UNIVERSITY OF SOUTHAMPTON

FACULTY OF ENGINEERING, SCIENCE AND MATHEMATICS

School of Civil Engineering and the Environment

Greening Academia: Developing Sustainable Waste Management at UK Higher Educational Institutions

By

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<u>ABSTRACT</u>

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<u>Doctor of Philosophy</u>

Greening Academia: Developing Sustainable Waste Management at UK Higher Educational Institutions

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Dealing with municipal solid waste has become a problematic issue in the United Kingdom (UK). With actions to mitigate the potentially adverse impacts of climate change debate and space for, and costs of, landfill becoming critical, a landfill-dominated strategy is no longer acceptable. In this context, the attitudes and behaviour of young adults, particularly university students, who often have little experience of taking responsibility for waste management activities, have not been studied in great detail. Since the 1960s, the UK higher education system has expanded six fold to >2.4 million students. The overall production of waste at Higher Education institutions (HEIs) is therefore very large and presents significant challenges as the associated legislative, economic and environmental pressures can be difficult to control and manage. Therefore, a comprehensive research focusing on university students is urgently required. Changing the way HEIs deal with their waste is an important issue because of fast-changing legislation and increasing costs. The solution is a new approach to waste management: a revolutionary change in the way that HEIs think, the way HEIs act and the way HEIs handle their waste. This has massive implications for the Higher Education (HE) sector. It means developing extensive institution-wide infrastructure to provide greater flexibility and user-centric solutions to suit the need of students and staff. It also means that HEIs work together and potential collaboration between HEIs and Local Authorities (LAs) to maximise resource efficiency, meet future legislative requirements and achieve their corporate responsibilities and commitments.

 This thesis reports on a study of waste management practices at HEIs in the UK. The issue was approached from both a theoretical and a practical standpoint. The study used the University of Southampton (UoS) as a case study and examined how waste recycling projects can be developed effectively using infrastructure, service provision and behavioural change techniques as part of a wider research programme investigating waste management in medium- and high-density housing. The study clearly showed that there was potential for significantly improving reuse and recycling at university halls of residence (HoR) and that more convenient and higher quality infrastructure and service provision resulted in higher recycling rates. Furthermore, students have lifestyles that impact significantly on waste arisings and consequently on waste management operations at HoR (and probably at HEIs and student-dominated residential areas). For schemes to be successful at HEIs, they must be based on a thorough understanding of students' recycling behaviour, and their perceptions of the barriers to recycling. The key to unlocking behaviour change lies in the provision of appropriate infrastructure and effective service provision alongside a targeted behaviour change programme. Mass media coverage especially the Internet has a rising influence on university students' environmental knowledge while environmental education at school has become the secondary source of information. The results also revealed that university students possessed less knowledge than they believed which makes informative behavioural interventions a vital component of effective recycling schemes at HEIs.

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DECLARATION OF AUTHORSHIP

I, Na Zhang declare that the thesis entitled "Greening Academia: Developing Sustainable Waste Management at UK Higher Educational Institutions" and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research.

 I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Part of the work have been published or submitted as a journal paper or within peer-reviewed international conference proceedings.

Zhang, N., Williams, I. D., Smith, N. F. & Kemp, S. 2008a. Recycling at Student Halls of Residence: A Case Study for the University of Southampton. . *Global Waste Symposium – Promoting Technology and Science Innovation.* Copper Mountain, Colorado, USA.

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Signed:………………………………………………………………………….
Date:

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ACRONYMS AND ABBREVIATIONS

ATR	Attitude Towards Recycling
BREW Centre	Business Resource Efficiency and Waste Centre for local authorities
CRR	Centre for Remanufacturing & Reuse
CRWP	Construction & Resources Waste Programme
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EAUC	Environmental Association for Universities and Colleges
EEMU	Energy and Environmental Management Unit
EU	European Union
HE	Higher Education
HEFCE	Higher Education Funding Council for England
HEI	Higher Educational Institution
HESA	Higher Education Statistics Agency
HoR	Halls of Residence
ISB model	Infrastructure, Service provision and Behavioural change model
Las	Local Authorities
LARAC	Local Authority Recycling Advisory Committee
LATS	Landfill Allowance Trading Scheme
MO	Moral Obligation
MSW	Municipal Solid Waste
NISP	National Industrial Symbiosis Programme
PBC	Perceived Behaviour Control
PIs	Performance Indicators
PESTLE	Political, Economic, Social, Technological, Legal and Environmental
rWFD	revised Waste Framework Directive
SN	Subjective Norm
SOGE	Sustainable Operations on the Government Estate
SUWMC	Southern Universities Waste Management Consortium
TPB	Theory of Planned Behaviour
TRA	theory of Reasoned Action
TS	Third Sector
UK	United Kingdom

UoS	University of Southampton
WCA	Waste Collection Authority
WDA	Waste Disposal Authority
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive
WRAP	Waste & Resources Action Programme
YPTE	Young People's Trust for the Environment

Chapter 1

1 Introduction

1.1   Contextual material

Higher education institutions (HEIs) are semi-autonomous institutions which largely define their own purpose or purposes (House of Commons, 2007). Over the last decades, there has been unprecedented demand for higher education (HE), as well as an increased awareness of its vital importance for societies. Research from HEIs' discoveries helps to meet societies' needs, solve difficult problems and continually improve our lives. HE systems and institutions have never been so closely linked to the sociocultural and economic development of nations. Significant capital has been invested over the last ten years in HEIs. The current United Kingdom (UK) HE sector is regarded as a priceless national asset – a £20 billion enterprise, educating more than two million students at any time and responsible for the majority of the nation's research capabilities (PA Consulting, 2008). University students are the leaders of tomorrow, and today's young generation needs to be equipped with new skills, knowledge and ideals. It has been placed firmly at the heart of the UK's 'knowledge economy'.

Universities occupy large areas of land and numerous buildings. They have growing student and staff numbers and consequently growing resource requirements and various complex activities which are not limited to education, as well as research, business development and outreach. Their activities result in direct and indirect impacts on society and the environment. There has been global concern for university policy makers and planners to mitigate the impacts of universities on the environment and for them to become generally more sustainable (Alshuwaikhat and Abubakar, 2008). As the result, the Environmental Association for Universities and Colleges (EAUC) was set up in 1996 with the aim of raising the profile of environmental management and facilitating improvement of environmental performance in member institutions. However, there is a perception that HEIs are not moving forward fast enough. There is widespread agreement that sustainable development is important and it is a growing political priority both nationally and internationally, but if the HE sector is to play its

full part in helping society meet the challenge of sustainable development, the momentum for change needs to continue and increase (HEFCE, 2008b).

The UK faces major challenges to manage waste sustainably. Mandatory household recycling targets have been set and driven by legislation deriving from the European Union (EU). The Waste Hierarchy is also a useful framework that has become a cornerstone of sustainable waste management, setting out the order in which options for waste management should be considered based on environmental impact (DEFRA, 2002). In 2000, Department for Environment Food and Rural Affairs (DEFRA) published the first Waste Management Strategy for England and updated it in 2007 (DEFRA, 2007b), Scotland (Scottish Environment Protection Agency (SEPA), 2003), Wales (Welsh Assembly Government, 2002) and Northern Island (Department of the Environment (DoE), 2006). For municipal solid waste (MSW) in England, a two-tier system is adopted in waste management. The Waste Collection Authority (WCA) is responsible for waste collection and the Waste Disposal Authority (WDA) is responsible for waste disposal. A few Unitary and Metropolitan Authorities serve both functions. The performance of local authorities (LAs) is evaluated by Department for Environment, Food and Rural Affairs (DEFRA) every year.

