling bins, or outside the campus.
  - During the period SKM monitored, the volume of containers recycled through the machines was much higher in term time (3,100 containers per week) than in the holidays (1,800 per week) although the capture rate (as a percentage of sales) was lower during the formal monitoring period (40% during the holiday period and 33% during term time). A 42% capture rate was achieved overall, including the 4,000 containers brought onto the site, 45% during the holiday and 36% during term time.
  - Interestingly, subsequent monitoring by Zero Waste Scotland during the remainder of the autumn term saw a higher term-time capture rate than previously, with a capture rate of ~45% (counting all containers) between October and the end of December (and ~41% counting just those sold on site). The absolute number of containers returned was also much higher (coinciding with the new autumn term, with the initial uplift seen at the end of the SKM monitoring period continuing). This may reflect a more 'normal' pattern of term-time usage (with most students on campus and no exams) than the end of the academic year, as well as the fact that communications efforts in the new term may have targeted the student population more effectively (given more regular time on campus for students, and the significant promotional effort at the start of the new term).
  - The absolute tonnages collected by the scheme were low, at 0.8 tonnes during the SKM monitoring period, ~0.1% of total recycling (all materials) on the campus. This is in part down to the light weight of the target materials in comparison with other recyclables such as paper and food. Figures for the whole year will be higher, given that term-time usage was much increased; however, relative to all site waste, it is still a small fraction of the total.
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- User surveys suggested that 26% had used the scheme at least once while 17% of respondents were regular users.
- About 85% of the total reward value was redeemed, showing a financial motivation to recover the deposit, with ~5% of the rewards (by value) being made as charitable donations.
- Of those surveyed, 11% claimed to be recycling more bottles, and 2% claimed to be recycling more cans, as a result of the scheme.
- The machines returned a high-quality stream of source-segregated aluminium cans and PET bottles which could in theory allow the university to obtain a higher material revenue or reduce waste management costs.
- While litter analysis showed some potential reductions, this was based on a very small spot sample and no firm conclusions can be drawn.
- Some 86% of survey respondents wanted to see the scheme continue, and 85% would welcome schemes of this type being more widespread in Scotland.

Implementation issues around container recognition and container rejections appear to have negatively affected scheme performance initially, but were largely ironed out subsequently. Some users also felt a wider spread of locations for returns should have been available. It should also be noted that the pilot monitoring was undertaken mainly out of term time, when relatively few students were on site. The fact that existing recycling facilities remained during the pilot, combined with the short period of term time (at the start and end of the monitoring period), may have also reduced machine usage. Far higher levels of use and a somewhat improved capture rate were seen in the autumn term.

## 2 Pilot description

**This section describes the pilot site at the Heriot-Watt University Edinburgh campus, and the population targeted by the pilot. It considers waste management systems in place before and during the pilot period, and then the detail of the Recycle and Reward scheme put in place, including sections on the communications and site resourcing requirements of the pilot. It should be noted that this was a deposit-refund pilot, although containers without a paid deposit were also accepted in the machines.**

### 2.1 Background and context

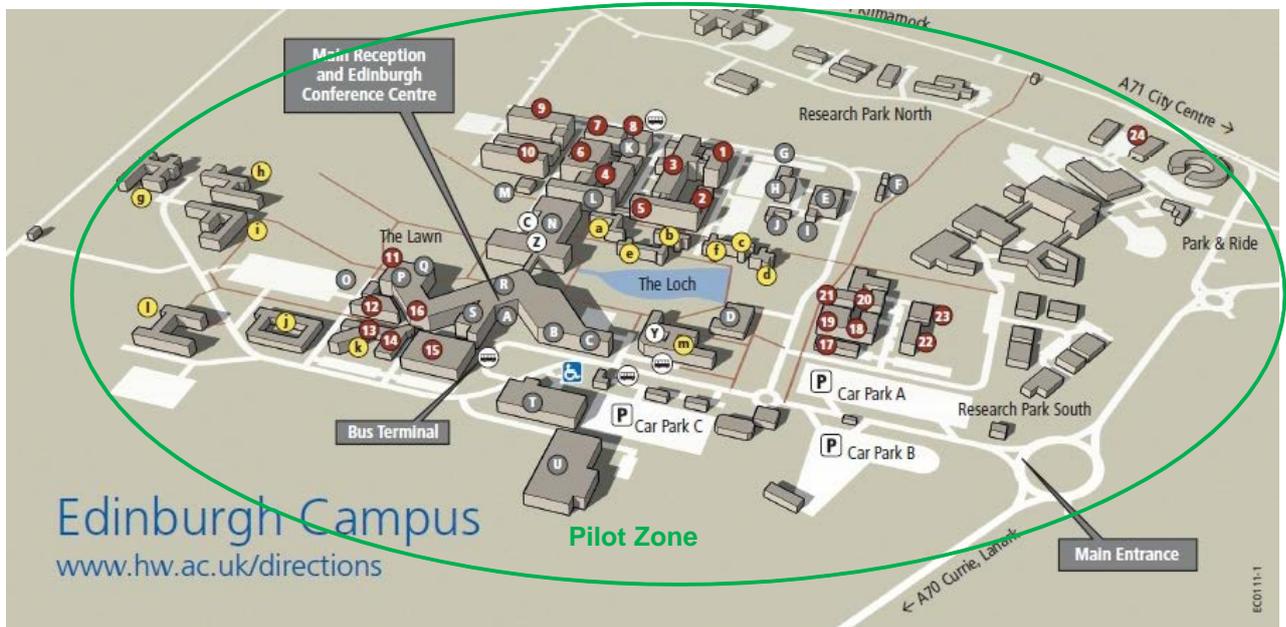
Heriot-Watt University has five geographically distinct campuses: the Edinburgh campus (where the deposit return pilot took place); the Scottish Borders campus in Galashiels; the Orkney campus in Stromness; the London associate campus; and the Dubai campus. These four other campuses were not part of the pilot and are not covered in this report.

The Edinburgh campus ('the campus') is located approximately six miles west of the city centre. Accommodating 1,666 administrative staff and 7,487 students, it is set within 380 acres of parkland, with no through routes. The campus comprises over 20 buildings, accommodating teaching and support functions and including the university library, the Sports Centre, the Student Union shop, nine catering facilities, several science teaching and research buildings, and 1,600 self-catering residences.

Just under half of the students reside on campus, with the remainder commuting, predominantly from Edinburgh city centre. Heriot-Watt already had an integrated recycling and waste management system and an ambition to 'minimise waste and ensure that there is effective control which promotes recycling where possible and provides responsible disposal elsewhere'.

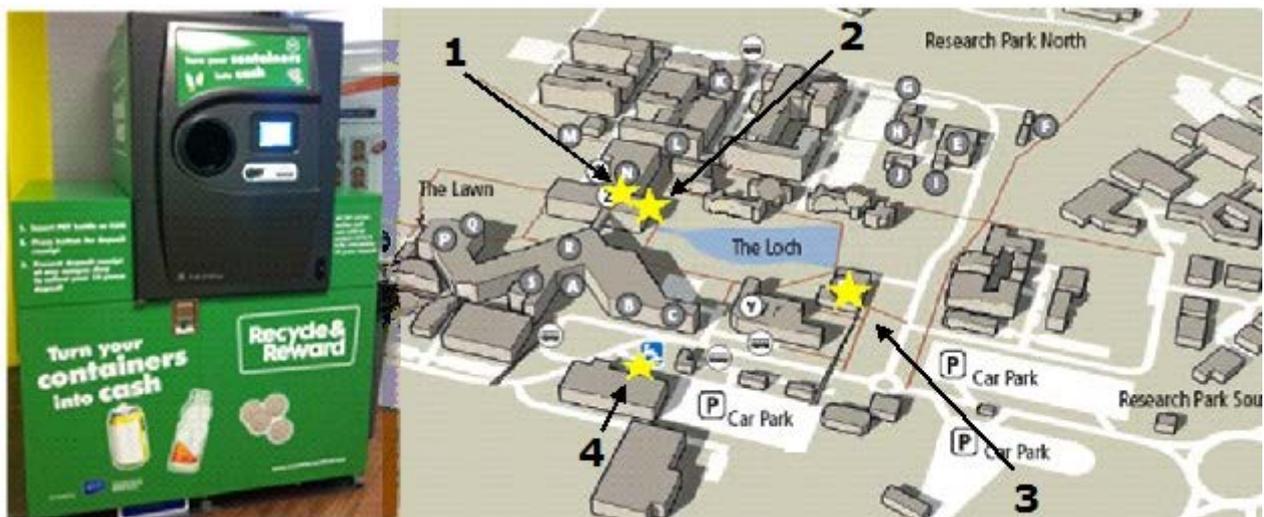
For the purposes of the pilot, the system boundary at the university was relatively well defined (Figure 1). The university provides conferences and function facilities all year round and, outwith term times, runs a number of residential courses, often for foreign students who are accommodated in the campus

residences. Therefore, while the system is semi-open, almost all individuals on campus are likely to be either part of the university or official visitors.



**Figure 1 Heriot-Watt University Edinburgh campus**

The layout of the HWU campus and the location of the Recycle and Reward machines are shown in Figure 2.



**Figure 2 A Tomra T63 machine at Heriot-Watt University with a map showing the locations of the machines**

## 2.2 Waste management arrangements before the pilot

Waste on campus is managed by a waste management team operating out of the recycling centre, located in the south-west of the campus. Before the pilot, the waste management operations were as follows:

- General waste was collected in internal (inside buildings) and external litter bins.

- Co-mingled glass and cans were collected in internal and external bins, and bulked at the recycling centre for collection and recycling by a waste contractor.
- Mixed plastics were collected in internal and external bins, and bulked at the recycling centre for transport by a waste contractor.
- Mixed paper and card were collected in internal bins (though these are not spread equally throughout the campus), and bulked at the recycling centre for transport by a waste contractor.
- Litter pick teams were deployed in external areas throughout campus, litter collected being bulked at the recycling centre for transport to landfill.

In resource and waste management terms, the campus can be described as 'semi-closed', since the campus is to a degree a self-contained village for resident students, while other students and staff commute daily to and from the site.

The flow of waste materials and associated waste data through the campus before the pilot implementation is shown in Figure 3.

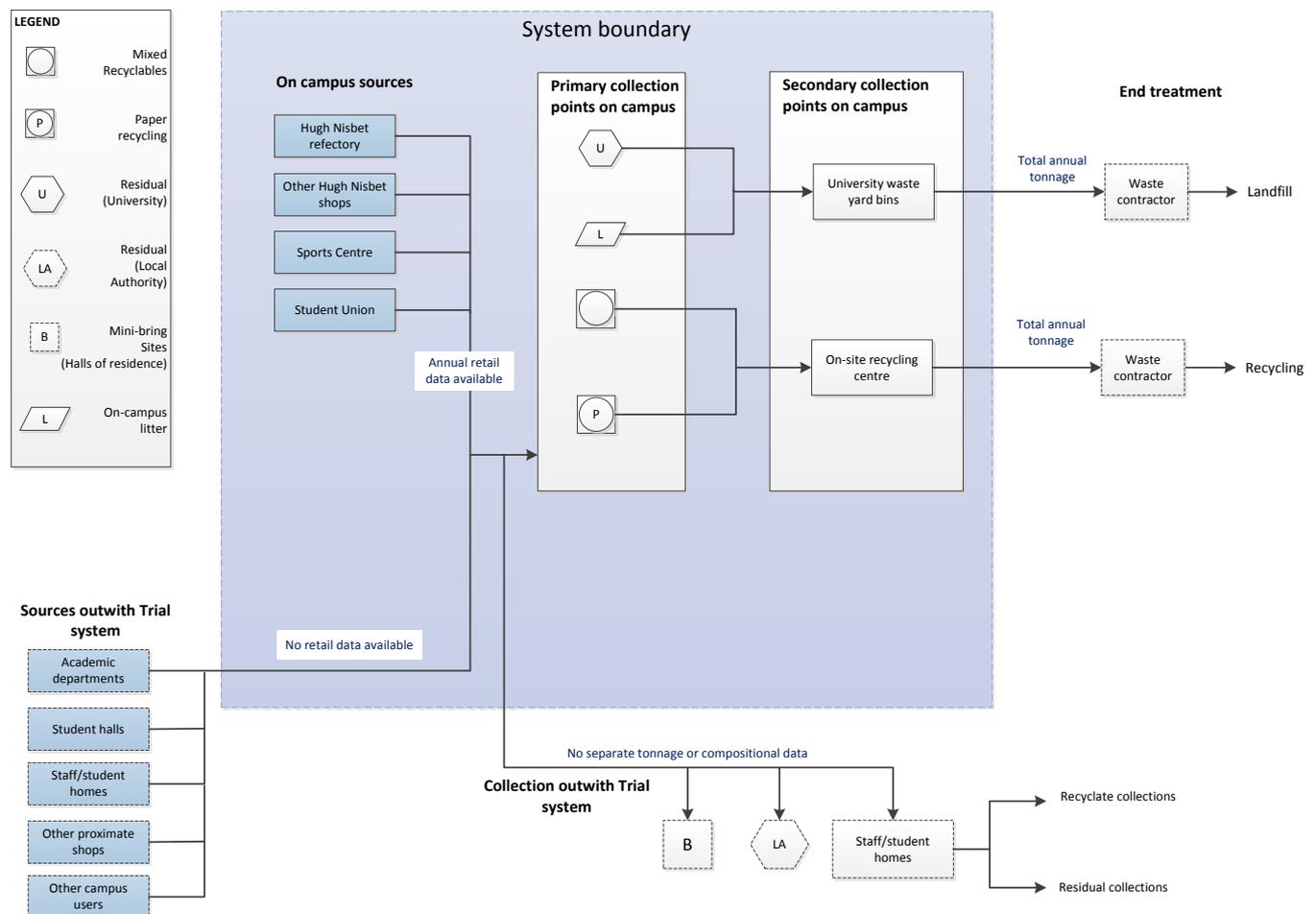


Figure 3 Flow of waste and waste data before pilot

## 2.3 Target population

It is reasonable to consider the 1,666 administrative staff and 7,487 students to be all within scope as the target audience, although not all will necessarily use the shops and vending machines on site. Containers bought on campus may not necessarily be consumed on campus, while, conversely, containers bought off site can be brought onto the site and were accepted in the machines.

While the campus boundary is open for foot and road traffic to pass through, the site is not really a cut-through or thoroughfare for general members of the public, given its location, so the scheme was only ever likely to be accessed by students, staff and visitors to the university. There is, however, a neighbouring business/research park, staff from which could in theory use the university's catering facilities and the Recycle and Reward machines. Thus, while material flows of targeted containers on and off campus did undoubtedly occur, this may be less than at some other sites (e.g. in town centres), and can be more easily identified in the returns data.

The summer vacation began on 18 May 2013 and teaching recommenced on 16 September 2013 following freshers' week (which started on Friday 7 September). Over the summer period the campus and sales outlets remain in use, for events and summer school students. This represents a more transient audience, and lower footfall than term time. Sales figures for targeted containers show an average of ~4,000 per week (over 18 weeks of vacation data), compared with 12,700 over the two weeks of term-time data, reflecting a significant population on site even during the summer vacation.

### 2.4 Recycle and Reward approach

The aim of this pilot was to test a simple deposit return system for single-use drinks containers. In this type of system a small, fully refundable monetary deposit is charged for each drinks container sold on site and, when the container is returned for recycling, the deposit is refunded. To achieve this the Recycle and Reward machines issued a voucher for 10p per targeted item, which could then be redeemed through the till at any one of the retail outlets on campus for 10p in cash, or as a discount on a future purchase. The retail outlets kept records of the numbers of barcoded items sold (via their till system) and the number of vouchers redeemed over the till.

Over the summer a third option was introduced so that users could elect, at the machine, to donate the value of their voucher to charity. Before the 'on-machine' option there was an informal approach, with a charity box in the Union shop where students could place their 10p vouchers. These would then be donated to RAG (Raising and Giving) the Heriot-Watt Student Union's charities group. No data were recorded for these informal donations.

All drinks containers sold in the retail outlets (catering facilities, Student Union, student shop and vending machines) and made from the target materials (PET plastic bottles and aluminium cans) were labelled with an add-on barcode to identify that they were included in the scheme and that a 10p deposit had been added to the purchase price. Containers bought outwith the scheme (e.g. off site) were also accepted by the Recycle and Reward machines for recycling (most kinds of drinks containers sold in Scotland were accepted: over 10,000 items), but no deposit or other reward voucher was issued. This policy was adopted to encourage recycling overall, and ensure that the rejection of unlabelled containers did not put users off using the scheme.

Use of the add-on bar code enabled the scheme to be assessed in terms of:

- overall recycling rates of containers (within the scheme and on the campus overall);
- a breakdown of recycling rates for the two main retail areas of hospitality (catering outlets and vending machines) and the Student Union (student shop, bar and café in the Student Union), though the use of individual add-on bar codes for each retailer; and
- 'capture rate' of containers brought on campus and then placed in the Recycle and Reward facilities.