In 1997, only 7% of England's household waste was recycled. In 2009, it had reached 37% (DEFRA, 2009). However, England's LAs must continue to develop appropriate waste management strategies if they are to reach their statutory targets and match the performance of other EU countries. Household recycling requires people's willing to recycle and the supporting infrastructure for them to do so. Each LA has to adapt to its own socio-economic conditions, so it is not possible to develop a 'one-size-fits-all' waste management system. One might expect that these adaptations would apply particularly to university towns and cities where the population is periodically boosted by a significant influx of young people, but very little evidence exists on the impact of universities on waste arisings and management.

HEIs are finding that waste management issues are being forced up the management agenda. The environmental impacts associated with the disposal of waste are now recognised as making a key contribution to the overall environmental impact of the organisation for many HEIs. In addition, the increasing numbers of statutory requirements, coupled with Landfill Allowance Trading Scheme (LATS) and escalating landfill tax means that addressing waste management issues is becoming an important priority.

Universities are very different from LAs or industrial sectors regulated by the (Environment Agency) EA and DEFRA although they have been compared to large towns or small cities in terms of the size of their population, geographic area occupied, types of basic service required and complexity of activities carried out. Waste management at HEIs is often a complex challenge; HEIs often produce large volumes of waste from its residences, catering areas, laboratories, workshops and grounds and it has strict duties to manage that waste safely. However, unclear rules on the waste generated by HEIs and lack of national guidance between the EA and DEFRA, create confusion at HEIs particularly and become barriers of green initiatives instead of drivers.

The economic landscape in 2009 was very different to what had been experienced over the previous 10 years. The world economy is experiencing a global recession and the likely consequent reduction in overall public funding and the changes in the global economy mean that the period of growth in public funding enjoyed by HE over the past decade is over and unlikely to return for some time (HEFCE, 2010). HEIs more than ever need to be prudent with their use of resources. In this sense, the 'Greening Academia' concept is becoming even important under the current economic climate.

1.2   Aim and objectives

The aim of this study is to establish that carefully designed recycling facilities, service provision and communication strategies at high density housing (university accommodation) can reduce waste sent to landfill. This will be achieved using a case study approach based at the University of Southampton (UoS). The underlying objectives are to:

1. identify, quantify, summarise and evaluate the waste collection, recycling and disposal approaches in UK HEIs;
2. examine the potential for improving waste management systems in HEIs;
3. describe how sustainable practice has been incorporated within the structures of the university, and describes the results of the environmental initiatives and the experiences and outcomes;
4. investigate the opportunities for and barriers to reuse/recycling by university students;
5. examine the potential for improving reuse and recycling at university Halls of Residence (HoR);

6. present a convenient, easy-to-use recycling system to the university by identifying, designing, implementing and evaluating different recycling schemes;

7. evaluate a series of reuse and recycling trials at the university HoR during end-term and move-out period towards the end of academic years when extra waste is generated;

8. examine the recycling behaviour and beliefs of university students;

9. make recommendations and a best practice case study for use by other HEIs in the UK.

1.3 Individual chapters

This thesis brings together the constituent parts of the research conducted in respect of PhD candidate. Chapter 2 provides thorough reviews and analysis of a wide range of related literature regarding waste management at UK HEIs. Chapter 3 outlines the methodological approach of the study. Each of Chapters 4 to 7 has been published or submitted as a journal paper or within peer-reviewed international conference proceedings. These are set in context below. Chapter 8 provides a general discussion and critical evaluation of the results of the preceding chapters and considers the most important findings further. Chapter 9 draws out the conclusion of the research and also makes some recommendations for further work.

Chapter 4: Waste management in UK higher education institutions (Zhang et al., 2008b) published in Proceeding Waste 2008: Waste and Resource Management – A shared responsibility Stratford-upon-Avon, Warwickshire, England, 16-17 September 2008.

This chapter addressed objective 1 and 2. A nationwide survey of HEIs in the UK was carried out in order to identify, quantify and evaluate the approaches to waste collection, recycling and disposal and examine the potential for improving waste management systems.

Chapter 5: Developing sustainable waste management at a UK University (Zhang et al., in review a)

This chapter is the foundation for all that follows and it describes the context in which the research was done and it forms the basis of the work to satisfy objectives 3 to 5. It critically reviewed why sustainable waste management has become a key issue for the HE sector to address and describes some of the benefits, barriers, practical and logistical problems. This chapter outlined the waste management systems developed by

one of the largest universities in Southern England – the UoS. The University was committed to protecting the environment by developing practices that are safe, sustainable and environmentally friendly and has developed a practical, staged approach to manage waste in an increasingly sustainable fashion. The chapter provided signposts to good practice and useful resources so that other institutions can access valuable information.

Chapter 6: Development of a reuse and recycling programme at University halls of residence in England (Zhang et al., in review b)

This chapter completes the outstanding requirements of objective 6 and 7. It is the second in a series in which the development of sustainable waste management at UK HEIs is discussed. As one of the most important economic and social drivers in the UK, the HE sector produces millions of tons of waste every year. However, many HEIs have been slow to engage in the shift to more economically and environmentally sustainable management of their wastes. Although some previous studies have explored students' recycling behaviour, there is clear lack of research on development of effective recycling systems in medium and high density housing dedicated to young people (in this case, university halls of residence). This follow-on chapter described in detail the development of a recycling project at HoR using the infrastructure service provision and behaviour change (ISB) model. The waste disposal and recycling approaches and practices typically used at university HoR are identified and critically evaluated together with opportunities for and barriers to reuse/recycling by university students. The study clearly showed that there was potential for significantly improving reuse and recycling at university HoR and that more convenient and higher quality infrastructure and service provision resulted in higher recycling rates.

Chapter 7: Understanding university students' recycling behaviour

How to change behaviour and increase university students' participation in recycling and waste reuse activities is, evidently, complex and requires an understanding of how and why students behave the way that they do. For schemes to be successful at HEIs, they must be based on a thorough understanding of students' recycling behaviour, and their perceptions of the barriers to recycling. The aims of this chapter, the third in the 'Greening Academia' series, were to investigate if and how the TPB can help to develop the design of a recycling scheme at a HEI and to investigate what factors significantly impact university students' recycling behaviour.

Two surveys were carried out in 2008 and 2009, respectively, at the UoS. The first survey tested students' recycling behaviour using the Theory of Planned Behaviour

(TPB) model. From 106 respondents, this study showed that the TPB model could only explain 33.1% of the variance in students' decision to participate in recycling and augured that a single mathematical model alone is not adequate enough to understand students' recycling behaviour. The second survey investigated other factors that influence students' recycling behaviour and compared their self-reported knowledge against tested knowledge.

Chapter 8: General discussion

In the chapter, results from different studies in this thesis were related and discussed as a whole. This research has contributed to existing knowledge and thinking in this subject area in several ways. The principal of these are stated below, and discussed as appropriate in the general discussion.

- HEIs like local authorities should be held accountable for sustainable waste management and regulated in a similar way.
- Transient population such as university students needs support of strong infrastructure and service provision in order to make recycling behavioural change.
- Education campaigns and interventions need to cater for the need of the student as a transient population.

Chapter 9: Conclusion

This chapter forms the conclusion of the thesis and summarises the main findings of this study and consists of a summary and recommendation for future projects.

Chapter 2

2 Literature review

2.1   Policy context

A range of policies at European, national and regional levels provide the policy context for waste management (see Table 2.1 & Figure 2.1). Most UK legislation impacting on waste management is now implemented as a result of European Directives. The current national controls on waste originate from the Control of Pollution Act 1974 and were greatly tightened with the introduction of the Environmental Protection Act 1990. Legislation originally focused on the disposal of waste, but since the introduction of the European Framework Directive (WFD) on waste control has extended to include the storage, treatment, recycling and transport of waste. The Waste Framework Directive was originally adopted in 1975 as Directive 75/442/EEC and the original Directive also enabled Member States to adopt their own national definitions of waste. The WFD was amended in 1991 in Directive 91/156/EEC. The amended version also introduced a European Union wide definition of waste and extended the scope of the Directive's from waste disposal to also cover waste recovery.