There were four Recycle and Reward machines located across the Heriot-Watt campus (represented on Figure 2):

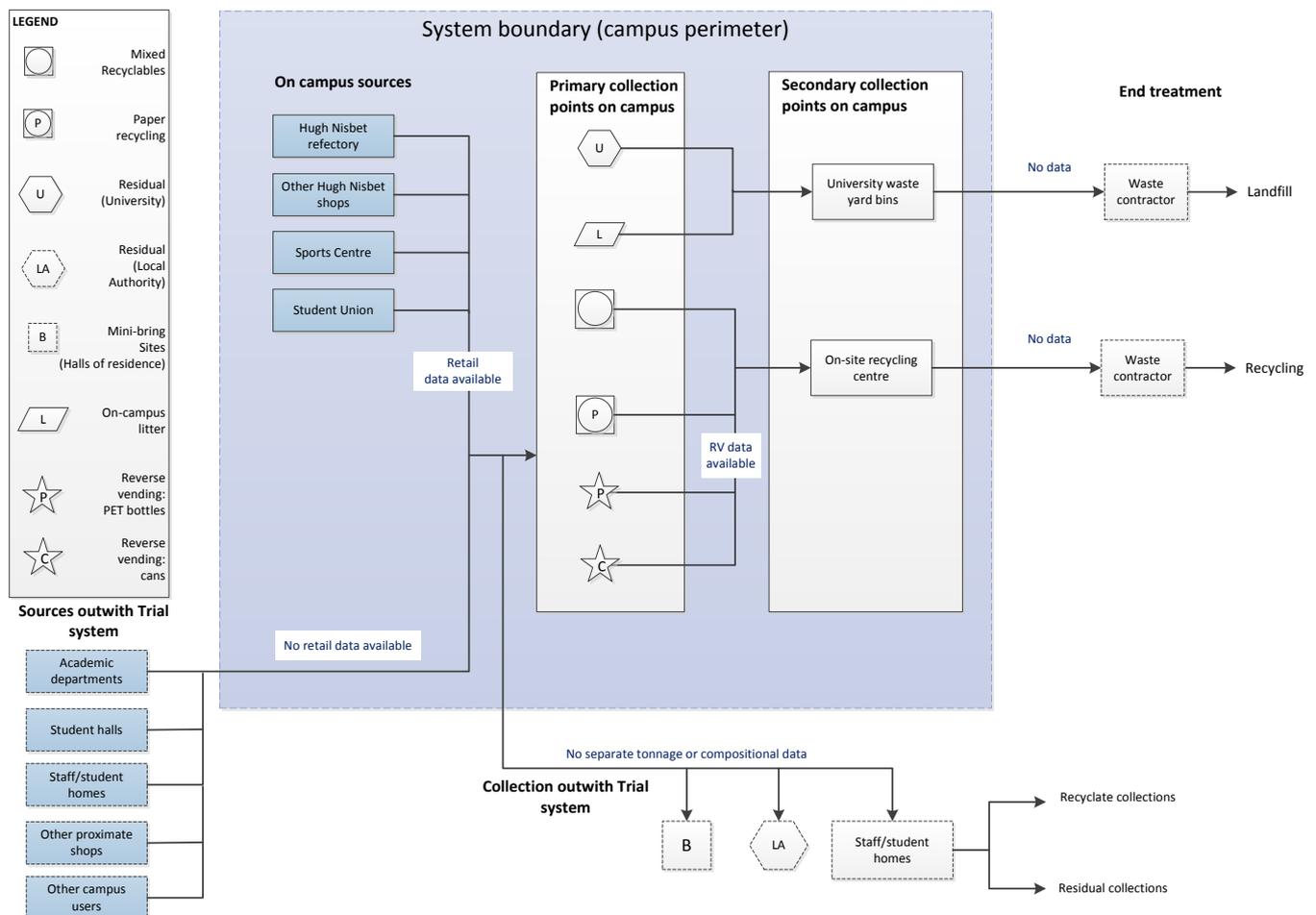
- 1 in the upper canteen in the Hugh Nisbet Building, in the corner of the main refectory area serving food outlets including Brio and Da Vinci's;
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- 2 outside the student shop in the Hugh Nisbet Building, in the main thoroughfare by shops and close to food outlets including The Piece and Elements;
- 3 at the Student Union, in the thoroughfare leading to Geordies Bar; and
- 4 at the Sports Centre, in the main entrance foyer close to vending machines.

The Hugh Nisbet Building is the largest on campus, and houses the majority of shops, services, and social areas.

Both machines in the Hugh Nisbet Building and the machine in the Student Union were Tomra T63 models, accepting both aluminium cans and PET plastic bottles. The machine in the Sports Centre was a Tomra 63 cabinet, accepting only PET plastic bottles, as only PET plastic bottles were sold at this location. The machines were installed in April 2013 and were operational from 6 May 2013, with reliable data from 10 May.

The containers recycled in the machines were collected by the HWU waste recycling team, who bulked and stored the materials for onward transport by the waste management contractor. The system flow of resources and wastes after the implementation of the pilot is shown in Figure 4.



**Figure 4 Flow of waste and waste data during the pilot**

Figure 4 illustrates that the materials diverted in the Recycle and Reward machines may come from two main sources: the stream of aluminium cans and PET bottles which were previously disposed of via the mixed cans/glass and mixed plastics recycling bins placed throughout the university, and those which would otherwise have been disposed of in general litter bins or discarded as litter throughout the university.

Where Figure 4 references data availability, it does so within the timeframe of the pilot. No end treatment data were available, since, as shown in Figure 3, these data are available only annually.

## 2.5 Promoting the scheme

Zero Waste Scotland provided communications support and resources to assist HWU to develop a communications plan and a timetable of activities for the pilot project. The plan was approved by Zero Waste Scotland, as were all graphics, materials and supporting text.

The university used campus-wide and more local communications to ensure that all audiences were aware of what was happening and why the university was involved in the project. The plan developed five key messages:

- Heriot-Watt's Edinburgh Campus is taking part in the Scottish Government's Recycle and Reward pilot programme, launching locally on 6 May 2013.
- Customers will pay a refundable deposit on drinks bottles and cans bought in all campus catering outlets (except Edinburgh Business School) and vending machines.
- Customers who then recycle the bottle or can in the special machine will receive a 10p voucher which they can exchange for cash, use as money off their next purchase or donate to RAG (Raising and Giving, Heriot-Watt Student Union's charities group).
- Two machines are located in the Hugh Nisbet Building, one in Central and the other on the ground floor opposite the shop; further machines are located at the Sports Centre and in the foyer of the Student Union building.
- This scheme is part of Heriot-Watt's ongoing commitment to reduce waste to landfill and increase recycling percentages.

The plan had three key phases, covering the launch of the project, the period till summer vacation and the relaunch of the project during freshers' week, to capture the intake of new students.

### 2.5.1 Staff engagement

Staff were identified to help deliver communications and included Hospitality Services staff (those who sell drinks), the Student Association Executive, Student Union staff (as a Recycle and Reward machine was located there), Sports Union staff (a machine was also located there), wardens in the halls of residences and those responsible for Transition Heriot-Watt (a community organisation for sustainability and wellbeing). Training sessions were run in April and May by Tomra and Zero Waste Scotland for all staff who wished to participate. The training was facilitated and attended by Estates staff, who were responsible for managing the project and waste collection within the campus. Training included a demonstration on how to use the machines and operational aspects such as cleaning and emptying them. It also prepared staff to provide information about the project, such as the value of the deposit and how to reclaim the deposit. Catering and Student Union staff were required to cascade the message to their staff internally.

Tomra provided regular support to ensure that staff at the university were competent in the use of the Recycle and Reward machines.

An item on the Recycle and Reward project was included in emails, electronic newsletters and social media sites to highlight the launch of the project on 6 May 2013. These were sent from the week beginning 15 April and included all staff, students and neighbours occupying the adjacent business/research park, who could use the university's catering facilities.

### 2.5.2 Public relations (PR)

A programme of PR opportunities went throughout the duration of the project. This started with a formal photo-call and launch of the Recycle and Reward scheme at the campus on 6 May, was

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attended by the university Principal and project team. The launch was promoted through university emails, newsletters and social media sites (including Twitter and Facebook) and externally through the university website and Student Union website.

### **2.5.3 Marketing communications**

#### **2.5.3.1 Flyers**

Following the launch, A5 flyers providing information on the nature of the scheme, the deposit charged on drinks containers, the location of the Recycle and Reward machines and how to reclaim the deposit were made available at the machines and all tills at retail outlets. Two flyers were available, one providing frequently asked questions (FAQ) on the project and the other describing how to participate in it.

#### **2.5.3.2 Posters**

In preparation for the launch, promotional posters (A0 and A3, print runs of 100 and 50 of each) were circulated around campus and the adjacent research park and were displayed around point of sale and the Recycle and Reward machines. They were also displayed on notice boards at the Student Union and halls of residence.

#### **2.5.3.3 Shelf talkers**

In the weeks following the launch, signage at the point of sale was placed in the hospitality catering and Student Union shops and catering areas. These included shelf talkers and A3 posters, with clear instructions on the charge for a 10p deposit on drinks containers, where to find the Recycle and Reward machines and how to reclaim the deposit.

#### **2.5.3.4 Machine signage**

Signage for Recycle and Reward was clearly visible at each machine site.

#### **2.5.3.5 Social media**

The primary social media routes were Twitter and Facebook, and internally with Transition Heriot-Watt, with regular messaging issued from the launch and then on an ongoing basis. For example, an update on the pilot progress was prepared at the end of July, detailing recycling rates and encouraging participation, whilst announcing the addition of the charity donation button, going live from 22 July 2013.

#### **2.5.3.6 Freshers' week**

HWU planned for enhanced communications during freshers' week, which began on 7 September 2013. A refresh of general communications was supplemented by a student awareness campaign targeting the new intake of students. For example, HWU advertised the Recycle and Reward project on the freshers' student wall planner, which is issued to all new students. Tomra and Zero Waste Scotland provided refresher training to staff and student helpers, who assist with introducing freshers to the campus. A5 flyers highlighting the project and location of Recycle and Reward machines were placed at tills within the retail and catering outlets. Shelf talkers were also placed in the refrigerated units and drink vending machines at the point of sale. Flyers and posters were placed throughout the campus and in as many buildings as possible and directional signage was displayed on lampposts adjacent to the Student Union, showing the location of the closest Recycling and Reward machines.

## **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 these were applied in this specific location, first describing the approach

to data collection on performance, and secondly 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 the extent to which this affects the conclusions that can be drawn about pilot performance.

### 3.1 Performance data collection

Quantitative data were gathered by various means as described below. Although some of the desirable waste data for the site as a whole were not available (see section 2, which discusses the lack of certain waste management data), there was a high level of engagement from the university and Student Union staff, who provided sales and redemptions data to compare with the machine returns data. See section 4.

#### 3.1.1 *Machine throughput*

Weekly summary readings of deposit data for each machine were obtained by Tomra via telemetry links. Data were then forwarded to SKM (the project monitoring contractor) for review and analysis.

In addition, the machines recorded individual transaction data throughout the pilot period. This was only downloadable at the end of the pilot and forwarded to SKM. It provided the following information in each case:

- machine location;
- time and date;
- transaction duration;
- number of containers (though not material);
- type of reward taken (voucher/charity donation/no reward as non-scheme container).

This level of detail allowed time period data analysis covering term time, exam time and holidays, and weekdays versus weekends. The transaction data set covered almost 15,000 transactions between 10 May and the end of September, with an increase in transaction numbers at the start of the autumn term. Zero Waste Scotland continued to collect data, and this increase proved to be sustained. This is the only pilot where data on use are available at this level of detail.

Machine downtime data were also gathered weekly by Tomra via a telemetry link to each machine and then forwarded to SKM.

#### 3.1.2 *Waste and recycling data*

Pre-pilot and post-pilot waste and recycling data should indicate any impacts on waste and recycling resulting from the pilot, including potential 'modal shifts' whereby participants recycle the same quantities as before, only through different routes, or actual changes in the quantities of recycling undertaken.

As shown in Figure 4, in-pilot waste management data for the period of the pilot were not available. Therefore, SKM undertook waste composition analyses on residual, recycling and (where applicable) litter waste streams in each of the four zones containing a deposit return machine. Litter composition analyses were undertaken on public thoroughfare areas away from the main zones to help determine the impact on littering. To understand any shift in waste composition as a result of the pilot, two rounds of analysis were undertaken. The first round was on 25 April 2013, before the pilot was implemented, and the second on 24 October, while the pilot was still ongoing.

It should be noted that, although this case study focuses on the pilot only up to 27 September, the machines remained in place until December 2013, so the scheme was still ongoing while the second waste composition analysis was carried out.

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### 3.1.3 Retail and rewards data

A record of the quantities of barcoded items sold by each outlet on campus by Hospitality Services, including items sold by vending machines across campus, was provided to SKM weekly by the hospitality manager. Data were broken down by both material and participating outlet. The number of units sold by the Student Union was likewise provided weekly by the Student Union manager. By understanding the location of the vending machines it is possible to nominally allocate sales data to one of the four zones containing the machines: Hugh Nisbet Lower, Hugh Nisbet Upper, the Student Union and the Sports Centre (though all containers were accepted in all machines). Vending machines in all other areas of the campus were allocated to an 'other' zone.

Retail data for the corresponding period in 2012 were not available.

Weekly readings of the quantity of vouchers issued by the machines were obtained by Tomra via telemetry links to the machines. Data were then forwarded to SKM. These data enabled an understanding of the number of bar-coded items collected in the machine versus total number of items collected (i.e. bar-coded and not).

The number of vouchers redeemed at each Hospitality Services outlet was provided weekly by the Hospitality Services manager, while the number of vouchers redeemed in the Student Union was provided weekly by the Student Union manager.

## 3.2 Social research: quantitative survey and in-depth interviews

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

- in-depth interviews with staff (Tuesday 22 and Tuesday 29 October);
- observational analysis (3.5 days: Monday 7, Monday 14, Wednesday 16 and Thursday 17 October);
- quantitative face-to-face surveys (500: Monday 30 September to Friday 11 October); and
- focus groups (three, two user groups and one non-user group: Tuesday 8 October).

### 3.2.1 In-depth interviews

The in-depth interviews were conducted on 22 and 29 October at Heriot-Watt University, each interview lasting approximately 45 minutes. The following people were interviewed:

- Hospitality Services general manager;
- retail manager of the Student Union shop;
- Head of Corporate Services and Deputy CEO of the Heriot-Watt Student Union;
- a charge-hand recycler; and
- a catering supervisor.

### 3.2.2 Observational analysis

The observational analysis was carried out on Monday 7 October, Monday 14 October, Wednesday 16 October and 18 October between 09:00 and 17:00. Although there were no quantitative targets set for the observational analysis, this activity was used to gain both qualitative and quantitative insight into user activity and behaviour.

### 3.2.3 Quantitative survey

The quantitative survey was carried out face to face by two NSA engagement officers over 10 days (between 30 September and 14 October) between 09:00 and 18:00. Participants were approached at random and invited to take part. The engagement officers approached students, staff and visitors, with

the primary target audience being those using the machine. Male and female students of mixed ages were canvassed to take part in the survey. Any students or staff observed using the machines at the time of surveying were approached to take part in the survey.

A total of 500 surveys were carried out at HWU as detailed in Tables 1 and 2. The overall profile of the surveyed population is summarised in section 2.3.

Age	Male	Female	Total
Under 18	13	14	27
18–29	220	224	444
30–44	12	8	20
45–59	5	3	8
Not given	0	1	1
Total	250	250	500

**Table 1 Age and gender profile of sample**

Category	Number	%
Staff	18	4
Undergraduates	406	81
Postgraduates	70	14
Visitors	5	1
Other	3	1

**Table 2 Staff/student/visitor profile of sample**

*Note: This question was multicoded.*

Participants	Number	%
Surveyed	500	100
Users	132	26

Non-users	368	74
Regular users (all materials)	84	17
Regular users: plastic bottles	83	17
Regular users: aluminium cans	15	3

**Table 3 Overall user profile**

*Note: Regular users are defined as those who have used the machines more than once and are still using the machine.*

Of those surveyed, 95% were students and 4% were staff. An equal number of males and females were interviewed. Just over a quarter of the sampled population had used the Recycle and Reward machines on campus, and 74% had not. Some 92% of the users were students, of whom 55% were male and 45% were female.

### 3.2.4 Focus groups

Respondents were recruited using a quota-sampled, free-find method on campus. This was done independently from the quantitative survey. Two groups were conducted among those who had used the Recycle and Reward scheme at HWU more than once (defined as 'users'). One group was conducted among those who had never used the scheme or who had used the machines once or twice but claimed they would not use them again (defined as 'non-users' and including 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.

Focus groups were conducted with students at the university on 8 October 2013. The two user focus groups took place at 13:30 and 15:30; the non-user group took place at 17:30.

Eighteen users and eight non-users took part in the Heriot-Watt focus groups.

There were eight participants in the first user group: six women and two men; two first-year undergraduates, three third-year undergraduates, two fourth-year undergraduates and one postgraduate student.

There were 10 participants in the second user group: four women and six men; one first-year student, three second-year students, two third-year students and four fourth-year students.

There were eight participants in the third (non-user) group: two women and six men; two first-year undergraduates, four second-year undergraduates, one fourth-year undergraduate and one postgraduate student.

## 3.3 Challenges encountered during the fieldwork

While the data collection process was effective, with excellent buy-in to the scheme from university staff, a number of challenges were encountered in delivering the planned monitoring. These are detailed in this section, including any implications for what can be concluded from this pilot.

### 3.3.1 *Waste data*

Waste management data at Heriot-Watt (pre-pilot and in-pilot) were not recorded with sufficient granularity to enable detailed analysis of how container recycling contributes to the bigger picture. The university had high-level data as an annual figure which identified the overall residual and recycling tonnages. Unfortunately, data for a more granular breakdown of recycling rates by material or by time period (monthly or even variations between term and vacation) were not available. An understanding of net changes in the quantities recycled amongst the target materials (aluminium cans and PET bottles) was therefore not possible. Neither was it possible to discern any modal shift (i.e. a shift from one type of recycling to another).

### 3.3.2 *Waste composition analysis*

To counter the lack of in-pilot waste management data, the waste composition analysis was undertaken to provide an indication of any change in patterns of waste disposal on campus. The sampling strategy for the analysis focused on the zones with Recycle and Reward machines, with waste analysed on particular days as spot samples before and during the pilot. These were, unfortunately, during different parts of the academic year and in addition some samples were missing or of low weight. Because of this, and the natural variation in waste generation/littering around the campus, the waste compositional analysis is thought to be of only indicative use.

### 3.3.3 *Retail data*

Hospitality Services provided data on units sold in retail outlets. These were initially understood to be PET bottles only, as no cans were sold in retail outlets. However, it became apparent in the later stages of the pilot that a small quantity of cans is sold in retail outlets. This has led to an unidentifiable but small number of cans sales being reported as PET bottle sales. Informal estimates from site staff are that this could be between 1% and 5%.

### 3.3.4 *Social research fieldwork*

Comparing and contrasting the social research data with the transaction data from the pilot significantly improves the insights into user behaviour, as well as the confidence that can be placed in some of the conclusions. Some of this fieldwork was conducted beyond the data monitoring period covered by the transaction data, i.e. after 27 September. As the pilot scheme continued throughout the term (until December), this is not considered likely to complicate analysis. It should be noted, however, that the distinction between the summer vacation and term time, in terms of those on site and their behaviour, is likely to be significant.

It is worth noting that student feedback was obtained relatively early in the 2013/14 academic year, during the third and fourth weeks of teaching, from 30 September to 17 October 2013. This may mean that new students were less familiar with the system than they would have been had fieldwork been conducted later. The data suggests that capture rates (recycling vs sales) dropped with the start of the new term (though the volume of containers returned increased), before starting to recover once again. (Subsequent data show this recovery was sustained.)

## 4 **Pilot performance and operation**

**This section starts with an overview of how the scheme performed, i.e. items returned versus sales, and rewards issued and claimed. A timeline of scheme performance is included, as the overall recycling rate gives a somewhat simplistic view of evolving scheme performance.**

**The following sections contain detailed quantitative and qualitative analyses of the schemes 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**

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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 recycle quality. Finally we consider operational aspects of the pilot, focusing on machine reliability (both actual and perceived) and staffing implications.

## 4.1 Overview

Unless otherwise stated the following analyses apply to the monitored pilot period of 10 May 2013 to 26 September 2013, during which the scheme was fully operational. Campus-wide quantities of units sold, collected, vouchers issued and redeemed, and average machine downtime are provided in Table 4. The study period covered 16 weeks of non-term time and four weeks of term time: one week at the end of the 2012/13 academic year and three at the start of the 2013/14 academic year.

Quantity	Cans	PET	Total	Term	Non-term
Sales	10,179	87,373	97,552	34,355	63,197
Units collected	6,788	34,022	40,810	12,490	28,320
Vouchers issued			36,473	11,289	25,184
Vouchers redeemed			31,115	8,427	22,688

**Table 4 Heriot-Watt University headline results**

Table 4 also shows a breakdown for these periods, though perhaps none of these weeks is ‘typical’ of term time use, covering the end of the summer term (with lower footfall on campus, and exams rather than scheduled classes and tutorials) and freshers’ week.

Quantity	Cans	PET	Total	Term	Non-term
Sales	10,179	87,373	97,552	34,355	63,197
Units collected	6,788	34,022	40,810	12,490	28,320
Vouchers issued			36,473	11,289	25,184
Vouchers redeemed			31,115	8,427	22,688

**Table 5 Heriot-Watt University headline results**

Not shown above, in the remainder of the autumn term (week commencing 4 October to end December), continued monitoring showed over 70,000 containers collected in 13 weeks (this includes some of the Christmas break, when usage was zero), a far higher rate of use than during the rest of the monitoring period (except for freshers' fortnight). Sales were far higher too, over 155,000 containers. Interestingly, whereas freshers' fortnight saw the capture rate for containers drop, the remainder of the autumn term saw recycling rates recover to the higher levels seen earlier in the pilot. Over 63,000 vouchers were issued, of which over 58,000 were redeemed.

Table 6 details the capture rate of units sold against units collected, the percentage of vouchers issued against vouchers redeemed, and the percentage of vouchers redeemed against units sold. It is shown for the overall analysis period and broken down by term and non-term time. Note that the number of containers brought onto site and not recycled is not known, so the 'true' capture rate of available containers is not recorded.

Analysis	Overall percentage	Term percentage	Non-term percentage
Overall capture rate (all units collected in machine against units sold)	42	36	45
Deposit-refund (in-scheme) capture rate (deposit bar-coded units collected in machine against units sold)	37	33	40
Vouchers redeemed against vouchers issued	85	75	90
Vouchers redeemed against barcoded units sold	32	25	36

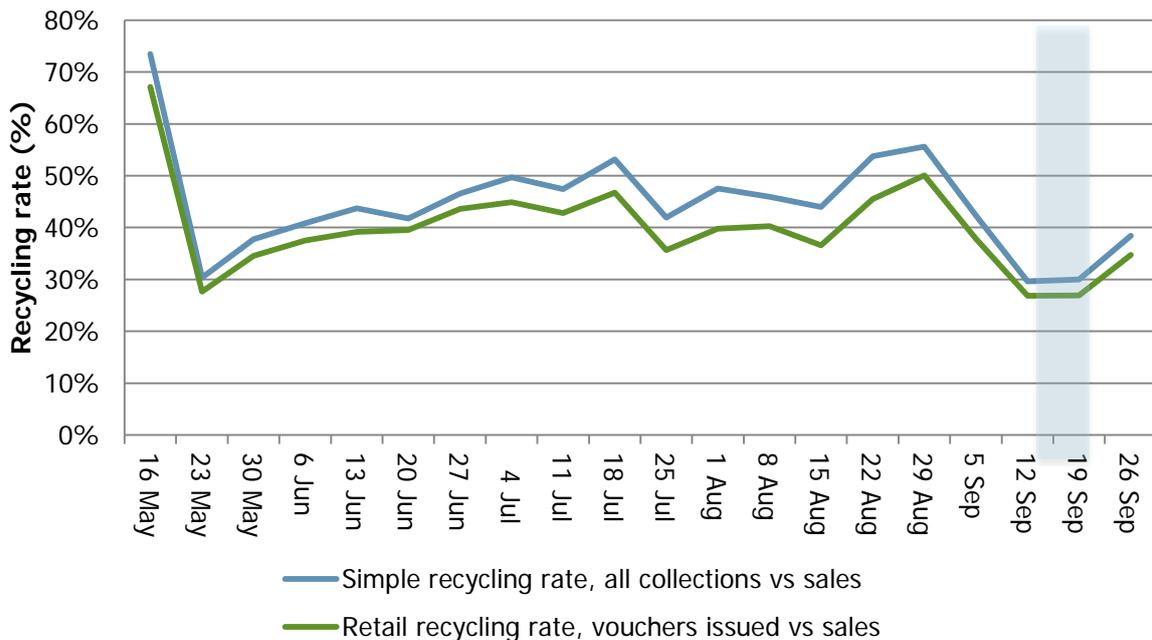
**Table 6 Heriot-Watt University headline analyses**

The headline analysis above demonstrates that 37% of deposit bar-coded units sold on campus were then collected in the machines. Just over 4,000 containers were imported onto site following purchase elsewhere (i.e. they were not bar-coded but of the target type). This makes the overall capture rate slightly higher, at 42%. Both rates have been shown, to indicate the impact the scheme had on driving or supporting wider recycling, and also because the overall rate would be the only one available in schemes that could not differentiate between the sources of containers (e.g. where only bar-coded containers were accepted).

From 4 October to end December, subsequent monitoring by Zero Waste Scotland shows the overall capture rate was ~45%, the capture rate for material sold with a deposit was ~41% and the

redemption rate for vouchers was ~92%. Thus, as overall volumes in circulation rose, scheme performance actually improved, matching or exceeding that seen during the holiday period.

Figure 5 shows the variation with time, the shaded areas indicating term time. If the reward were the only driver for users to collect and return containers, then initially this 'non-reward container' recycling would be expected to tail off; likewise if the main driver were novelty use of the machine. However, the gap between the two rates is steady, showing no drop-off over the pilot. This would suggest that the driver was simply the ability to recycle, or the continued 'enjoyment' of using the machine.



**Figure 5 Capture rate trend**

The term and non-term time analysis (based on the limited term-time data available from May to the end of September) shows that the sales were more than twice as high per week (2.17 times) in term time, and voucher issues were almost twice as high (1.79 times). The capture rates and redemption rates were marginally higher in non-term time, during the SKM monitoring period, though this effect appears not to persist during 'typical' term-time conditions as recorded in the autumn. This initial finding is therefore likely to be skewed by the split and small number of weeks of term time compared with the greater period of continuity across the non-term time. Originally it was hypothesised that some of the non-term time users (e.g. summer school people) behaved differently for some reason, but this may in fact not be necessary to understand the data. The difference between the bar-coded recycling and other recycling is also greater over summer.

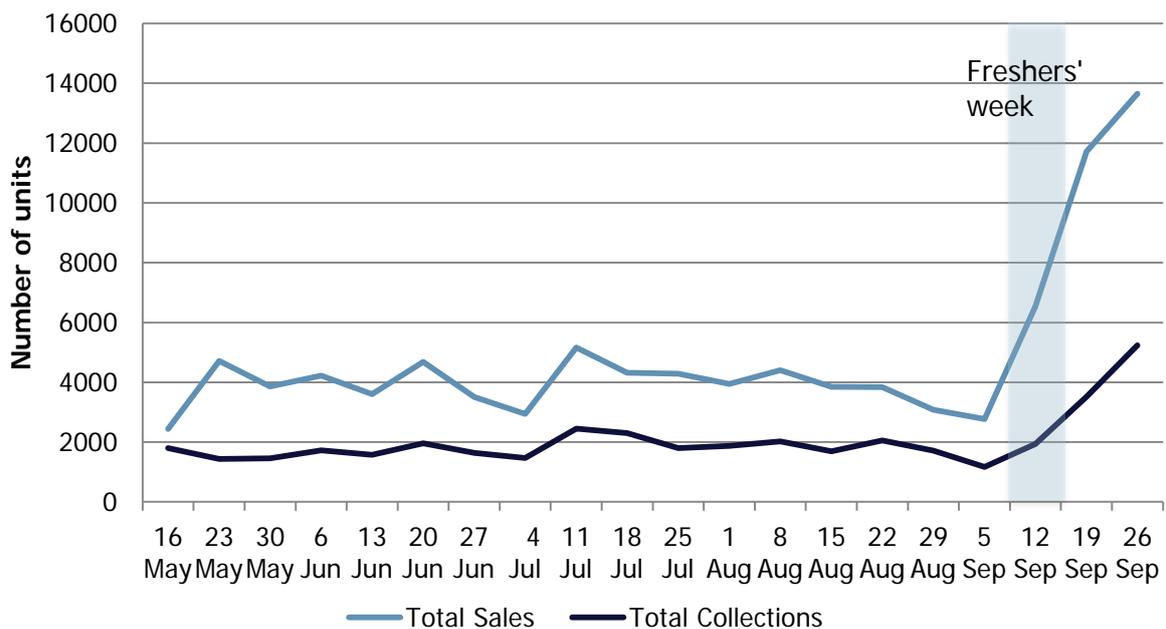
The overall capture rate, although it dipped after the launch and the end of term, improved through the summer to a peak of 55% (which was not wholly expected, as this is a less permanent population, and habit forming would therefore be expected to be less strong) and then showed a marked drop at the start of term, with a subsequent rise. The scale of the recovery at the end of the pilot does seem to mirror that seen at the start. Further post-pilot data will be needed to show whether this is a spike or a level of activity more related to an established system in a fully populated university. These data have been subsequently collected by Zero Waste Scotland and are shown as Figure 6. To give a clearer view of trends within an established scheme, this figure omits the week commencing 16 May (which saw very low volumes, and thus shows an artificially high return rate, perhaps further complicated by the initial setup period) and week commencing 27 December (which again saw very low volumes due to the holiday, and an artificially high recycling rate as a consequence). Following both launches (at

the scheme start, and for the new term) we can see a gradual improvement in performance, followed by a plateau. Variation during the summer is higher, perhaps reflecting the more changeable sales volumes and less regular patterns of use. It should be noted that the volume of containers recycled during the autumn term is far higher.



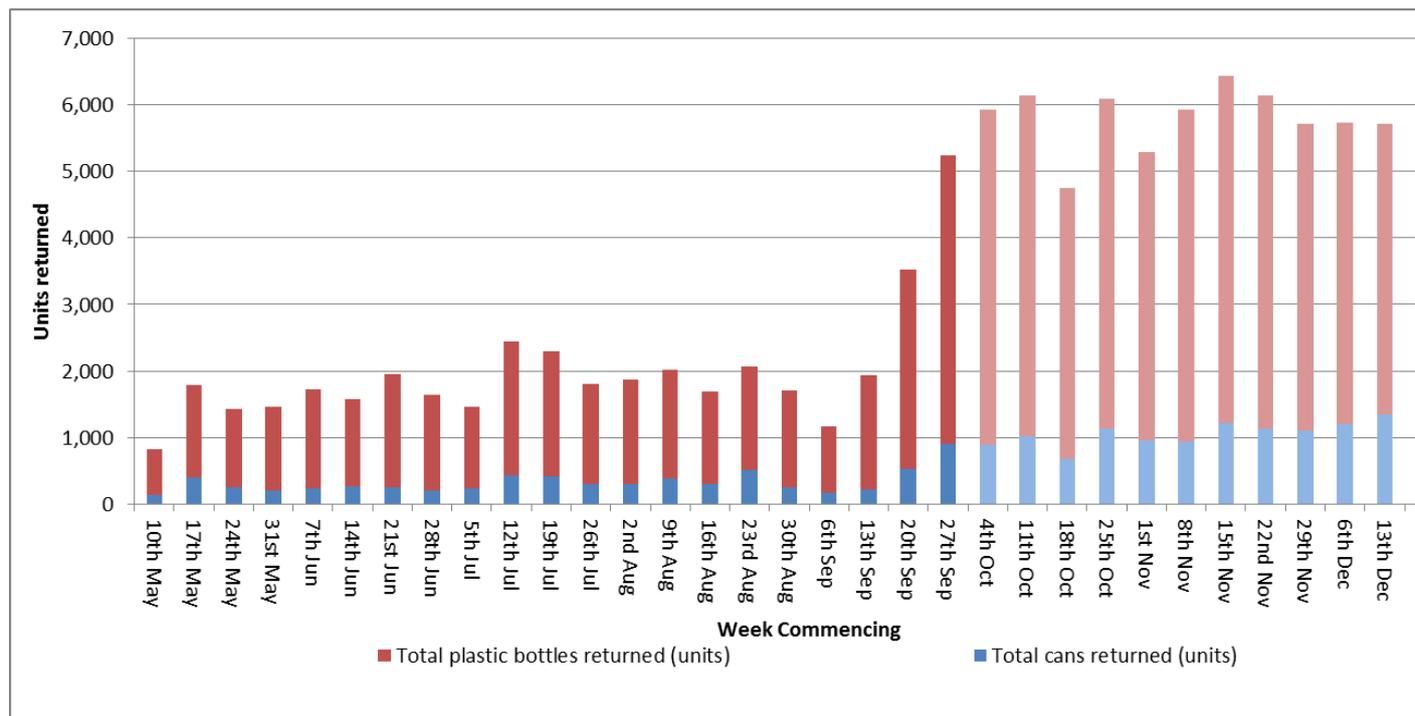
**Figure 6 Capture rate trend covering SKM and subsequent Zero Waste Scotland data collection, with week 1 outlier omitted**

After the low figure at the start of pilot, the lowest rates were during freshers' week. Freshers' week is clearly a very busy time for HWU, with many activities centred around the Student Union; but equally, with lots going on, recycling may not be a top priority, and new (and, based on some focus group observations, perhaps returning) students may have been unfamiliar with the scheme. Pilot projects conducted at other universities show similar results. Figure 7 shows that the trend for retail sales rises dramatically through those weeks and, while the number of containers collected does increase, it is at a lower rate.