The requirements of the Landfill Directive were transposed into national legislation through the Landfill (England and Wales) Regulations 2002. The Landfill Directive sets demanding targets to reduce the amount of biodegradable municipal landfilled. LATS was proposed for England to help the UK meet these targets. The Landfill Directive represents a step change in the way we dispose of waste in this country and will help drive waste up the hierarchy through waste minimisation and increased levels of re-use, recycling and energy recovery. Recently DEFRA has agreed that the UK's approach so far to meeting those targets should be changed. The revised approach to municipal waste is based on European Waste Catalogue will have significant impact on HEIs.

In the UK, landfill tax is seen as another key mechanism in enabling the UK to meet its targets set out in the Landfill Directive. The UK landfill Tax was introduced in 1996. Since 1999, the cost of the landfill tax has risen via the 'landfill tax escalator' which has increased the rate of landfill tax per tonnes on an annual basis. Form 1999 to

2004, the escalator was £1 per tonne; it increased to £3 per tonne between 2005 and 2008. With effect from 1 April 2008, the escalator is now £8 per tonne. By 2014/2015, landfill tax will reach £80 per tonne.

Table 2.1 EU and national waste legislation and policy targets

Year	Directive or strategy	Target	Reference
2008 – 2011	Landfill tax	Increase of landfill tax by £8/ton/year from 2008 until at least 2010	(DEFRA, 2007b)
2010	The EC Landfill Directive	Reduce biodegradable waste to 75% of the 1995 level	(DEFRA, 2005)
2010	Waste Strategy for England 2007	Recycling and composting 40% of household waste and 53% of municipal waste by 2010	(DEFRA, 2007b)
2013	The EC Landfill Directive	Reduce biodegradable waste to 50% of the 1995 level	(DEFRA, 2005)
2015	Waste Strategy for England 2007	Recycling and composting 45% of household waste and 67% of municipal waste by 2015	(DEFRA, 2007b)
2020	The EC Landfill Directive	Reduce biodegradable waste to 35% of the 1995 level	(DEFRA, 2005)
2020	Waste Strategy for England 2007	Recycling and composting 50% of household and 75% of municipal waste by 2020	(DEFRA, 2007b)
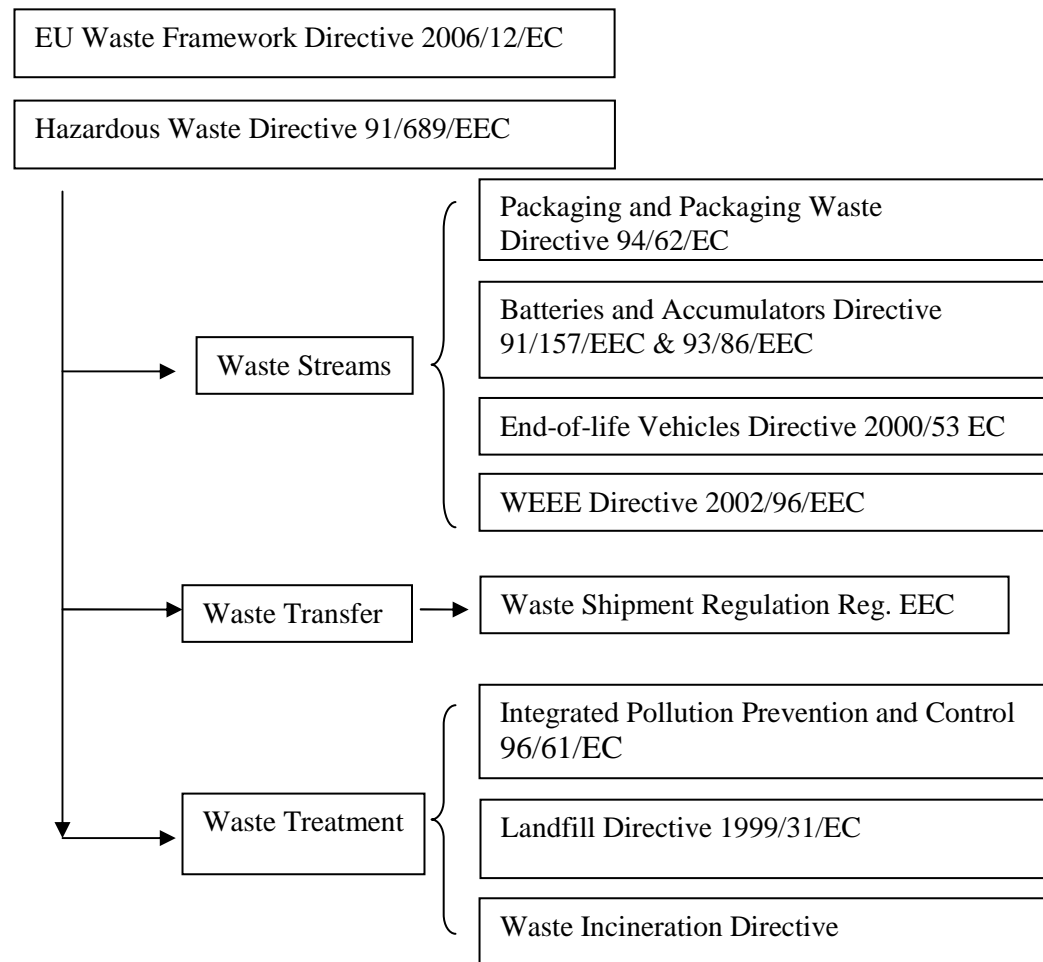
Figure 2.1 Overview of European legislation

2.2   Waste management in the UK

Mandatory household recycling targets have been set and driven by legislation deriving from the EU. Within the UK, waste strategies have been produced for England (DEFRA, 2007b), Scotland (Scottish Environment Protection Agency (SEPA), 2003), Wales (Welsh Assembly Government, 2002) and Northern Island (Department of the Environment (DoE), 2006). For MSW in England, a two-tier system is adopted in waste management. Waste Collection Authority (WCA) is responsible for waste collection and Waste Disposal Authority (WDA) is responsible for waste disposal. A few Unitary and Metropolitan Authorities serve both functions. The performance of local authorities (LAs) is evaluated by the DEFRA every year.

In 2008/09, England generated 27.3 Mt of MSW, a reduction of 4.1% over the preceding year (DEFRA, 2009a). Household waste represented 24.3 Mt (89%) of MSW, or 403 kg of household waste per person, of which 9.1 Mt (37.6%) had some sort of value (recycling, composting, energy from waste and fuel manufacture (*ibid*.)). Although there remain considerable regional variations, the proportion of MSW being

recycled or composted stood at 36.9% in 2008/09, which represents England's best ever waste management performance (DEFRA, 2009a). The value is still relatively low in comparison with many other EU countries. It is difficult to compare recycling rates between countries as different measurements are used. Nevertheless, other EU countries such as the Netherlands, Austria, and Belgium appear to achieve much higher levels of recycling: more than 50% in some cases (Eurostat, 2009). England's LAs must continue to develop appropriate waste management strategies if they are to reach their statutory targets and match the performance of other EU countries.

Household recycling requires people willing to recycle and the supporting infrastructure for them to do so. Each local authority has to adapt to its own socio-economic conditions, so it is not possible to develop a 'one-size-fits-all' waste management system. Although one might expect that these adaptations would apply particularly to university towns and cities where the population is periodically boosted by a significant influx of young people, very little evidence exists on the impact of universities on waste arisings and management.