**Figure 7 Comparison of sales and collections**

Figure 8 shows the trend of overall collections by material, including the Zero Waste Scotland monitoring period (in paler colours). Clearly the plastic containers dominate. During the SKM monitoring period they represent 83% of the returns. Plastic represented 92% of the retail sales during this period. The pattern is broadly the same during the autumn term. The recovery rate for cans is in fact significantly higher, though, as a percentage of all units sold (around 62% over the whole period May to December, compared with around 40% for plastic bottles). (This is based on a simple recycling rate – all containers returned vs retail sales – as the proportions of different containers brought in from outwith the scheme are not known. Given their low volume, they will not change this picture very much.)



**Figure 8 Overall collections by time and material type**

Figure 9 shows the trends for plastic collections at each machine during the SKM monitoring period; Figure 10 shows the trend for cans. In both cases the Hugh Nisbet Lower is the most used machine, followed by the Hugh Nisbet Upper. It was not possible to return cans in the Sports Centre (and they were not sold there).

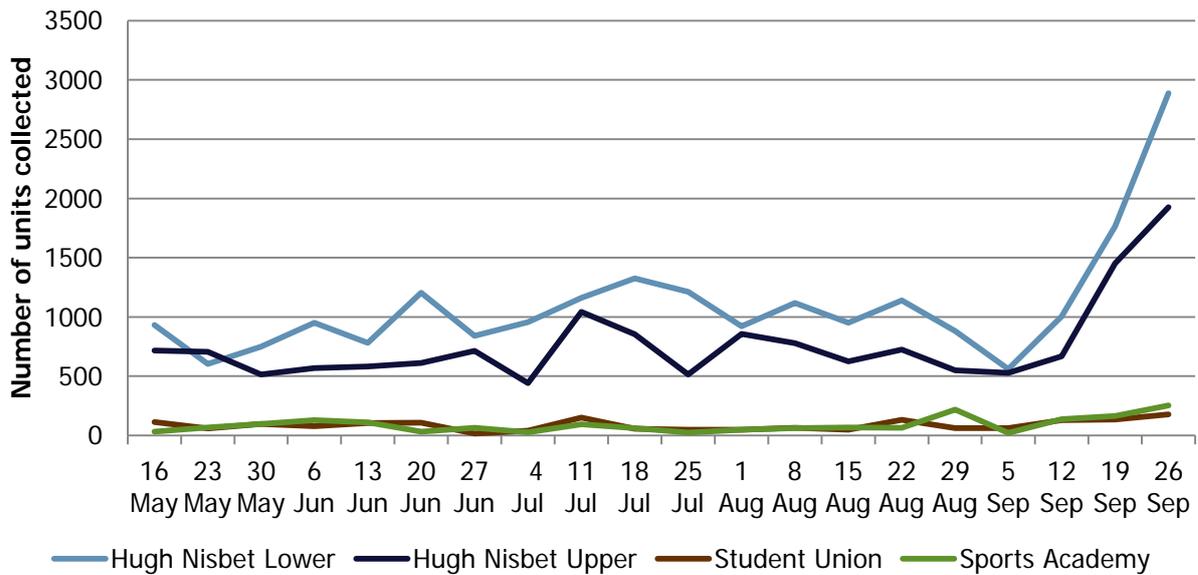


Figure 9 Plastic (PET) bottles collected by the machines

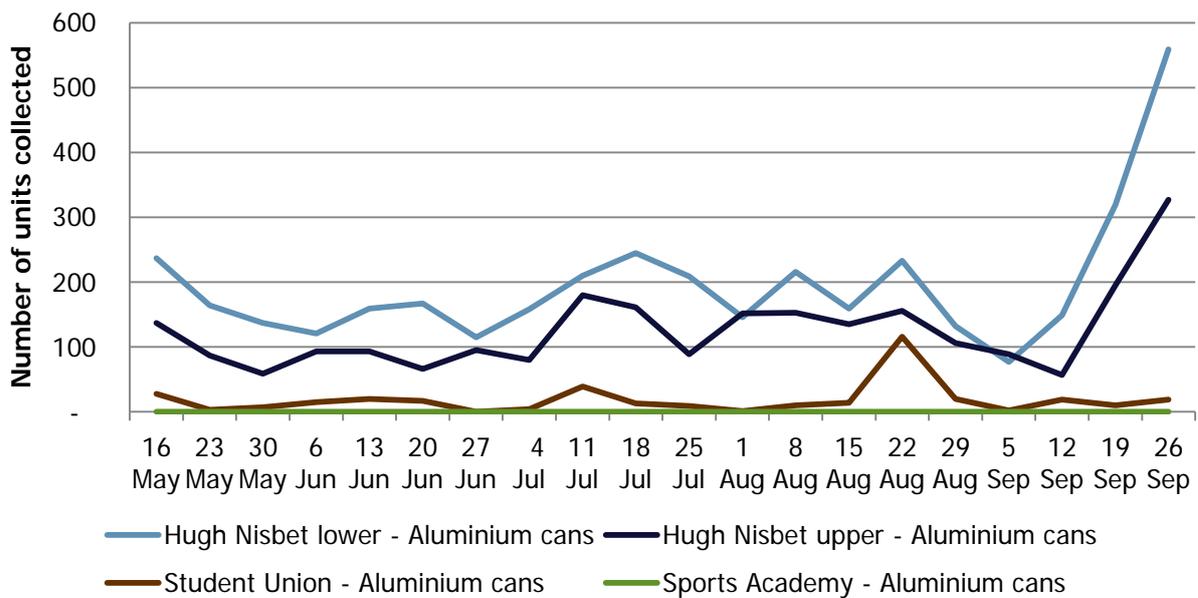
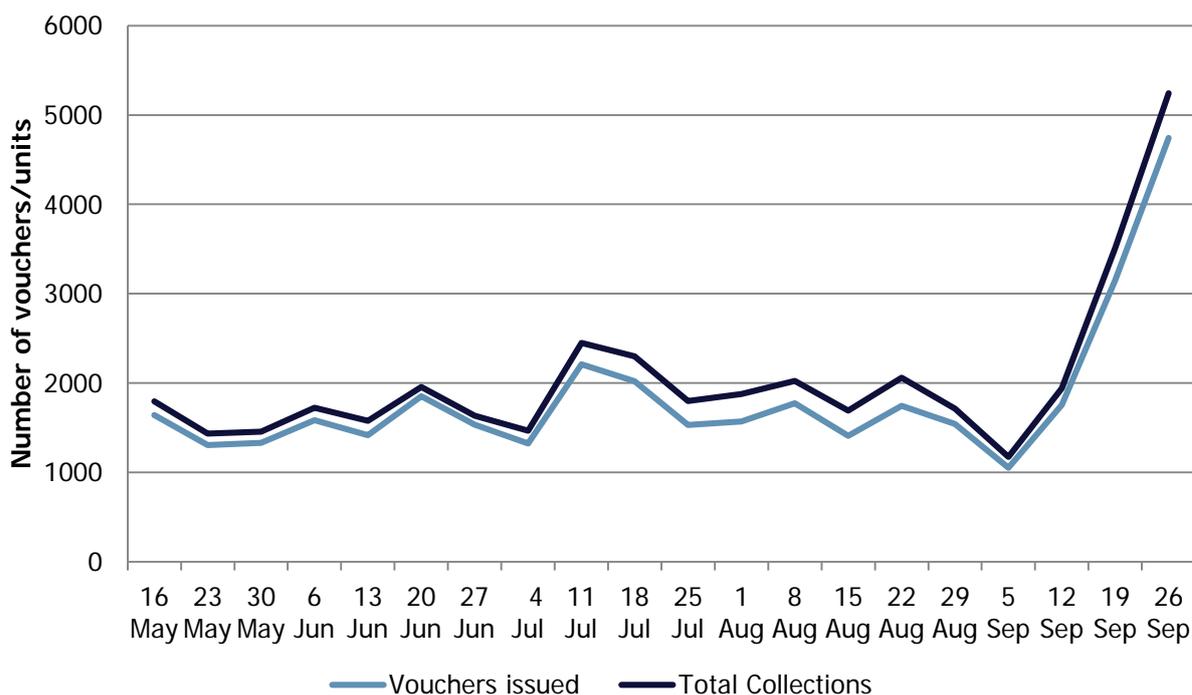


Figure 10 Cans collected by the machines

Figure 11 shows the trend of total collection across the four machines (which includes containers sold as part of the deposit return pilot and containers brought in by the users) and the trend of vouchers issued (which relates only to the containers sold as part of the deposit return pilot). During the summer vacation period there is an increase in the proportion of ‘outside’ containers, but the overall trends follow the same path. No meaningful deviation from this close match was observed during subsequent monitoring by Zero Waste Scotland.



**Figure 11 Comparison of collected deposit containers (by vouchers issued) and all collected containers**

#### 4.1.1 Transaction analysis

Most of the analysis has been based on data that were provided during the pilot on a weekly basis. At the end of the SKM monitoring period, a detailed dataset was provided showing each transaction (i.e. visit to the machine to deposit one or more containers), the date, the time and the number of units collected (although it does not provide a material split).

The number of transactions at different times of the day, week and academic year are provided below. This data shows that weekday collections account for 87% of all transactions, very evenly spread across the week (Monday 16%, other days 18% each). Saturday (7%) and Sunday (5%) are significantly lower, as might be expected, with lectures and activities mainly being restricted to the working week.

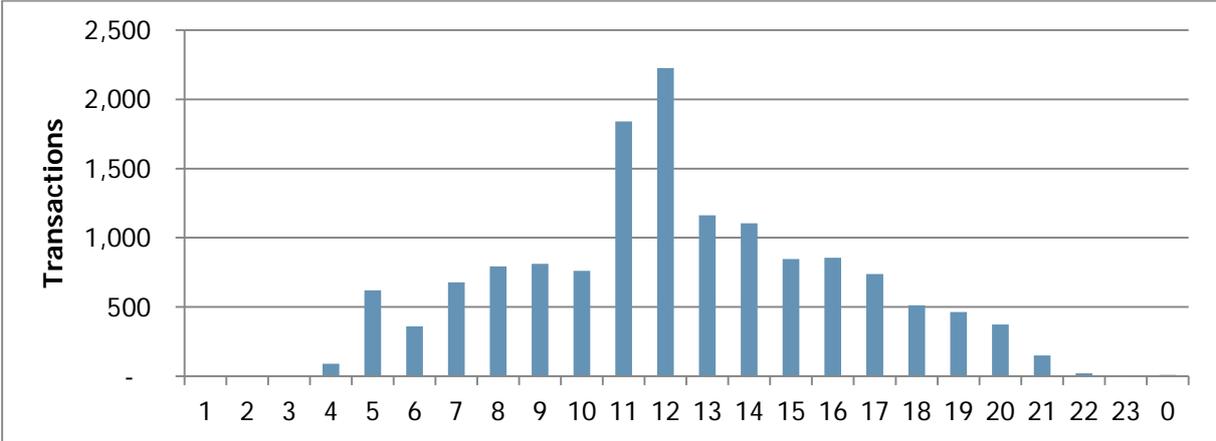
The analysis for the number of units (containers) collected follows a similar pattern, with weekdays accounting for 89%, but there is an increase during the week from Monday at 14% through to Friday at 20%. This may be an indication of users hoarding units or of cleaners doing rounds at the end of the week. This is shown in Table 7.

Day of week	Percentage transactions (visits to the machines)	Percentage units collected (number of containers placed in machine)
Sun	5	4
Mon	16	14
Tue	18	18

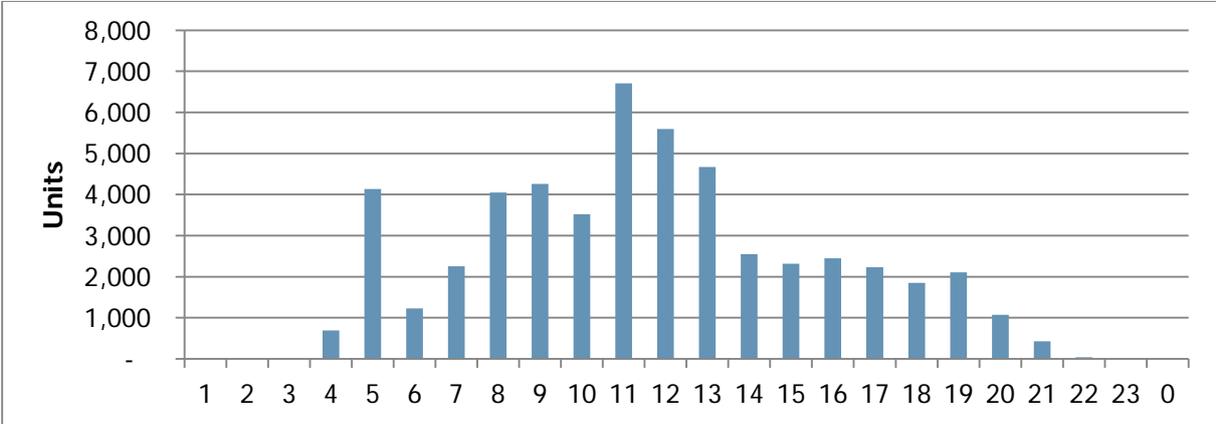
Wed	18	18
Thu	18	19
Fri	18	20
Sat	7	7
<b>Total</b>	<b>100</b>	<b>100</b>

**Table 7 Proportion of activity over the week**

Figures 12 and 13 look at the comparison of transactions and units by time of day. Both the transactions and units collected show a peak at lunchtime, as would be expected in such an environment as a university, where students and staff would purchase and return containers during the lunch break. Transactions and units either side of it show the expected increase from the start of the day to the end, with the final transactions at midnight. The start of the day is very early, 04:00, with both transactions and units collected showing a peak at 05:00; this peak is particularly high for units collected, which would indicate a greater number of ‘multiple unit’ collections possibly related to an early cleaners’ shift.

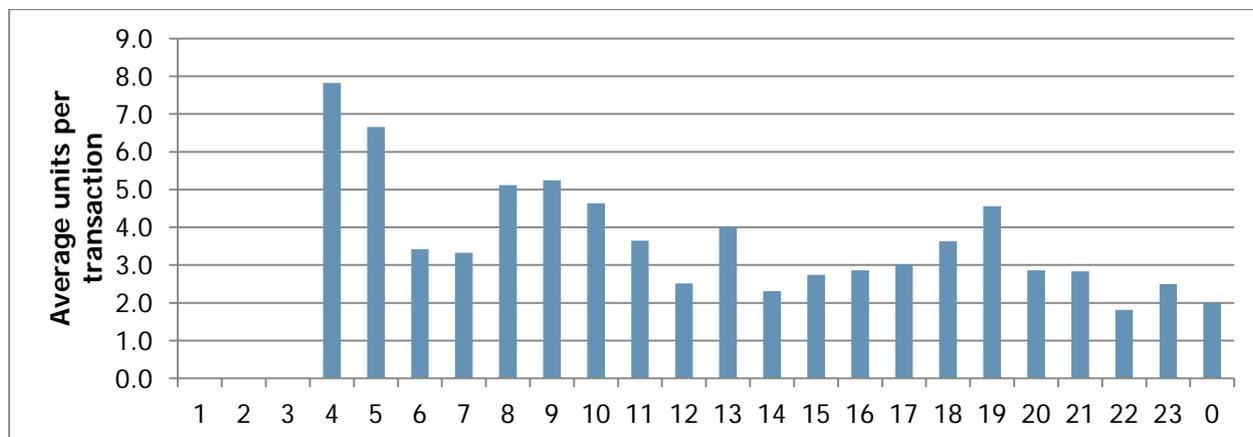


**Figure 12 Transactions by time of day**



**Figure 13 Units by time of day**

This is supported by the data shown in Figure 14, which shows the average units (containers) per transaction at each hour. The largest units per transaction occur at 04:00 and 05:00 (7.8 and 6.7 units per transaction). The next largest is around 09:00 and then around 19:00. The lunchtime peak for activity has an average of 2.5 units per transaction.



**Figure 14 Average units per transaction by hour of day**

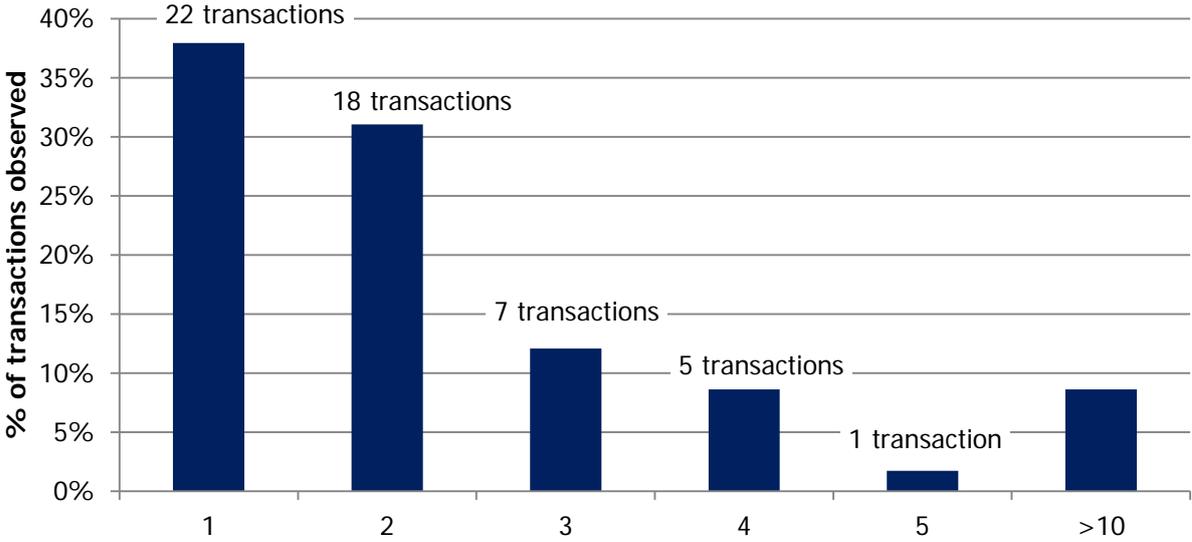
Within each hour (except for 22:00) the average is over two units per transaction. However, this average does not represent the typical use. The most frequent (modal) number of units per transaction is one (62% of transactions were the return of a single collected container). A further 12% of transactions are returning two containers, and the remaining 25% of transactions cover three to 82 units per transaction.