2.3   The UK higher education sector

The expansion of the HE sector across the world has been phenomenal since the 1960s (Schofer and Meyer, 2005). The HE system in the UK has expanded remarkably over this period, with a six fold increase in the number of students and more than 370,000 academic and non-academic staff now directly employed by UK universities (Greenaway and Haynes, 2003, HESA, 2009c). The UK HE sector has expanded from just 400,000 students in the 1960s to over 2,400,000 in 2007/2008 (Greenaway and Haynes, 2003, HESA, 2009b, c). There are currently 168 HEIs and more than a third of a million students graduate from UK universities every year (HESA, 2008, 2009a). Universities play a multi-faceted role within local and regional economies and are of key importance in the creation and transfer of knowledge to the UK economy through teaching, research and other activities (Wells et al., 2009). One of the consequences of this expansion has been a corresponding growth of physical infrastructure and services on campuses and at student halls of residence (HoR), which has led to a parallel impact on the natural environment. For example, since 1990, the total carbon emissions from the HE sector have risen by an estimated 34% (HEFCE, 2009).

The HE sector has significant purchasing power. Universities UK (2006b) estimated that HEIs spent approximately £16.6 billion in 2003/04, of which £14.3 billion was estimated to have been expended on UK goods and services. This

expenditure generated £25.6 billion of output in other UK industries, with personal off-campus expenditure of students amounting to £1.5 billion annually. The HE sector provides >1.2% of full time equivalent employment in the UK and owns 25 million m^2 of gross space; this represents an estimated 20% of the whole UK office market, with annual revenue costs of £1.67 billion, a third of which goes on repair and maintenance (HEFCE, 2007). Ward et al. (2008) found that in 2006, the reported total energy consumption from all sources in funded HEIs was equivalent to the consumption of one third of a million average UK householders or 30% of the householders in Wales. These figures illustrate the overall importance of the downstream segment of the HE sector.

Although recycling practices and behaviours have been well studied in residential areas in the UK (see for example: (Barr et al., 2003, Darby and Obara, 2005, Davis et al., 2006, Martin et al., 2006, McDonald and Oates, 2003)). There is little quantitative information on how much and what types of waste the HE sector generates every year and how much of this material is reused, recycled or recovered. In 2002, the government published 'Waste Not, Want Not' (DEFRA, 2002), which highlighted that data on specific waste streams, their quantities, growth rates, composition, and impacts were inadequate. It also concluded that data collected and published relating to waste management was widespread but not very well co-ordinated. In response, the government undertook to establish a new sustainable waste management programme, developed and implemented a national three-year plan waste data strategy and programme (DEFRA, 2006a). Thus the importance of a comprehensive waste management data collection and reporting system has been widely recognised but has not been put in place for many key sectors, including the HE sector.

2.4 The higher educational institution approach

2.4.1 Sustainability at higher educational institutions

In line with other sectors, the sustainability of HEIs has become a concern worldwide for policy makers, and under increasingly intense scrutiny from environmental pressure groups, sustainability movements, university stakeholders, student activism and NGOs (Alshuwaikhat and Abubakar, 2008). The concept of sustainability in HE started with the Stockholm Declaration, which was the first declaration to recognise the interdependency between humanity and the environment (United Nations Educational Scientific and Cultural Organization (UNESCO), 1972). In recent years, UNESCO (2005) declared 2005–2014 as the decade of Education for

Sustainable Development, clearly recognising the urgent need to integrate sustainable development issues and principles into education and learning.

Velazquez et al. (2006 p.812) defines a sustainable university as:

'a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfil its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles.'

In 2008, the Higher Education Funding Council for England (HEFCE) published a strategic review of sustainable development in the HE sector in England, which stated that:

'Within the next 10 years, the higher education sector in this country will be recognised as a major contributor to society's efforts to achieve sustainability - through the skills and knowledge that its graduates learn and put into practice, its research and exchange of knowledge through business, community and public policy engagement, and through its own strategies and operations'.

Sustainability implies that the critical activities of HEIs are ecologically sound, socially and economically viable, and that they will continue to be so for future generations. Universities have a moral and ethical obligation to act responsibly for the environment (Armijo de Vega et al., 2008) and its inhabitants (Armijo de Vega et al., 2003). Soares et al. (2008) claim that HEIs should not only educate, but also demonstrate environmental principles and stewardship by taking action to understand and reduce impacts that result from their activities. Their role in promoting sustainability can be demonstrated in several aspects. Firstly, unlike many other large institutions, HEIs often have extensive in-house expertise on the wide range of topics that are needed for their sustainable development and are able to combine local and global knowledge to create synergies with the potential of developing new solutions (Forrant and Pyle, 2002). Secondly, the HE sector is a vital incubator for future leaders as well as for research, innovation and demonstrating a variety of model practices. It plays a key role in instilling and spreading the value and practices of sustainability as it is training future generations who will need to envision, endorse and implement sustainable development (Thompson and Green, 2005). Thirdly, HEIs can potentially influence the rest of society by enhancing outreach, engagement and collaboration (Stephens et al., 2008). However, the barriers to sustainable development in HE are

similar to those in other sectors of society, including a lack of sufficient money for projects, time and commitment (Evangelinos et al., 2009, Pittman, 2004, Velazquez et al., 2005).

Outreach to a university's surrounding communities is also vitally important in the pursuit of sustainability. The UoS is continually working to extend its partnerships and share learning and practice in sustainability with the local community. As an example, it aims to promoting sustainability in the local community by encouraging students in private accommodation to manage their waste responsibly, thereby avoiding nuisance and pollution from waste. It also collaborates with local charities to enable them to gain donations and monetary value from the reuse and recycling of materials from the university.

2.4.2   Waste management at higher educational institutions

The EA and DEFRA have historically recognised that environmental rules should be tailored to the type of entity being regulated. The Household Waste Recycling Act 2003, Landfill Allowance Trading Scheme (England) Regulations 2004, contain examples of regulations specifically focused on LAs. Unfortunately, the HE sector has not had the benefit of focused regulations. This has resulted in confusion, misunderstanding, and misapplication of environmental regulations. For example, under section 75(5)d of the Environmental Protection Act 1990, waste generated by HEIs is classified as household waste. The national Waste Strategy 2007 set a 40% recycling target for household waste by 2010 and 45% by 2015 (DEFRA, 2007b). In practice, waste from many HEIs is collected by private contractors and treated as commercial waste. However, there are no specific recycling targets for commercial waste, therefore waste that should have been recycled is sent to landfill due to ambiguous definitions. Mixed messages and lack of enforcement mechanisms have discouraged HEIs to implement sustainable waste management in their institutions.

HEIs are major consumers of resources, main employers in many towns and cities, and owners of innumerable buildings and large facilities. Through both direct and secondary or multiplier effects, the HE sector generated over £45 billion of output and the total employment created was equivalent to ~2.5% of the workforce in employment (Kelly et al., 2006b). As institutions for research, teaching and policy development, HEIs are often at the forefront of activities relating to sustainability and environmental responsibility. However within HEIs, progress towards sustainable operations has been slow; more than a decade ago, Alabaster & Blair (1997, p.102) pointed out that 'many

HEIs are still struggling to green themselves and to establish a natural culture of environmental responsibility, especially in the current economic climate when expansion innovation and proactive stances are more problematic'.

Table 2.2 Methodologies used to collect UK waste arisings data (adapted from (DEFRA, 2005)).