Subsequent term-time monitoring by Zero Waste Scotland during the autumn showed these patterns of use continuing.

From the focus groups, two usage models emerged:

- Most commonly, students simply used the machines every time they had an empty bottle or can and were near the machines.
- A minority collected items or had formed a habit of specifically seeking out a machine into which to deposit collected units (collections).

The observational analysis confirmed that most users placed one or two items in the machine when visiting. All observed transactions where five items or more were placed in the machine were done by catering staff (Figure 15). During the in-depth interviews one member of staff noted that students also brought in boxes of materials from their halls of residence to recycle in the machines.



**Figure 15 Numbers of items being collected at Recycle and Reward machines**

Figure 16 represents the spread of collections over the day. Each column across the diagram is an hour of the day, from 01:00 on the left through to midnight on the right. Each row is the number of containers returned at a visit by a user ('units per transaction'), from one container at the top to 82 containers in one visit at the bottom. The numbers in the cells of the diagram are the number of visits of that number of units per transaction at that hour of the day. Colour coding to the value of this number helps to show the pattern of use.

This clearly indicates that the most transactions are of one unit collected at lunchtime (11:00 or 12:00), shown in red. It also shows that more than 16 units in a transaction is unusual, and that the very high numbers of units per transaction, though rare, do skew towards the first half of the day.

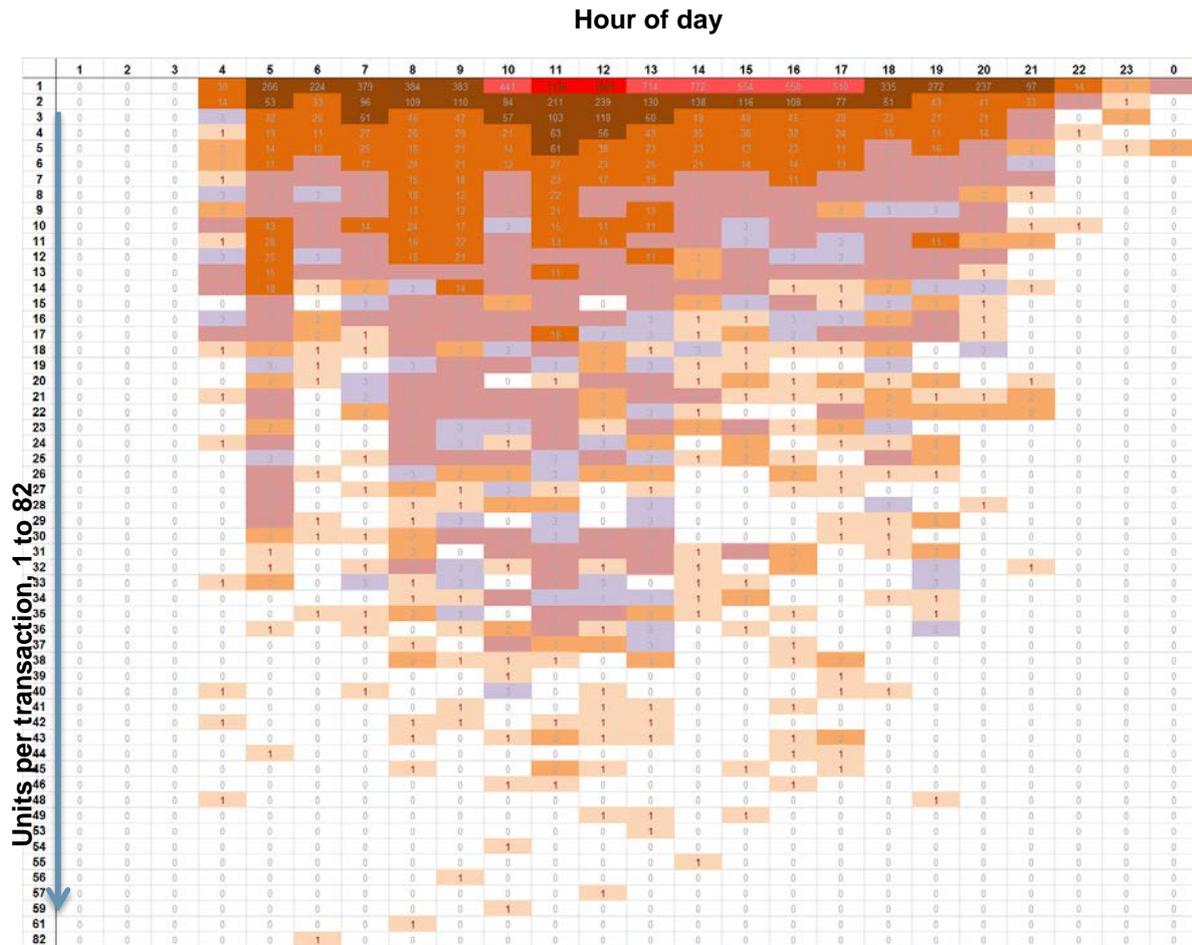


Figure 16 Profile of frequency of each number of units per transaction grouped by hour of the day (11 May to 27 October 2013)

## 4.2 Social research insight into items recycled

Observational and survey analysis was consistent with the machine data in the sense that users recycled far more PET plastic bottles than cans. As many as 95% of the users surveyed claimed they had recycled PET plastic bottles, and 15% had recycled cans. The sales data for the pilot period show 90% plastic bottles versus 10% cans as shown in Table 4. During the observational analysis, over a 3.5-day period, 330 PET plastic bottles and 23 cans were successfully recycled, an observed ratio of 93.5% plastic bottles to 6.5% cans. By comparison, the machine data on units collected for recycling over the pilot show 17% cans to 83% plastic bottles as shown in Table 4. This comparison indicates that the observations were not entirely representative of the actual behaviour over the pilot as a whole, with a somewhat lower amount of can recycling observed.

Based on survey responses, the introduction of the Recycle and Reward machines has had a positive impact on the recycling behaviour of students and staff, in terms of both an increase in the number of containers being recycled and a reduction in the number of items being discarded into waste bins. The survey data for repeat machine users are described for plastic bottles and cans in sections 4.2.1 and 4.2.2.

### 4.2.1 PET plastic bottles

Before the machines were introduced, the regular users (83 people, 17% of total users) had disposed of their PET plastic bottles in the following ways:

- put them in a waste bin (39%, 32 people);

- recycled their bottles on campus (35%, 29 people); and
- recycled their bottles at home (14%, 12 people).

Of the total sampled population, 25% (126 people) had recycled PET plastic bottles in the machines and 11% (57 people) claimed they now recycled more bottles on campus since the machines had been introduced.

Some 12% (62 people) of the total sampled population claimed they now recycled all or almost all of the bottles they bought on campus.

#### 4.2.2 *Aluminium cans*

Before the machines were introduced, the regular users (15 people, 3% of total users) had disposed of their cans in the following ways:

- put their cans in a waste bin on campus (67%, 10 people);
- recycled their cans on campus (7%, one person); and
- recycled their cans at home (7%, one person).

Of the total sampled population, 4% (20 people) had recycled cans in the machines; 2% (nine people) claimed they now recycled more cans on campus since the machines had been introduced.

Only 2% (10 people) of the total sampled population claimed they now recycled all or almost all of the cans they bought on campus.

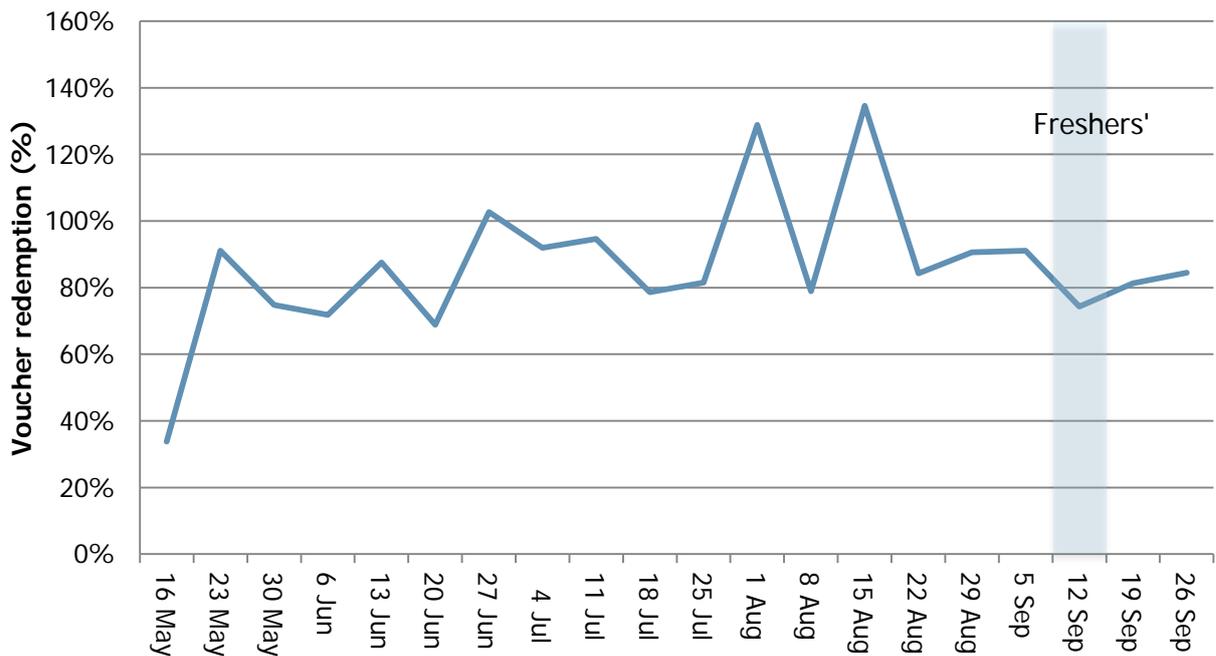
### 4.3 Rewards issued and claimed

The analysis suggests that participants showed a good level of understanding of how the pilot worked and a motivation to redeem the deposit, with 85% of vouchers being redeemed in the retail units overall. Section 5.3 discusses views on the appropriateness of the rewards. A total of 81% of users surveyed indicated that the 10p deposit was an appropriate incentive to recycle.

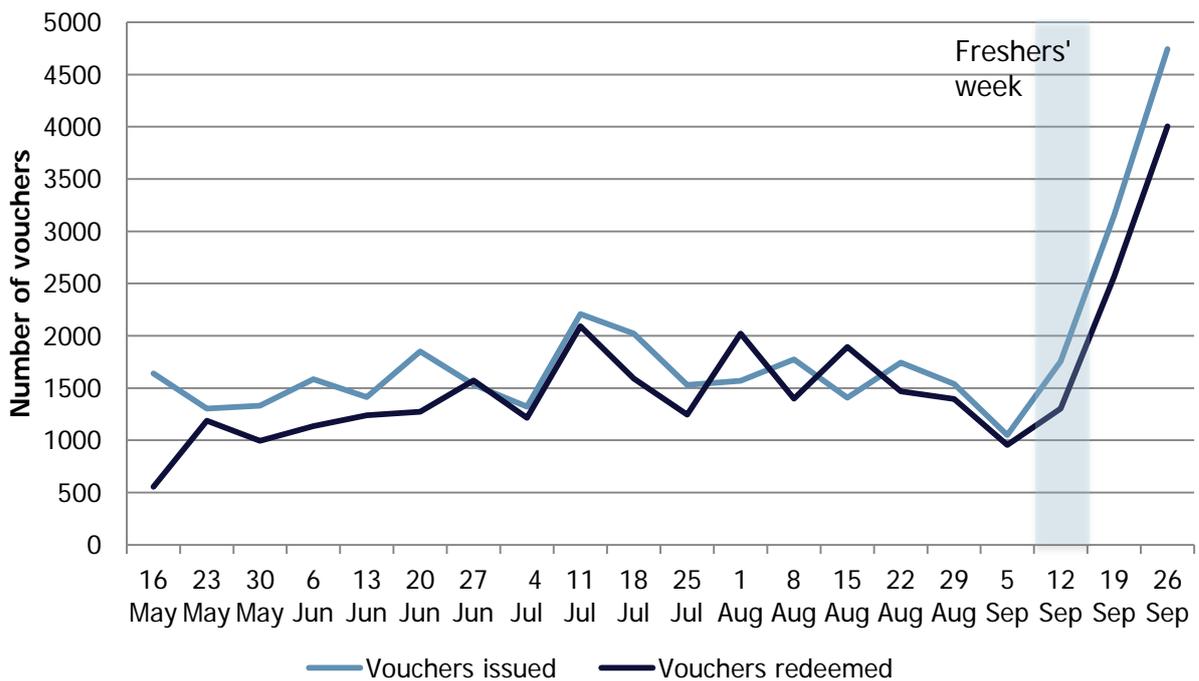
In the survey, 26% of the users stated that they had not reclaimed their deposit, which is at odds with the 85% redemption rate figure. A few users in the focus groups reported they had thrown the vouchers away because they did not expect to use them in the near future, and one group member had given the voucher to a friend who collected them. The potential problem of vouchers expiring was raised, although there was no expiry date on vouchers in this scheme. Clearly this would be important for people stockpiling them for future redemption.

The variation in redemption rates over time can be seen in Figure 17. The trends in the issue and redemption figures that create this rate are shown in Figure 18. The voucher redemption rate dipped in freshers' week but then recovered, presumably for the reasons already mentioned, i.e. that freshers' week is very busy for students and voucher redemption would not be a top priority.

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**Figure 17 Voucher redemption rate**



**Figure 18 Trends of vouchers issued and redeemed**

Figure 18 suggests that there is a lag between receiving vouchers and redeeming them, due presumably to a natural delay in returning to a retail outlet to redeem the deposit and in part due to stockpiling vouchers. From the survey results, 55% of users claimed they had redeemed their vouchers, of whom 45% used them the next time they bought something, 23% used them straight away and 21% saved them for later use. From the observational analysis, 82% collected a voucher, but only 2% reclaimed their deposit immediately at a retail outlet. Some 5% did not leave with a

voucher, either because the machine did not issue a voucher or because people left their vouchers at the machines.

The lag in transactions results in a redemption rate greater than 100% in three weeks (Figure 17). This is less obvious during term time and may have been caused by the different approach to the scheme by the 'summer users' at the university. With a paper-based scheme there is a fraud risk, but the data and survey responses about bulking up vouchers before redemption suggest that the limited periods when redemption rates exceed 100% are not due to fraud.

Voucher redemptions in the autumn (October to December) were 92%, with the patterns seen consistent with those during the SKM monitoring period.

Over the full 20 weeks of the pilot, £3,111 worth of vouchers or donations was issued. During the 10 weeks of the pilot when charity donation was an option, the overall value was £1,826, of which £89 was donations (4.9%). Charity donations peaked at 11% in the week of introduction and then remained relatively steady between 2.6% and 5.8% per week.

The transaction data recorded by the machine shows that 88% of the collection and return of in-scheme units (i.e. those with a deposit) led to an issue of a voucher and 12% led to donations at the machine. Compared with the 4.9% by value, this implies that larger transactions were generally for cash. As some of the units recycled were out of scheme (i.e. sold without a deposit), the overall proportions were that 63% of transactions took a voucher, 9% were donations, and 28% did not qualify for a voucher. This is in line with the observational analysis, where 10% overall donated to charity.

Zero Waste Scotland subsequently analysed term-time data for the autumn term, which give a similar picture. Taking the data for September to December, 12% of all transactions recorded donated to charity, as did 15% of those that were eligible (the difference is made up of containers imported from outwith the scheme and thus not eligible for a returned deposit). However, this figure is closer to 4% if considered in terms of container volumes, implying that a charity donation is far more likely on smaller-value transactions, and less likely on larger-value transactions.

#### 4.4 Awareness of the machines and their correct use

Awareness of the machines amongst those surveyed was 84%, though there could be some skew of the sample, as surveying was conducted in areas close to the Recycle and Reward machines. Only 14% claimed conscious awareness of activities carried out to promote the Recycle and Reward machines on campus. Awareness of campaigns was, unsurprisingly, higher among the users; 24% of users recalled seeing some form of communication/promotion compared with 10% of non-users, and the promotions were rated more highly by the users (78%) than the non-users (62%).