Waste category	Method of data collection	Coordinating body	Frequency
Municipal	WasteDataFlow	DEFRA	Annually
Commercial & Industrial	Waste production survey	Environment Agency	Triennial
Construction & Demolition	ODPM survey	Department for Communities and Local Government	Biennial
Hazardous	Consignee quarterly returns	Environment Agency	Quarterly
Non-organic Agricultural	No regular data collection		
Non-mineral M&Q	No regular data collection		

The methodologies used to collect waste arisings data in UK are summarised in Table 2.2. Historically, most UK HEIs simply hired a contractor to deal with its waste arisings. However, the commercial drivers for change have become significant as the cost of waste collection and disposal in the UK has increased sharply due to the introduction of and subsequent increases in Landfill Tax. Relevant legislative drivers are shown in Table 2.3.

Many HEIs use waste management activities, especially recycling, as a starting point for sustainability initiatives (Mason et al., 2003, Pike et al., 2003). They can potentially save money for HEIs and recycling projects are often highly visible and generally non-controversial (Barlett and Chase, 2004). Table 2.4 summarises ongoing campus recycling activities in the HE sector across the UK and elsewhere. However, setting up environmental initiatives such as recycling programmes is no easy task. It is widely recognised that the following ingredients are key to successful environmental projects at HEIs (Creighton, 1998, Evangelinos et al., 2009, Kaplowitz et al., 2009, Richardson, 2007):

- Understanding how HEIs work, especially how internal decisions are made;
- Commitment and demonstrated support for environmental actions;
- Sufficient funding;

- A university-wide co-ordination;
- Adequate communication and knowledge;
- Well planned infrastructure; and
- Reliable contractors.

HEIs are often characterised by extensive bureaucracy, lack of integration due to decentralised management, high staffing levels with unclear chain of responsibilities and high turnover of staff and students (Velazquez et al., 2005). Previous studies suggest that strong leadership, the support of senior administrators and the adoption of a clear environmental policy are critical components of successful environmental projects (Richardson, 2007, Velazquez et al., 2005).

Despite the future or long-term benefits, a lack of funding remains a major concern for all involved in sustainability initiatives (Dahle and Neumayer, 2001, Levy and Dilwali, 2000), and it is often difficult to overcome. It is essential that all stakeholders see environmental initiatives as effective and 'making a difference' (Davio, 2001). It is also important that they understand and realise the negative impacts if the initiatives are not implemented (Carpenter and Meehan, 2002).

Leading and co-ordinating waste management initiatives is difficult in large organisations such as universities which often comprise hundreds of departments and divisions with thousands of staff and students. One means of ensuring effective implementation is to appoint an individual who is responsible for co-ordinating the environmental management and performance of the institution. According to a study by People & Planet (2009), 84 out of 126 UK universities have employed at least one full-time and one part-time staff with a clear stated environmental function in the university. The level of responsibility and influence of environmental staff varies from university from university. General areas for day-to-day management include coordinating and leading the delivery of a University's waste management strategy; monitoring and ensuring legal compliance; developing and implementing sustainable procurement policies; writing environmental reports; and liaising with staff, students, other universities, local authorities, contractors and regulators.

Table 2.3 Legislative standards that apply to the UoS' waste management practices.

Legislation	Compliance
Control of Pollution (Amendment) Act 1989	The University has to make sure that its contracts are registered with the Environment Agency and hold a waste management licence.
Environmental Protection Act 1990	The Environmental Protection Act 1990 separates waste regulation from operational work in local authorities and implements more regulations and controls.
Duty of Care Regulations 1991	The University has a Duty of Care to ensure all waste is managed to prevent its escape to the environment. The University uses licensed waste contractors to dispose of the different waste streams. Each movement of waste requires a waste transfer note (unless the contractor is exempt, such as a charity), which must be kept for at least two years.
Oil Storage Regulations 2001	Oils (above 250 litres) stored outside buildings must be in bunded areas or tanks providing 110% of the volume stored.
End-of-life vehicles (ELVs) Directive 2003	The aim of the Directive is to increase the recovery and recycling of old cars by setting laws demanding the use of Authorised Treatment Facilities (ATFs) for their breakdown and reprocessing.
Waste Electrical and Electronic Equipment Regulations (WEEE) 2005	The WEEE regulations seek to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment. The University's responsibilities are to ensure that all WEEE is collected for treatment or recycling, and that the WEEE is delivered into the correct logistical chain to ensure it recycled or disposed of appropriately.
Animal by Products Regulations 2005	Places controls on the storage, transport, treatment, and disposal of animal by-product food and research waste produced by the University.
Environmental Permitting Regulations 2007	The regulations apply to the University regarding the permitting or exemption for storage of waste at University premises.
Hazardous Waste (Amendment) Regulations 2009	The regulations cover the management of harmful wastes and require registration of University premises where more than 500kg is produced. Each movement of hazardous waste requires a consignment note, which must be kept for at least three years.
Batteries Directive 2009	The regulations place requirements on the University for the collection, treatment and recycling of waste batteries and accumulators.
Environmental Damage (Prevention and Remediation) Regulations 2009	Regulations brought into force for England new rules (the Environmental Liability Directive) to force polluters to prevent and repair environmental damage that they have caused - the 'polluter pay' principle.

Table 2.4 Campus recycling activities/programmes across the HE sector.

Resource	Description	Source	Resource type
Waste aware campus (UK)	This programme aims to help staff and students at Scotland's colleges and universities introduce and promote effective waste prevention and recycling services. Information provided includes: case studies, a campus recycling directory and how to guides.	www.wasteawarecampus.org.uk/about.asp (Last accessed Aug 18 2009)	Toolkit
EcoCampus (UK)	EcoCampus is an Environmental Management System (EMS) and award scheme for the higher education sector that encourages and enables universities to take up a structured management system.	www.ecocampus.co.uk (Last accessed Aug 18 2009)	Environmental management system
EAUC (UK)	This programme provides an on-line Waste Management Guide that provides information, new case studies, links to other sources of information and guidance.	www.eaucwasteguide.org.uk (Last accessed Aug 18 2009)	Guide
Green Gown Award (UK)	An annual award that recognises exceptional initiatives taken by universities and colleges across the UK to become more sustainable. The Awards have a variety of categories that universities and colleges can illustrate their achievements in both academic and estates management.	www.eauc.org.uk/green_gown_awards (Last accessed Aug 18 2009)	Award
People and Planet 'Green League' (UK)	The Green League ranks UK universities using key environmental indicators, including waste management, water consumption, carbon emissions.	www.peopleandplanet.org/greenleague (Last accessed Aug 18 2009)	League
College and University Recycling Council (USA)	A network of campus-based recycling professionals who face similar challenges and opportunities in managing college and university programs. It aims to organize and support environmental program leaders at HEIs in managing resources, recycling, and waste issues.	www.nrc-recycle.org/curcmission.aspx (Last accessed Aug 18 2009)	Organisation
Recycling market	A program that encourages graduates to donate their used furniture, electric	www.greenaction.org/features/index.	Programme

(Japan)	appliances and books to be reused by new students. It started in 1999 and has become a national programme across Japanese universities.	shtml (Last accessed Aug 18 2009)	
Moving Towards Zero Waste (UK)	HEFCE funded this project within its Leadership, Governance and Management Fund. The aim of the project was to work with HEIs in different English regions to implement, improve and extend reuse schemes in student halls of residence and on campus.	http://www.lse.ac.uk/collections/environment/OurInitiatives/WasteAndResources/ZeroWasteHefce.htm (Last accessed Nov 2 2009)	Programme
Rhodes University (South Africa)	The study considers the use of paper by academics and student computer laboratories at Rhodes University as a basis for identifying areas to reduce the amounts used and increase rates of recycling.	(Amutenya et al., 2009)	Research

Effective and sufficient communication is another important component for successful waste management at HEIs. The implementation of recycling schemes must be accompanied by sufficient publicity and promotion. Previous research shows that there is a recycling knowledge gap among the segments of the university community on what to recycle, where to recycle and how to recycle (Kaplowitz et al., 2009, Kelly et al., 2006a, McDonald and Oates, 2003). Due to the set-up and the number of people involved in a HEI, key information is often unavailable or dispersed in several departments. To address this, Thomas and Green (2005) suggested using a small and stable group of people in each department who are committed to the initiatives is effective in communication.

Growing and sustaining the participation of a whole university community is central to the success of any campus-recycling program (Kaplowitz et al., 2009). It is thus essential to design and implement strategies that will minimise barriers to recycling and previous studies have suggested that a convenient infrastructure also plays a vital role (Kelly et al., 2006a, Ludwig et al., 1998, McCarty and Shrum, 1994). However, most studies have tended to focus on recycling behaviour (e.g. Amutenya et al. ,(2009); Gunton and Williams (2007)), but development of parallel infrastructure and service provision at HEIs has not been afforded the same priority.

Although this may seem obvious, anecdotal evidence available to the authors emphasises the (disproportionate) importance of hiring a reliable and trustworthy waste management contractor; numerous recycling schemes have failed when contractors decided, often with no warning, to stop or change collections, procedures and charges. A contractor's suitability should be thoroughly assessed based on objective, evidence-based criteria such as: reliability; technical expertise; experience and track record; equipment and facilities owned by the contractor; operational strategies and practices; public health and environmental protection practices.

2.4.3 Case studies

Some projects have been established to help HEIs to manage their waste, for example, Zero-Waste in Student Halls, London's University Halls of Residence Recycling Project, Saving Money by Measuring Waste. However, these projects have limitations, such as short-term, regional studies; lacking of systematic approaches and in certain cases missing monitoring.

2.4.3.1 Case study 1 – University of Bristol

Aim of the scheme

The aim of this project was to demonstrate that by improving the recycling facilities at university accommodation, it can reduce the waste going to landfill.

Scheme description

The Energy and Environmental Management Unit (EEMU) of the University of Bristol tried a pilot in-room recycling scheme to increase recycling rate in Burdock Hall. Each student bedroom was provided with a recycling bin in addition to their waste bin. Promotional activities included speaking at inductions, posters, flyers and notes from the EEMU (University of Bristol, 2004).

Key findings

The amount of material recycled per student in the University of Bristol halls of residence increased by 30% between the academic year 2002 and 2003. The scheme improved recycling on average by 132% compared to the year before with a 350% increase in paper recycling (University of Bristol, 2005). The city council helped to collect from the recycling stations as it helped contribute to their domestic recycling targets. The scheme was also considered as successful in terms of the key elements being no increase in work for the hall staff, promotional activity and the visual impact of recycling bins across the site (University of Bristol, 2004).

Limitations

Although this project demonstrated that recyclable materials can be diverted from landfill by providing recycling facilities to the students, however, very little accurate data was collected from this project. The main limitations were:

- Little baseline data was collected. Baseline data is the first set of data should be collect in order to understand use of resource and discover the amount of waste produced. It also establishes a record where projects start from and recycling potential.

- No systematic monitoring methods were put forward. The only data set available from this project was the weight of material recycled per student from each hall. Comparison of the weights of recycled material per student among the halls revealed vast disparities.

- No evaluation was undertaken for this project. Common evaluation indicators include: students' participation rate, understanding of the schemes and contamination levels. None of them had been carried out for this project, therefore, efficiencies of the scheme was unknown.

- This project was externally supported by Bristol City Council. To some extent, this project is not representative, since this type of support may not be available to other HEIs in the UK.

2.4.3.2 Case study 2 - Recycling in Southwark Project (CRISP)

Aim of the project

The aim of the project was to encourage reuse, recycling and increase awareness of the waste issues in student halls in London (Recycling in Southwark Project (CRISP), 2006).

Project description

This project was running between October 2004 and March 2006 and worked with 21 universities and 185 halls participated. Each hall manager was visited to establish existing and potential external recycling facilities. Once the external recycling facilities were put in place, internal kitchen recycling bins were set up. Two sets of questionnaire surveys were carried out. One was to assess the current waste management practice and the other one was to ascertain student attitude and behaviour towards recycling (Recycling in Southwark Project (CRISP), 2006).

Key findings

The key findings of this project are summarised as follows (Recycling in Southwark Project (CRISP), 2006):

- Recycling infrastructure

Existing recycling facilities were found to be very limited and inconvenient in student halls. Furthermore, those facilitates were underused by students due to lack of publicity, infrequent collection and no contact information.

- Communication, education and awareness

The university hall managers and students were found to have little knowledge of recycling and university recycling campaigns. In addition, communication needed to be emphasised for the cleaners who spoke English as a second language.

- Reuse potential

It was found that huge amount of items which could be diverted form the landfill by reusing them. Many universities intend to explore, however, further research and data are needed.

Limitations

This project was externally funded by the London Recycling Fund, however, often universities are restricted by their budgets and personnel for any recycling

schemes. Therefore, the recycling schemes proposed from this project may not be feasible for most HEIs in the UK. Furthermore, very little operational data can be found from this project. Similar to the Bristol project, no evaluation of the project was undertaken.

2.4.4 Waste management at the University of Southampton

There is a relatively high population density of students in Hampshire in comparison with other parts of the UK according to the Eurostat (2005). In the two largest cities in Hampshire (Southampton and Portsmouth), the university student population contributes 18 and 11% of the total population respectively.

The University of Southampton provides accommodation to 5,000 students, with 20 halls of residence (University of Southampton, 2008). Each flat is generally shared between six to eight students. In the halls, it was the responsibility of the students to take their recyclables to the recycling facilities, although there were no support materials or trainings available to the students to guide them. Limited recycling facilities were available at some of the halls in 2006/07, which included:

- a number of 1100 litre euro bins (1040 x 970 x 1100 mm) for recycling paper and cardboard supplied by an external service provider ('Company A').
- a number of glass bottle banks supplied by Company A or Southampton City Council.

The facilities were typically situated in car parks or open areas and were often located at two or more different places across the halls i.e. often hidden away and inconveniently located. All of these factors led to poor participation in recycling and a poor (estimated) recycling rate. When interviewed on 15 July 2007, the environment manager of the university, Dr Neil Smith explained that under the landfill tax rate £24, the University spends £60 to landfill each ton of general waste produced.

Some recyclables in halls and on campus were stored in 1100 litre euro bins and were collected by private contractors: 'Company A' and 'Company B'. The recycled paper and card bins were emptied at £3 per lift and plastic bottles and cans bins were only collected on campus b for a flat fee of £12 per for per lift.

2.5 Previous research on students recycling

Household waste recycling practices and behaviours have been well studied in the UK. One might expect that these adaptations would apply particularly to university towns and cities where the population is periodically boosted by a significant influx of

young people, however little research has been done on students' recycling behaviour especially in student HoR. University students generate substantial amounts of waste throughout term-time and particularly during end-of-term periods when they move out. As with other types of high-density housing, HoR often struggle to achieve high recycling rates (WRAP, 2009). Timlett and Williams (2009) shows that of the 59 'high density' local authorities (≥28 persons per hectare), only 5 perform above the national average.

On the other hand, the buying power of young adults, especially university students, has increased dramatically in recent years (Mangleburg et al., 1997, Soyeon, 1996). This is important in terms of sustainable waste management for a number of reasons. Young people have different lifestyles compared to the general public. They generally have less familiarity and experience with purchasing products compared to older consumers (Mangleburg et al., 1997) and have little experience of taking responsibility for domestic waste management activities, especially recycling (Gunton and Williams, 2007). As the unit prices of new clothing have declined substantially, 'fast fashion' provides the marketplace with affordable clothing aimed mostly at young people. Therefore, at the end of each academic year's moving-out period, a large quantity of clothes are thrown away by students as items which are no longer required or cannot be transported or stored.