The most common forms of communications recalled (by the 14% of those that were aware), in addition to the branded machines, were posters (52%), word of mouth (22%), email (10%), the flyer (9%), social media (7%) and the university staff (6%).

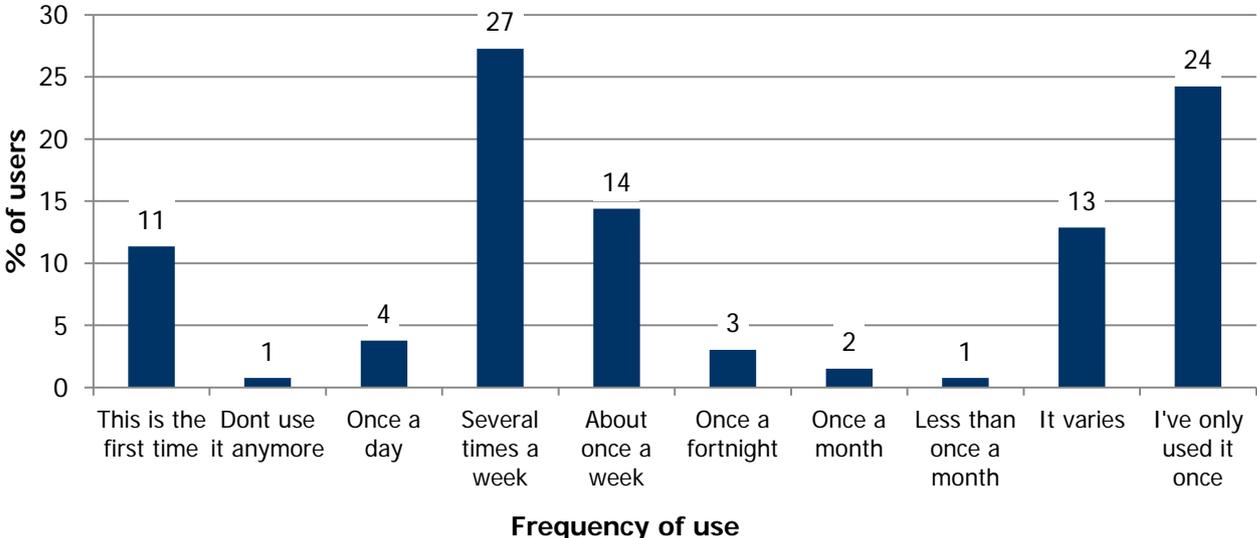
During the in-depth interviews, all staff agreed that although the initial promotion of the scheme had been good it had reduced over time. Although extra promotional activity was undertaken during freshers' week, it was suggested that information could have been put into the freshers' pack given to all students, and that more face-to-face communication including at points of sale would have been beneficial in raising awareness of the scheme. Other suggested methods for ongoing communications to further encourage students and staff to use the scheme included using the student newsletter, using more regular updates by email and providing further information on the containers themselves about the deposit and return process.

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Some 40% of those surveyed were aware of the deposit, although several participants in each focus group had not realised they had paid deposits for the items or that the prices on campus had increased with the introduction of the scheme. Both groups wanted greater transparency, with the non-users resenting that they were being 'penalised' for not recycling. In the in-depth interviews, some members of staff were initially cynical about the introduction of the machines, believing it was a way for the university to make money, but this perception had changed with greater awareness and they 'now recycled anything they can to get the 10p'. Staff also felt that many of the students did not fully understand how the scheme operated. In response to this, the staff in the Student Union had developed additional promotional materials that more fully explained the scheme to students.

### 4.5 User groups and usage practices

Of the total population surveyed, 26% had used the Recycle and Reward machines at least once and 17% had become regular users (64% of those that used the scheme). The patterns of use are displayed in Figure 19 as a percentage of users, i.e. 27% of the 26% (~7% overall) use the machines several times per week and 14% of 26% (~4% overall) about once per week.



**Figure 19 Frequency of using the Recycle and Reward machines**

Over the 3.5-day observational period, 95 people were observed using the Recycle and Reward machines; 67 in the canteen, 19 in the foyer outside the Student Union shop, two in the Sports Centre and seven in the Student Union. Overall, the machines were predominantly used by students (76%) compared with staff (24%), with more male (64%) than female (36%) students observed using the machines. (Some transactions were by the same individual, generally a member of staff, making repeat visits to the machines during the observational period. For example, 20 transactions were made by one member of staff in the canteen during the observational period on 7 October 2013.) The majority of people visited the machines alone (75%) or in pairs (15%). The overall observational sample profile is detailed in Table 7.

Sex	Number of students	Number of staff	Total	% user split (students)	Actual % population split (students)
Male	46	19	65	64	60
Female	26	4	30	36	40
Total	72	23	95	100	100

**Table 7 Observational analysis sample profile for Heriot-Watt University**

The actual ratio of male to female students is reported as 60:40, which corresponds to the proportion of male to female students observed using the Recycle and Reward machines at the university. In other words, there is no gender bias.

The overall survey profile of users comprised 77% undergraduates, 14% postgraduate students, 7% staff and 2% others. From the survey it appeared that undergraduates and postgraduate students were equally likely to use the machines (25% undergraduates and 27% postgraduates). Of the staff surveyed (18 people), half had used the machines.

During the in-depth interviews, staff (be they teaching or facilities staff) expressed mixed opinions about who they believed were using the machines. Several of the staff interviewed felt that the machines were being used more by staff than by students (although the observations identified that 24% of users were staff), with staff collecting large numbers of items and redeeming the vouchers, especially the cleaning and catering staff. Other staff members felt that the machines were well used by both staff and students, with perhaps more overseas students using the machines as a result of previous experience with similar schemes in other countries.

### 4.6 Impact on litter

The people in the survey were asked directly about their view on how the Recycle and Reward pilot had affected litter. Just over one fifth of people surveyed believed the introduction of the Recycle and Reward machines had helped to reduce litter levels at the university. During the focus groups, one group of users claimed the impact on litter was yet to be realised; the other groups claimed not to have noticed a particular litter problem on campus before or after the introduction of the scheme.

During the in-depth interviews, the majority of the staff interviewed suggested that, because the university had already implemented a strict anti-litter policy, litter was not an issue on campus and that they had not noticed any change as a result of the introduction of the Recycle and Reward scheme. One member of staff suggested there might have been an increase in the amount of localised litter due to rejected items being left around the machines.

A compositional analysis was taken of litter before and during the pilot. In both analyses, the areas covered by the sampling were identical and in the mainline and plaza areas of the campus. Less litter was picked during the in-pilot analysis (11.6kg against 20.1kg during the baseline analysis), and Figure 20 shows that the proportion of PET in the litter fell from 6% to 3%, while the proportion of aluminium cans rose from 3% to 4%. This data could suggest a reduction in litter and in plastic bottles, the main material collected by the Recycle and Reward machines. However, the small sample size and period, combined with natural variability in litter levels, does not make it possible to draw any firm conclusions on whether the pilot has led to less littering or not.

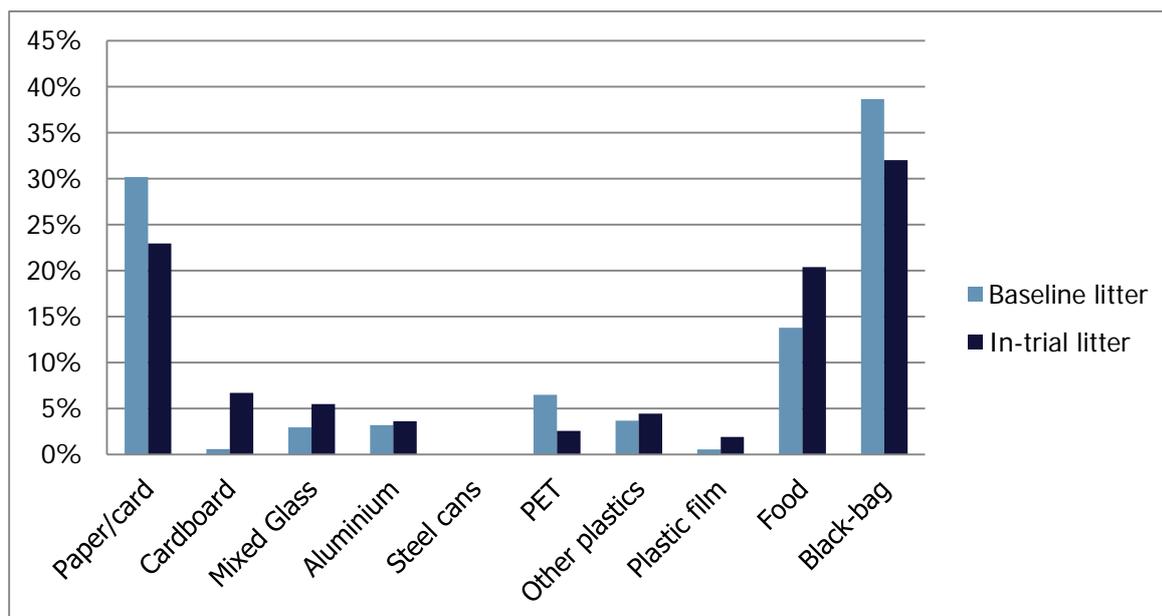


Figure 20 Baseline and in-pilot litter composition

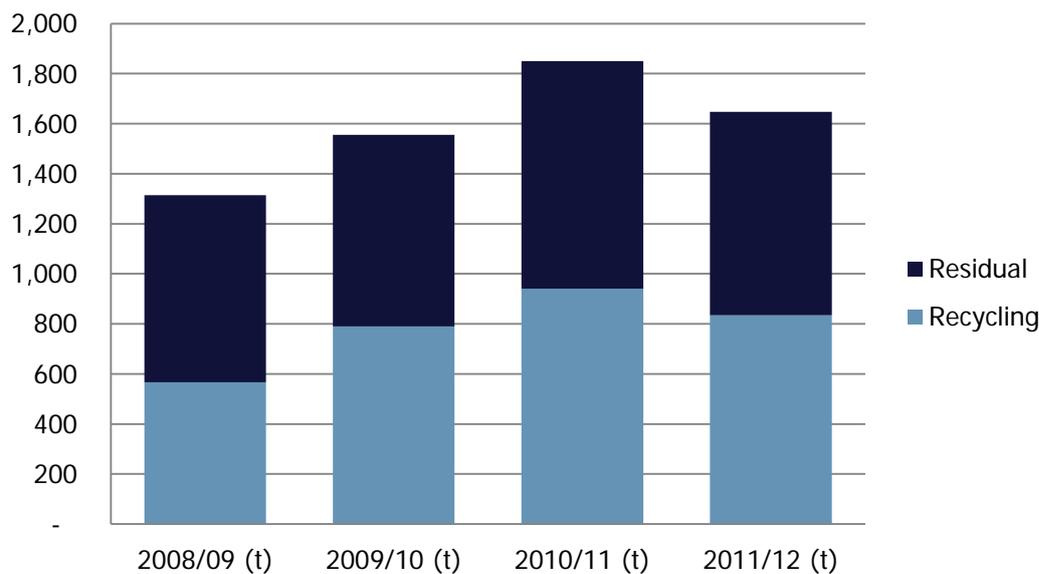
## 4.7 Impact on overall waste

### 4.7.1 Overall waste levels

Table 8 and Figure 21 show recycling, residual and total waste between 2008/09 and 2011/12, including residential and non-residential wastes but excluding construction waste. The baseline data show that overall waste rose annually by ~18–19% before an 11% drop in 2011/12. Over the same period the recycling rate of around 50% was maintained.

Category	2008/09	2009/10	2010/11	2011/12
Recycling (t)	567	790	941	835
Residual (t)	748	765	909	813
<b>TOTAL (t)</b>	<b>1,315</b>	<b>1,556</b>	<b>1,850</b>	<b>1,648</b>
Recycling rate (%)	43.1	50.8	50.9	50.7
Annual waste change (%)	–	18	19	–11

Table 8 Baseline waste data



**Figure 21 Baseline waste**

The in-pilot data do not exactly match the time periods, and are also relatively limited in detail. Using the standard weights for cans (14g) and PET bottles (22g) that were recorded on other pilots, the actual level of recycling through the Recycling and Reward machines would have been ~0.8 tonnes over the pilot period, which would extrapolate to 2.4t over a year. Hence, even if overall waste data had been available, with annual recycling of over 800t (all materials), the impact of the materials collected through the machines would not have been discernible. The higher usage of the machines in the autumn term as measured by Zero Waste Scotland would suggest that the estimated yearly tonnage above would be low. If we take the SKM monitored tonnage for May to September as ~0.8t, but assume the ~1.4t collected from October to December would be more typical of usage in the period from January to April as well, then the annual take through the scheme would be between 4 and five tonnes.

Data subsequently provided to Zero Waste Scotland by HWU suggest that around 0.8t of cans and bottles were recycled a month on campus during a five-month period in 2013/14, though we do not know how this relates to holiday periods, which would clearly be a critical variable. If we assume this to be a term-time figure, then it would compare to an estimated term tonnage collected through the scheme of ~0.46t a month, suggesting over half of the containers being recycled on the campus are coming through the deposit return machines. Given the data uncertainties, this conclusion should be treated tentatively.

It is also worth noting that overall site recycling of bottles and cans is likely to include material that is not accepted by the Recycle and Reward machines (because it sits outwith their scope and/or is bought off campus). Items might include small drinks containers bought off site, larger drinks containers (e.g. more than 500ml), milk and non-drink items such as shampoo or cleaning products. All machines were sited relatively centrally on campus (whereas other recycling facilities are more widely spread) so both convenience and eligibility of items may be factors.

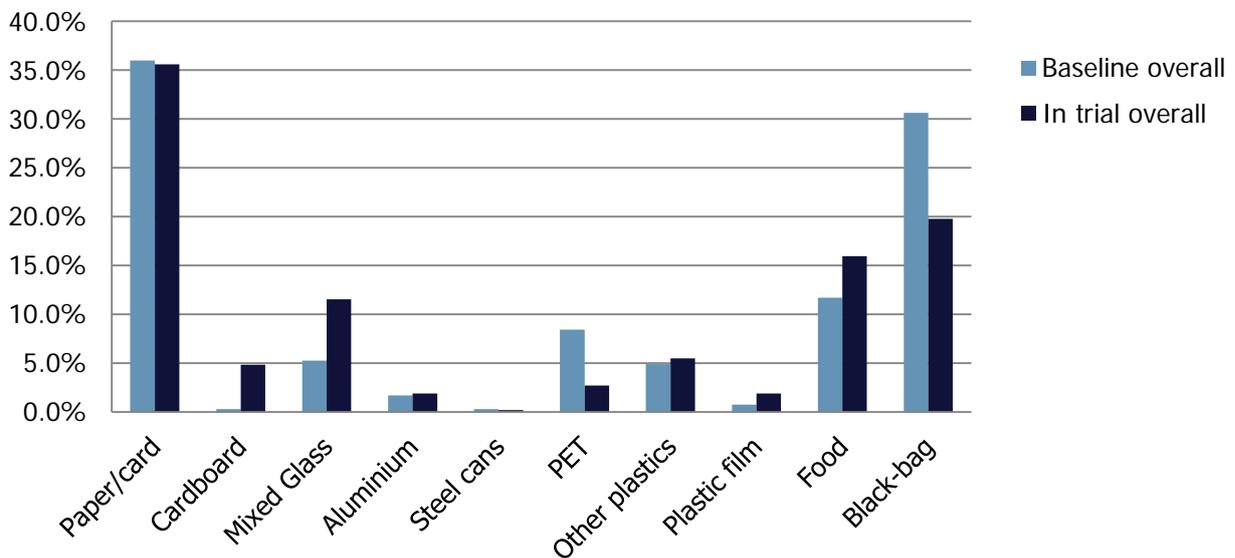
#### 4.7.2 Waste composition analysis

To counter the lack of quantitative data on waste, a waste composition analysis was undertaken. As noted earlier, this partly addressed litter; however, a wider analysis was also undertaken to determine any changes in the profile of residual and recycling waste streams in the four zones where machines were located. A baseline analysis and an in-pilot analysis were undertaken. The sample zones and categories were as follows (including the litter pick):

- Hugh Nisbet Building Upper Level – residual;
- Hugh Nisbet Building Upper Level – recycling;
- Hugh Nisbet Building Lower Level – residual;
- Hugh Nisbet Building Lower Level – recycling;
- Student Union – residual;
- Student Union – recycling;
- Sports Centre – residual;
- Plaza – residual waste bins;
- Plaza – recycling waste bins; and
- Plaza – litter pick.