Over the last 40 years, a relatively small number of studies have examined university students' recycling behaviour (Allen et al., 1993, Amutenya et al., 2009, Boyce and Geller, 2001, Couch et al., 1978-1979 , Geller et al., 1975, Goldenhar and Connell, 1993, Gunton and Williams, 2007, Katzev and Mishima, 1992, Kelly et al., 2006a, Ludwig et al., 1998, Luyben and Cummings, 1981-1982, Luyben et al., 1979-1980, Mason et al., 2003, Mason et al., 2004, McCaul and Kopp, 1982, Pike et al., 2003, Witmer and Geller, 1976). Many of the studies are from North America and focus on short-term manipulations of specific conditions whose effects were measured to prompt recycling behaviour. A few studies reported the effectiveness of monetary incentives in increasing recycling behaviours (Geller et al., 1975, Luyben and Cummings, 1981-1982); flyers-only appeared to be the least effective intervention technique (Witmer and Geller, 1976). Nevertheless, removal of the reward resulted in a return to baseline results (Couch et al., 1978-1979).

Austin et al. (1993) demonstrated the effects of informative prompts on a university campus by placing signs over the bins. The results showed that prompts were effective only if they:

- Made a specific request or appeal;

- Were in close proximity to the area in which the individuals were expected to respond, and

- Requested responses that are convenient to those who must respond.

These results supported those of Katzev and Mishima (1992), who reported the positive effects of feedback effects on paper recycling on a North American college campus. During the two-week intervention period, feedback increased paper recycling 76.7% above the baseline level. Kim et al. (2005) also reported that publicly posted written feedback can increase recycling on recycling at a South Korean university, respectively. McCaul and Kopp (1982) found that goal-setting enhanced recycling of aluminium cans by students, while written commitment had little effect in increasing recycling. Wang and Katzev (1990) evaluated the relative effectiveness of group commitment, individual commitment, and tokens on paper recycling in a student HoR. It showed that the students recycled 3-5 times more paper than those in the baseline group during the intervention. However, when the treatments were removed, only the individually committed subjects continued to recycle significantly more paper than the controls.

2.6 Factors that influence students' recycling behaviour

There has been extensive research into recycling behaviour but there is still a lack of understanding about how factors can influence recycling behaviour which might lead to improvements in recycling performance. Many previous studies have concentrated on the public in general rather than focusing on specific social groupings, particularly transient population groups such as university students (Amutenya et al., 2009, Robertson and Walkington, 2009, Williams and Gunton, 2007a).

2.6.1 Theory of Planned Behaviour model

There are many different social-psychological models that seek to explain recycling behaviour. Behavioural models can provide the means to identify the driving forces behind recycling behaviour and in a given area determine the main likely success factors. Darnton (2008) provided a comprehensive review of models of behaviour and theories of change. Each behavioural change theory or model focuses on different factors in attempting to explain changes of recycling behaviour. A summary of models that have been used to determine recycling behaviour can be found in Table 2.5.

The TPB model (see Figure 2.2), developed from the Theory of Reasoned Action (TRA) model (Fishbein and Ajzen, 1975), provided a theoretical framework to predict behaviour via social psychology and has been used recently to understand recycling behaviour. It hypothesises that behaviour can be best predicted from one's intention, and intention is a function of three determinants, attitude towards behaviour, subjective norm and perceived behaviour control.
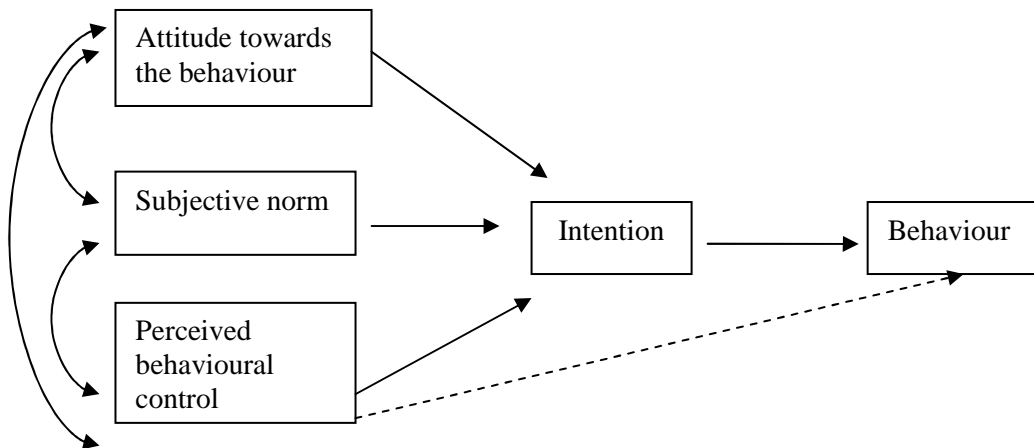
Figure 2.2 Schematic diagram of the Theory of planned behaviour.

The TPB model has been applied to a wide range of behaviour domains including consuming behaviour (Smith et al., 2007), vitamin intake (Pawlak et al., 2007), healthy eating (Åstrøm and Rise, 2001), drinking and alcohol consumption (Collins and Carey, 2007, Huchting et al., 2008) and driving behaviour (Warner and Aberg, 2006). Some studies have used it to explain students' recycling behaviour: Cheung et al. (1999) examined paper recycling behaviour among college students in Hong Kong and found that the TPB model significantly predicted intention and self-reported recycling behaviour and explained 28% of the variance. General environmental knowledge and past behaviour were also found to be significant in predicting behaviour and explained 34% of the variance altogether with the TPB model. McCarty and Shrum (1994) investigated the linkage between values and attitudes and attitudes and behaviour in a study that focused on university students. It was found that immediate concern about convenience had strong relationships with attitude and behaviour but values were not directly related to self-reported recycling behaviour.

Table 2.5 Models that have been used to determine recycling behaviour.

Model	Description	Applications
Theory of Planned Behaviour (TPB)	Behaviour is considered to be a direct function of behavioural intention. Intention is formed by attitude, subjective norm and perceived behavioural control. Additional factors were often added in the model.	TPB is the most commonly used model to predict recycling behaviour in the recent research trend such as (Taylor and Todd, 1995).
Socio-psychological models	These models are specifically designed to generalise behaviours and predict aggregate outcomes. Thus often they do not identify the wide variability in the behaviour of different individuals, but rather describe the average behaviour of all individuals.	Clearly no individual, organisation or society actually behaves in precisely the way a theory or model describes, as they will be influenced by various different factors, impacting in different combinations, and to different extents.
Altruism model	According to the altruism model, behaviour is influenced by social norms, personal norms, and awareness of consequences. (Schwartz, 1977).	Hopper and Nielsen (1991) examined Schwartz's model within the context of recycling behavior. They found that consistent with Schwartz's altruism model, recycling behaviour is influenced by social norms, personal norms, and awareness
Non-psychological factors models	Some research compared the differences between recyclers and non-recyclers. Simplifying such profiles into simple conceptual models can clarify understanding.	Many of the factors were investigated, such as knowledge, motives, and demographic characteristics (Vining and Ebreo, 1990), income (Saltzman et al., 1993), gender and education.
William and Gunton model (2007b)	This model was used to explain university students' environmental behaviour.	The factors that could influence students' recycling and environmental behaviours include: Perception of ability to make a difference; situational barriers; attitudinal disposition; levels of awareness; concern for the environment and parental influence and habitual behaviour.

It is possible that the TPB model does not adequately explain recycling behaviour, especially amongst young adults with little experience of daily waste management operations. Although there is substantial evidence that supports the TPB's ability to predict recycling intention and behaviour, a large proportion of the variance remains unexplained. As a consequence, additional factors have been included in some previous studies. In theory, the TPB model is open to inclusion of additional variables as long as there is a strong theoretical justification for their inclusion and the variables can explain a significant portion of unique variance in the behaviour (Ajzen, 1991). The TPB forms the conceptual framework of this part of the study:

- Intention

A central proposition of TPB is that behavioural action is a direct, positive function of behavioural intention.