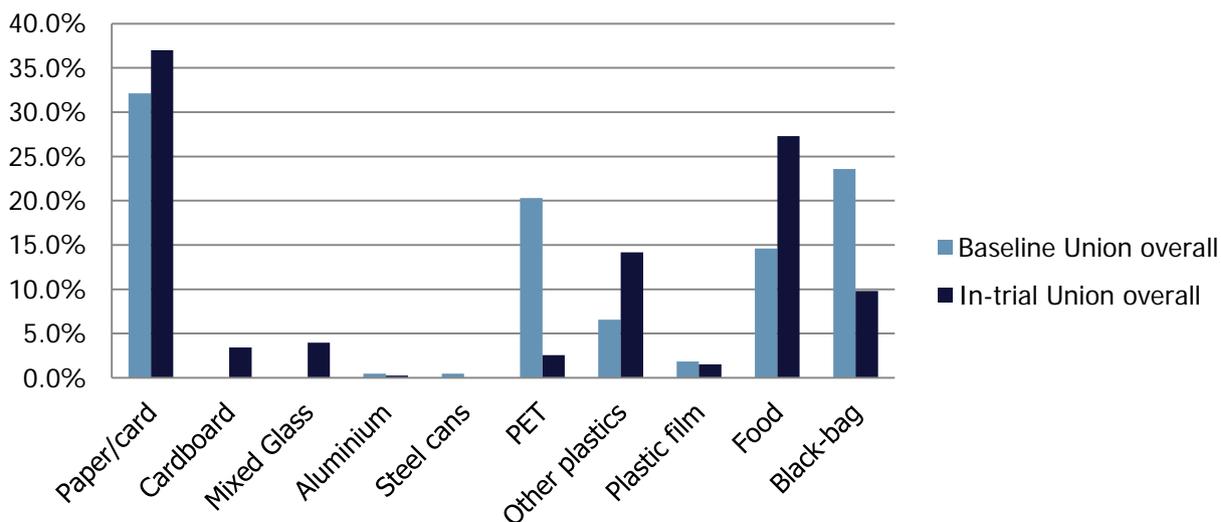
A number of limitations were encountered, in particular materials not being presented for sampling. During the baseline analysis the sample for the Sports Centre was not presented, while sample sizes for the Hugh Nisbet Upper and Lower zones were low. The baseline analysis was undertaken during the Easter vacation, though the campus population was nevertheless high because of exams. In total 40kg of waste was presented. During the in-pilot analysis, which was during term time, samples for the Hugh Nisbet Lower zone residual and recycling were not presented. In total 148kg of waste was presented. For comparison, the average through the Recycle and Reward machines was 5.5kg per day during the holiday period and 9.7kg per day during term time. It therefore has to be noted that the compositional analysis offers only indicative information rather than robust evidence.

The overall results are shown in Figure 22. This shows that the proportion of PET bottles in waste sampled across site fell from 8.4% in the baseline case to 2.7% in the pilot period. The proportion of aluminium cans remained at ~2% (1.7% baseline, 1.9% in pilot). This suggests that the pilot had some success in diverting PET bottles from existing waste management streams (e.g. recycling and residual).



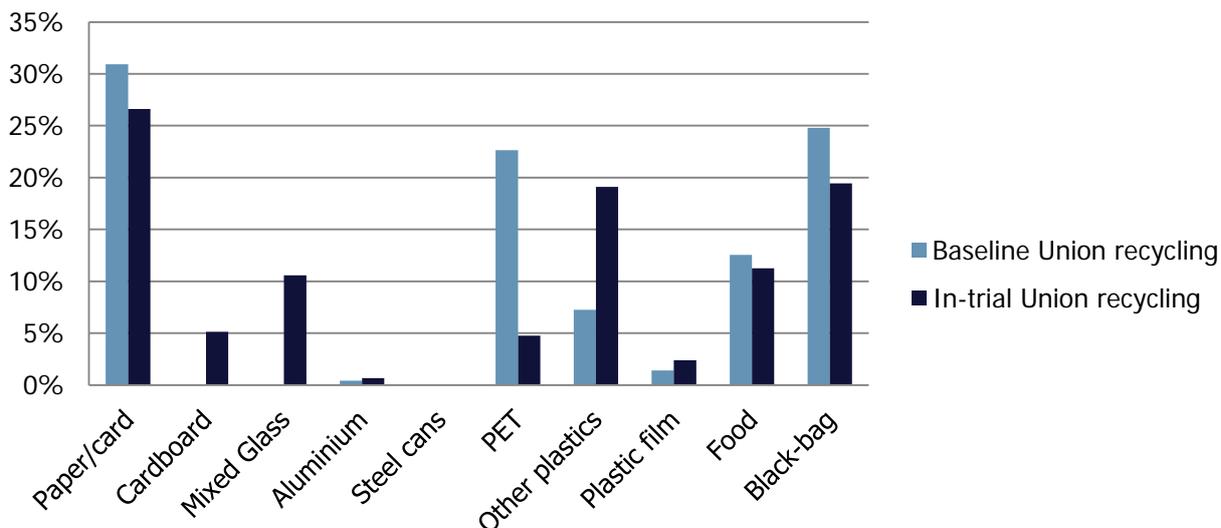
**Figure 22 Baseline and in-pilot overall waste composition analysis**

Figure 23 compares overall composition in the Student Union. It shows that there has been a substantial fall in the presence of PET bottles in the Union's waste streams, from 20% to 3%. The change in aluminium cans was too small to be considered. The non-recycled waste stream at the Student Union had a baseline of 0.8% PET and an in-pilot proportion of 1.2%, hence negligible overall.



**Figure 23 Baseline and in-pilot overall waste composition, Student Union**

Figure 24, comparing recycling composition in the Student Union, indicates that there was a modal shift from the main recycling bins to the Recycle and Reward machines. The original residual waste contained 0.8% aluminium cans but in the pilot this was zero.



**Figure 24 Baseline and in-pilot recycling waste composition, Student Union**

While these findings are in line with the other elements of analysis, indicating a net positive overall effect on recycling, they cannot be considered robust because of the weaknesses in the analysis indicated earlier.

#### 4.8 Impact on container sales

During the in-depth interviews, catering and hospitality staff did not feel that the Recycle and Reward scheme had had an impact on sales or footfall. The Student Union shop mentioned that there might have been a slight increase in footfall, while recycling staff in the stores had not noticed a change in the volume of packaging produced. Detailed quantitative analysis of the impact of the pilot on sales is

not possible, as week-on-week sales for the previous year were not available and, in any case, many other factors are likely to complicate a direct comparison.

The majority of the bottles and cans that students consumed were bought on campus. Of those surveyed, 4% of users (three people) stated that they bought more on campus than they had previously and 80% (67 people) bought the same as before.

#### 4.8.1 *PET plastic bottles*

Among those who regularly recycled their PET plastic bottles (17% of the total population, 83 people):

- 86% (71 people) bought all of their bottles on campus;
- 14% (12 people) bought some of their bottles on campus;
- 13% (11 people) brought bottles from home; and
- 2% (two people) bought from nearby shops.

#### 4.8.2 *Aluminium cans*

Among those who regularly recycled their cans (3% of the total population, 15 people):

- 87% (13 people) bought all of their cans on campus;
- 7% (one person) bought some of their cans on campus;
- 7% (one person) bought from nearby shops; and
- 7% (one person) was unsure.

### 4.9 Impact on material quality

The machines returned a high-quality stream of source-segregated aluminium cans and PET bottles and there were no complaints recorded about cross-contamination of material streams. The only issues raised related to the presence of bottle tops, which remained with PET bottles and would have to be sorted by the reprocessor. This is an issue for all plastic bottle collections. Before the pilot, the university collected the target materials in bins for mixed cans and glass and in bins for mixed plastics. By providing source-segregated aluminium can and PET bottle streams it may be possible to command higher material prices.

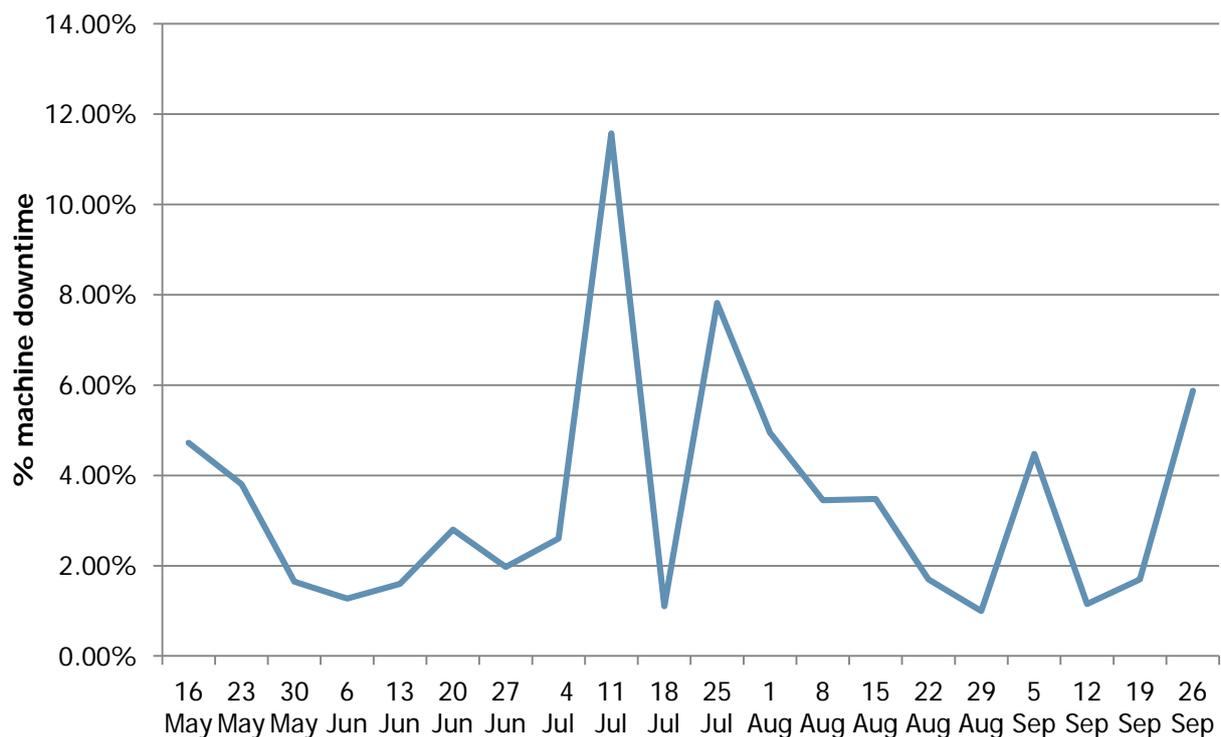
### 4.10 Operational factors

**This section considers the machines' technical reliability, and also how reliable the users and staff thought them.**

#### 4.10.1 *Machine reliability and material rejection*

The machines were identified as being reliable by the majority (82%) of the users surveyed and by the staff interviewed. However just over a third of users had experienced some problems when attempting to use the machines; the main reasons given were that the machines were either out of order or full. Staff felt that the Recycle and Reward machines were very reliable and they were able to fix minor issues such as clearing jams in the machines. They felt the engineers were supportive, quick to respond and good at solving any problems. The machine at the student shop had been the most troublesome because of jamming and as result it needed to be cleaned on a more regular basis.

The reported data supports the feeling that the machines were generally available and reliable, shown in Figure 25. This averages at only 3.4% downtime over the pilot period.



**Figure 25 Machine downtime per week**

There is anecdotal evidence from users of the machines at the university that some machines, including those in the Hugh Nisbet Lower and Upper zones, would not always accept PET bottles without bar codes, and that the machines were unable to read bar codes where they were sometimes damaged or missing. Clearly no machine can be expected to read a missing bar code and so this would be a problem for any scheme.

During the in-depth interviews it was noted that at times users had to insert the items into the machine multiple times before they were accepted and these users became frustrated when the machines would not accept their items. It was also suggested that more information clearly explaining why materials had been rejected would have been beneficial. A number of staff commented that rejected items were left discarded at the machines.

Items being rejected by the machines was a barrier to use, with one fifth of the users claiming that the machines would sometimes not accept items they were trying to recycle. During the observational analysis 14 plastic bottles (4% of the total presented) and 3 cans (14% of the total presented) were rejected. This is a small figure, particularly for the PET stream which was the largest by far. One of the reported reasons for rejects was the need for an updated database of accepted products.

The machines did not record any quantitative data on rejects, but university staff were required to collect rejected containers and report the bar codes to Tomra, so that these drinks containers could be added to the database. This was done periodically. New products and special promotional drinks containers have unique bar codes and rejection of these items might have been higher at the start of the pilot, or at intermittent points during the pilot, following the introduction of seasonal product lines.

During the observational analysis and other site visits, discarded bottles and cans were commonly seen around some of the machines. It was also observed that, when items were rejected, five users put the rejected items into a general waste bin, three left their items at the machines and one took the rejected item away. It was suggested that recycling bins should be placed beside the machines to

ensure that, when items were rejected or were unable to be placed in the machine because the machines were full, they could still be recycled. This had not been done, since it was felt that having two recycling points at the same location would be confusing; however, a small general waste bin was placed at each machine, with a separate reservoir to dispose of any residual liquids left in containers.

#### 4.10.2 *Location of the machines*

From the survey, 11% of non-users would be encouraged to use the machines if they were in locations perceived as better or more convenient. From the focus groups it also emerged that the location of the machines was both a key facilitator and a barrier to usage. It was acknowledged that the current sites, where drinks containers were bought and discarded, were generally appropriate.

However, non-users claimed to rarely discard empty drinks containers in the current locations and said they would be more likely to use them if they were located at the key crossroads or at the main reception, which was a main departure point from the campus. Both students and staff suggested that there should be more machines spread more widely across campus in areas of perceived higher footfall. Suggested locations were the halls of residence, departure points from the university and the Sports Academy<sup>1</sup>.

See section 5 for further information.

#### 4.10.3 *Resourcing implications*

The pilot was managed by the campus environment and energy manager, who in turn directed the recycling teams to ensure that the machines were emptied effectively. At the onset of the pilot it was expected that additional recruitment of staff would be required, but subsequently the project was resourced within existing roles, the exception being the administration, promotion of the scheme and technical support provided by Tomra, the equipment supplier.

While no additional staff were employed, the environment and energy manager had to dedicate a lot of extra time to the pilot, which was onerous given his existing schedule. Resources were required to administer the deposits and refunds, apply add-on bar code labels to drinks containers in both the hospitality and Student Union retail areas, and provide data for the monitoring and evaluation of the pilot (including sales figures and voucher redemptions). In addition, resources for marketing and promoting the scheme were provided by university staff, with support from Zero Waste Scotland communications. Further support was provided by Tomra, on an as-needed basis, to help develop the project and provide technical services. Additional work was also undertaken by the University Waste Team.

This additional effort is largely, in our estimation, down to the pilot itself (e.g. the addition of labels to products for sale would not be required at the university if part of a nationwide programme) and the need to gather data for Zero Waste Scotland monitoring purposes. Outside the pilot, day-to-day activities would largely revolve around ensuring that the machines were operating correctly and emptied as necessary. For schemes of this sort, involving a deposit and refund arrangement, there would also be the need for some financial support in processing the financial aspects.

## 5 Public reactions to the pilot

**In assessing public reactions, this section considers the views of only the target population for the scheme, i.e. students and staff. It 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**

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<sup>1</sup> This is a different facility to the Sports Centre

**benefits of the scheme and also highlights any questions raised about the scheme, and user suggestions for changes.**

## 5.1 User views and motivations

The majority of users liked the Recycle and Reward machines, with overall satisfaction and ease of use both rated highly or very highly (79% and 96% respectively). The vast majority of users rated the operating instructions as easy or very easy to follow (92%). During the observations only one person seemed unsure of how to operate the machines and was assisted by a friend.

During the focus groups it was noted that when the machines accepted items they were very easy to use. However, there were some misgivings amongst users about exactly how to use the machines the first time and the potential for embarrassment if the first attempt was unsuccessful. Waiting for a quiet time to use a machine was suggested as a solution to this. During the in-depth interviews it was also noted that, overall, students found the machines easy to use but could get frustrated if items were rejected.

Some users in the focus groups were not fully knowledgeable about the details of how the scheme operated. There was confusion over why some items were accepted but no voucher or option to donate to charity was offered, or why some items were rejected by the machines. At the very least, users wanted their PET plastic bottles and cans to be accepted for recycling even if they did not receive a voucher or option to donate to charity. Some of the confusion here may relate to unfamiliarity with deposit schemes in principle. The user and non-user focus groups showed limited understanding of the deposit principle and the link to the fact that vouchers are not always offered.

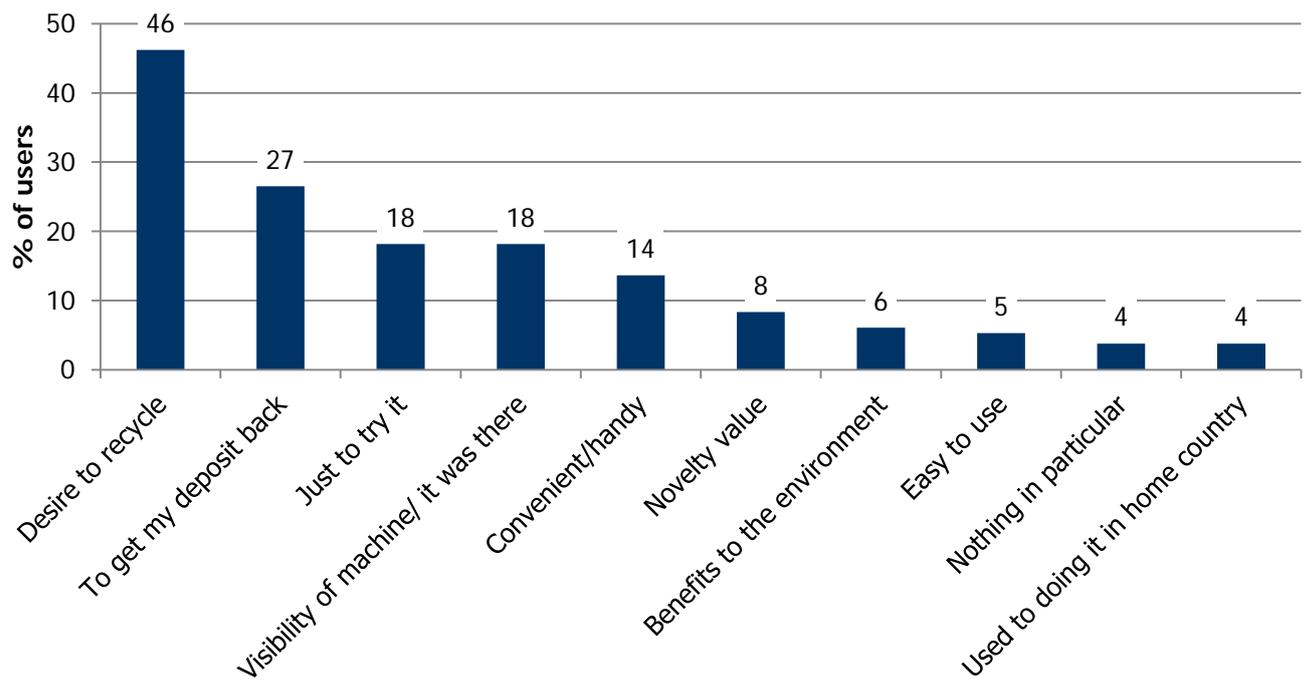
From the survey, the difficulties encountered by users were:

- materials rejected (20%);
- full or broken machines that were out of operation (14%); and
- blank/no vouchers issued (4%).

As discussed, this last difficulty may represent the system functioning correctly if these items were in fact from outwith the scheme. The data shows that 11% of containers were outwith the scheme.

The desire to recycle (46%) and claiming back the deposit (27%) were the primary motivations to use the machine, as displayed in Figure 26. A desire to try it and 'have a go' was also a major factor, novelty and convenience being factors. Some reported using the machines because they were a convenient way of recycling with the added incentive of a reward or a means of donating to charity.

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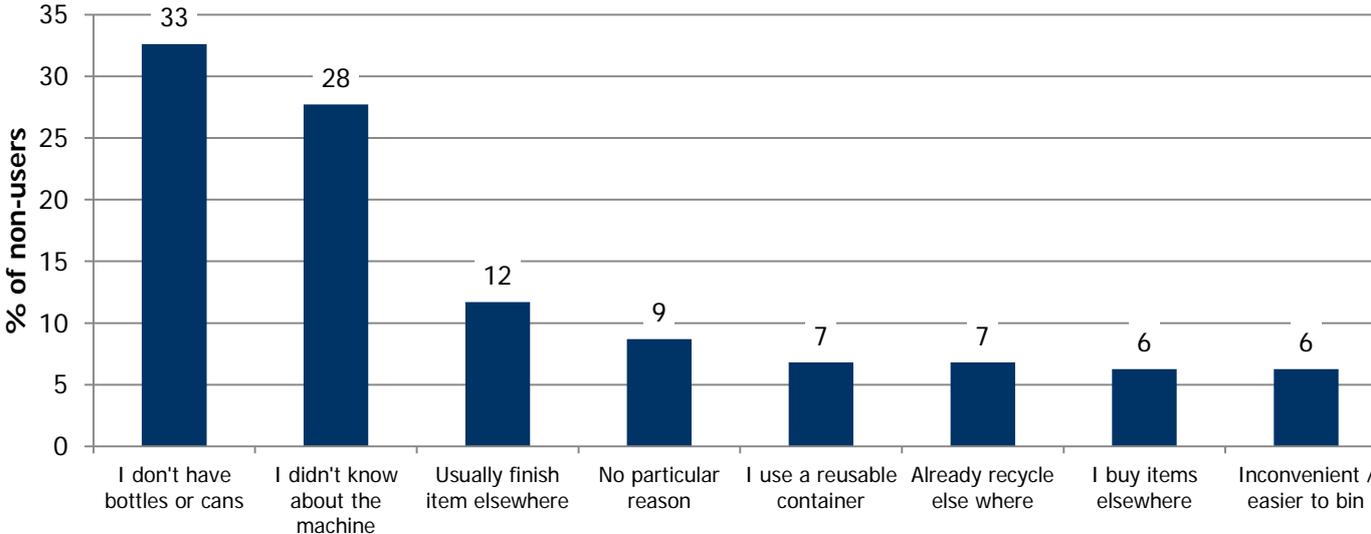
**Figure 26 Motivation to use the Recycle and Reward machines**

Students and staff during the focus groups and in-depth interviews also suggested the following benefits:

- business: the potential for financial savings on waste and litter; increased trade on campus; donations financially benefiting charity; the creation of employment opportunities; and enhancement of the university's environmental credibility, image and reputation.
- environmental: encouraging recycling and making wider environmental issues such as discarded plastics more salient; a reduction in littering; and
- practical: easy to use, well maintained and makes recycling easier for people who could not recycle these items at home.

## 5.2 Non-user views

Of those surveyed, 74% did not use the Recycle and Reward machines. The primary reasons were that they did not have bottles or cans to recycle (33%) or were unaware of the machines (28%). These and other reasons recorded are displayed in Figure 27.



**Figure 27 Reasons for not using the Recycle and Reward machines**

The justification for non-use identified during the focus groups were:

- rarely discarding items at the machine locations;
- insufficient number of machines in places where drinks containers were discarded;
- lack of saliency of the scheme, i.e. forgot about it;
- reluctance to seek out machines; and
- infrequently using the campus outlets which accepted the vouchers.

From the survey, the primary changes that might encourage non-users to use the machines were:

- if they used the bottles or cans the machines accepted (29%);
- if they were made aware of the Recycle and Reward machines on campus (20%);
- if there were more promotion, advertising and information to support the scheme (19%);
- by locating the machines in more suitable areas (11%); and
- if they did not have to pay a deposit (4%).

During the focus group the non-users also suggested they would be more inclined to use the machines if they were sited in different locations, e.g. at the 'crushes', i.e. busy crossroads in the university, or at the main reception, which was a central departure point from the university. This underlines the attitude, expressed towards recycling in general, that most would not make a special effort to recycle, even to redeem their deposit, but would recycle if convenient.

Some people at the focus groups suggested that, as non-users, they were penalised by having to pay a deposit that they would not get back, while some users noted that the vouchers were a disincentive to participate, as they infrequently used the campus outlets which accepted the vouchers. Some non-users insisted that they simply required more recycling bins around campus rather than a monetary incentive to encourage them to recycle. When asked directly in the survey work, however, 82% of the non-users surveyed indicated that as a result of becoming fully aware of the machines they would now consider using them.

### 5.3 Appropriateness of the rewards

In the focus groups, users agreed that it was reasonable to implement a deposit return scheme at the university as a means of encouraging recycling, to enable those who could not recycle at home, to

increase recycling rates at the university and perhaps to encourage consideration of wider pro-environmental behaviours.

When informed about the reward, 76% of all survey respondents, both users (81%) and non-users (75%), indicated that the 10p deposit was an appropriate incentive to recycle. Users also considered 10p as 'fair' given the recognised need to balance deposit with return, i.e. not so high in value as to prevent students from buying items on campus but not so low as to negate the benefit as an incentive to recycle. It was suggested in one focus group, however, that the relative price of the item had to be taken into account, i.e. the deposit was too high when, for example a 500ml bottle of water on campus was beginning to be as expensive as a 1.5l bottle purchased elsewhere. This risk of displacing purchases is real in a geographically limited scheme such as this.

A few of the users claimed they had resented the 'price hike' and reported a change in their purchasing habits e.g. switching to cheaper drinks such as water and bringing drinks in from home. Some claimed not to have known that the price increase was a deposit that would be returned. Some users in the focus group felt that the price increase and introduction of the scheme had not been sufficiently synchronised, which may have contributed to this misunderstanding. It is clear, however, that the deposit element of pricing may not always be clear to the purchaser, especially as part of 'meal deals', or other promotions. Once the scheme was understood the price increase was then more likely to be found acceptable.

The non-users responded well to the option to donate to charity with some reporting that it might encourage their participation. All respondents reflected that they did or could feel good about themselves for recycling and giving to charity with a single act. That said, only 4.9% of value was donated during the 10 weeks of the pilot when charity donation was an option. Students considered donating to RAG (Raising and Giving) Heriot-Watt Student Union's charities group acceptable, although they would like this to be promoted further to reinforce trust in this aspect of the scheme. One user suggested donating deposits to a central fund and then distributing the money among University societies.

Students described the paper vouchers as counterproductive to minimising waste. It was suggested that it would be a good idea to have a system where points could be added to matriculation cards. This was seen as more environmentally friendly, convenient and less demeaning than redeeming low value vouchers. Students also responded positively to the idea of vouchers being redeemable in more locations on campus and making them more versatile e.g. to be used for printing.

Staff interviewed during the depth interviews had different opinions of the rewards. Some felt it was appropriate, others felt that the 10p was enough of a price increase to pay but was not a high enough amount to incentivise people to recycle and suggested that a deposit of between 20p and 25p would have been more effective.

## 5.4 Legacy of the Recycle and Reward scheme

The large majority of those surveyed (86%) were clear they would like the Recycle and Reward scheme to continue in the university, with 85% keen to see similar schemes become more widespread across Scotland.

During the focus groups and in-depth interviews, staff, student users and non-users agreed that the scheme should continue for a number of reasons. Generally, it was felt to be a positive development and had been interesting and effective in aiming to increase recycling on campus, raising the importance of environmental issues and encouraging students to get involved in recycling. Given that the infrastructure was in place, and well supported, there seemed little reason not to continue the scheme.

Downsides to continuing the scheme were seen as the financial and environmental costs of running the machines. The scheme would have to be cost neutral in the long term to be sustainable at the university. The university has committed to continuing the scheme for at least one year beyond the funded pilot period. Projected operating costs based on both current and improved deposit-return rates indicate the scheme will be self-financing in the future.

## 5.5 Other observations

Improvements, suggested during the social research, that could be made to the scheme to encourage further participation and 'buy in' from staff and students (both users and non-users) are detailed below. These are the views as expressed and clearly some apply specifically to a stand-alone scheme at the university more than they would to other contexts. Suggestions included:

- Improve internal communications to ensure that there is greater clarity about the individual roles and responsibilities of all staff involved in the ongoing management, running and maintenance of the scheme, including ongoing staff training.
- Promote the scheme better, with greater transparency about the deposit return process, how the machines work and which empty containers can be recycled.
- Communicate how the system works as well as its existence, and that it may need to be a more continuous process where there are changing audiences (i.e. at the start of every new academic year).
- Make further information about the scheme available in terms of the environmental and financial costs and benefits.

## 6 Conclusions

**Overall, the deposit and return scheme, using the Recycle and Reward machines, seems to have been well received and well used by a significant proportion of students and staff members at the university. The Recycle and Reward machines were well liked by the majority of users, with overall satisfaction and ease of use both rated highly or very highly (79% and 96% respectively). The vast majority of users also rated the operating instructions as easy or very easy to follow (92%). The machines were identified as being reliable by the majority (82%) of the users surveyed and by the staff interviewed. This is supported by the machine data, which showed overall downtime for the machines at just 3.4% on average.**

Two usage models were commonplace. The most common one was where users simply used the machines every time they had a bottle or can and were near the machines. Alternatively, a minority (including cleaning staff) stockpiled items and then specifically sought out a machine to put the collected units in.

Overall the scheme saw 41,000 containers recycled through the machines over the 20 weeks of monitoring. This included 34,000 bottles and 7,000 cans. Figures for the autumn term, after the SKM monitoring finished, were even higher, averaging over 5,000 containers a week. The large majority of the beverage containers had been purchased within the campus and had the 10p returnable deposit. During the SKM monitoring period, just over 4,000 units were recycled that did not have the deposit and so were most likely brought in from outside the campus.

The overall capture rate (total machine returns including the 4,000 extra containers vs total campus sales of targeted items) was 42%. During the holidays the capture rate was 45% compared with 36% in term time; however, the total number of containers recycled was much higher in term time than in the holidays, 3,100 containers and 1,800 per week respectively. The capture rate during the holiday period rose steadily from 30% to 56%. The three weeks of autumn term also saw climbing recycling rates of 30%, 30% and 38% and it would be expected that the term time recycling rate would continue to climb as term progressed and the student population became more familiar with the scheme.

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The in-scheme capture rate (targeted containers recycled through the machines vs total campus sales of those targeted items) was 37% overall during the SKM monitoring period, though some may have been recycled elsewhere on campus. Interestingly, subsequent monitoring by Zero Waste Scotland during the autumn term saw a higher term-time capture rate than previously, with a capture rate of ~45% (counting all containers) between October and the end of December (and ~41% counting just those sold on site). The absolute number of containers returned was also much higher (coinciding with the new autumn term, some of which was also seen during the SKM monitoring period). This may reflect a more 'normal' pattern of term-time usage (with most students on campus and no exams) than the end of the academic year, as well as the fact communications efforts in the new term may have targeted the student population more effectively (given more regular time on campus for students, and the significant promotional effort at the start of the new term).

The amount of recycling through the Recycling and Reward machines was estimated at ~0.8t over the pilot period, which would extrapolate to 2.4t over a year (cf. over 800 tonnes of all recycled materials, including heavier paper and food waste). However, the tonnages seen during the autumn term would suggest a much higher figure, with annual capture perhaps more likely to approach ~4.9t. This is a sizeable proportion of all cans and bottles recycled on the site, though some uncertainty remains around the exact percentage. Waste compositional analysis indicated that plastic bottles in the general waste may have been reduced and plastic bottles from the other recycling facilities transferred into the Recycle and Reward machines, although the data were not considered robust enough to draw firm conclusions.

A total of 26% of people surveyed had used the Recycle and Reward machines at least once, and 17% used them on a regular basis. Some 25% of the total sampled population had recycled PET plastic bottles in the machines, with 11% claiming they now recycled more bottles on campus since the machines had been introduced. Only 4% of the total sampled population had recycled cans in the machines, with 2% claiming they now recycled more cans on campus since the machines had been introduced.

Participants redeemed 85% of the vouchers and donated just under 5% of the reward value to charity. The research showed that there was a lag of several days in many redemptions and that some vouchers were stockpiled, particularly by university staff. While 62% of transactions were for only one item, transactions as large as 82 containers were recorded. One of the suggested improvements to the scheme was the use of a student card to collect the returned deposits rather than the paper vouchers.

The interview data showed that only 40% of those surveyed were aware that a deposit of 10p was added to the cost of each of the drinks containers sold on campus, and only 14% were aware of communications and promotion of the pilot. The deposit return concept itself had been covered but was not the focus of the communications or branding, which may be why it was not well understood. A great deal of effort was put into the communications of the pilot, and further communication activities were undertaken during freshers' week at the start of the new term. It is clear that regular communications are required to inform the annual intake of new students. Of the non-users in the survey, 82% indicated that, as a result of becoming fully aware of the machines and how the scheme operates, they would now consider using the machines.

The social research found that the main motivator for using the machines was the desire to recycle (46% of those surveyed), followed by claiming back the deposit (27% of those surveyed). Other strong drivers were the novelty of using the machines and the convenience of recycling while also making a charity donation. When informed about the reward, 76% of all survey respondents, both users (81%) and non-users (75%), indicated that the 10p deposit was an appropriate incentive to recycle. Some staff, however, felt that 20p or more would have been a more appropriate incentive to recycle.

It is clear that the location of the machine will have a great impact on use. Non-users suggested they would be more inclined to use the machines if they were sited in different locations, e.g. at the 'busy crossroads in the university', or at the main reception. This underlines the attitude, expressed towards recycling in general, that most would not make a special effort to recycle, even to redeem their deposit, but would recycle if convenient.

Students and staff during the focus groups and in-depth interviews suggested the following benefits:

- business: the potential for financial savings on waste and litter; increased trade on campus; donations financially benefiting charity; the creation of employment opportunities; and enhancement of the university's environmental credibility, image and reputation.
- environmental: encouraging recycling and making wider environmental issues such as discarded plastics more salient; a reduction in littering; and
- practical: easy to use, well maintained and makes recycling easier for people who could not recycle these items at home.

The machines returned a high-quality stream of source-segregated aluminium cans and PET bottles, which could in theory allow the university to obtain a higher material revenue or reduce waste management costs.

While litter analysis showed some potential reductions, this was based on a very small spot sample and no firm conclusions can be made.

In terms of legacy, the large majority of participants (86%) were clear they would like the Recycle and Reward scheme to continue in the university, with 85% keen to see similar schemes become more widespread across Scotland including at supermarkets, schools, town centres, and bus and railway stations.

## 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.
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## 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

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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; machine supplier provided weekly data on vouchers issued	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 weekly data for 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 weekly data for voucher redemption figures provided 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 weekly data for 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 weekly data for voucher redemption figures provided 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](http://zerowastescotland.org.uk)  
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