- Environmental attitudes

Environmental attitudes often play an important role in pro-environmental behaviour, many studies in the literature have found that the effect of attitude towards environmental behaviour is positively related to environmental behaviour (Barr et al., 2003, Kollmuss and Agyeman, 2002, Scott, 2002). The attitude-action gap is known as the discrepancy between an individual's verbal and actual commitment towards environmental issues (Pickett-Baker and Ozaki, 2008); this can be a big challenge for university recycling programmes (Chung and Leung, 2007, Gunton and Williams, 2007).

- Subjective norm

Subjective norm is regarded as an individual's perception of the moral correctness or incorrectness of performing behaviour (Ajzen, 1991). People are often motivated to recycle by actual pressure they receive from family and friends to do so (Ajzen, 1991). Jennings (2004) carried out a study of recycling behaviour and attitudes on first year university students in North America and found that students who believed that the norm was for their peers to recycle reported a greater recycling procedural knowledge (what, where and how to recycle) and they conformed to this norm. However, this norm is often not internalised since they have no desire to improve their recycling habits.

- Perceived behavioural control (PBC)

PBC (Ajzen and Madden, 1986) is defined as 'a person's estimate of how easy or difficult it will be for him or her to carry out the behaviour'. The most important determinant of recycling behaviour is access to a structured and institutionalised program that makes recycling easy and convenient (Derksen and Gartrell, 1993).

Regardless of other factors, if it is not reasonably convenient to engage in environmentally sound actions, then people are less likely to do it. In the Knussen et al. (2004) study, they found that a lack of facilities influences the relationship between perceived behavioural control and recycling intention. Jennings (2004) reported similar results in a study which was carried out in a North America university. Students who felt that recycling centres are easily available to students reported higher levels of recycling.

- Moral obligation

Conner and Armitage (1998) found that in 9 out of 10 studies, moral norm was a significant predictor of intentions. Beck and Azjen (1991) argued that moral obligations should have important influence on the performance of behaviours with a moral or ethical dimension, such as drug use (McMillan and Conner, 2003).

2.6.2 The ISB (Infrastructure, Service provision and Behaviour change) model

Previous recycling studies have tended to be piecemeal in nature; they tend to explore the impact(s) of one or a few isolated variables without providing a larger theoretical framework for doing so (Lindsay and Strathman, 1997). Most university waste management studies have tended to focus on behaviour (e.g. Allen et al., (1993); Amutenya et al., (2009); Gunton and Williams, (2007)) and development of parallel infrastructure and service provision has not been afforded the same priority. There is an absence of a wider approach/methodology from previous studies. Few studies have systematically investigated the type of infrastructure and service provision required at HEIs, especially at student HoR. An integrated framework which pinpoints the complex interplay of different factor is clear needed.

Our group at the University of Southampton has argued that a behaviour-centric approach to encouraging the public to recycle has limited effectiveness (see e.g. Timlett and Williams, 2011). We believe that three significant clusters can facilitate pro-environmental practices: infrastructure, service and behaviour (ISB). Figure 2.3 illustrates the complex interplay of these three clusters when designing new recycling schemes. There has been a tendency to primarily use the behavioural cluster such as the TPB model to drive pro-environmental practices such as public participation in recycling schemes. However, behaviour change models are consequential (or linear), with values and beliefs as underlying foundations for action. In reality, individuals do not make choices about behaviour in isolation; they are constrained by the environment in which they act, especially in medium and high density accommodation such as student HoR.
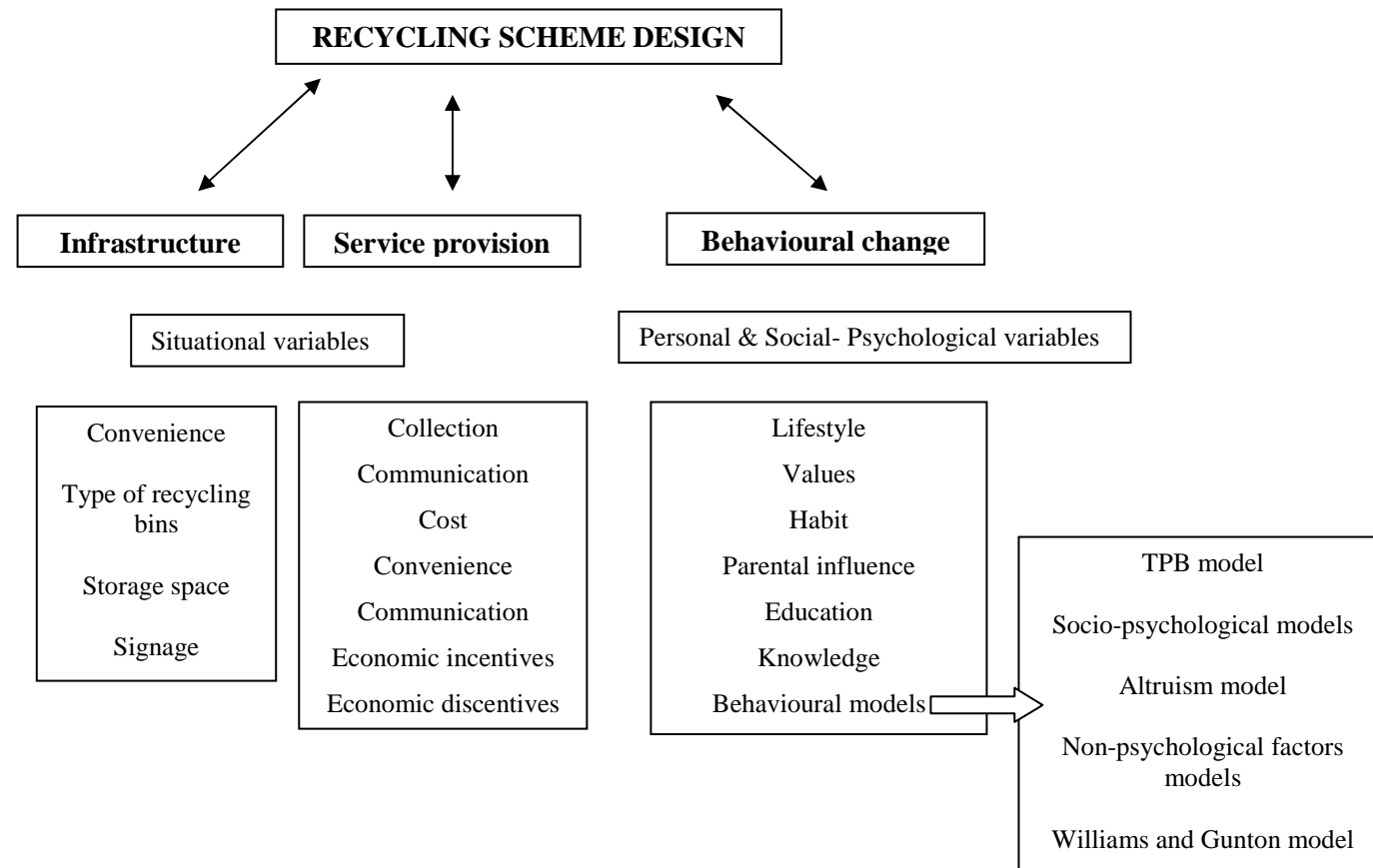
Figure 2.3 Conceptual map of factors that influence recycling scheme design

A successful recycling programme requires: firstly, a convenient and well-signposted infrastructure. Convenience here consists of two means: the distance to the collection spot where recyclables are carried to and the time spent on recycling. The literature has regularly compared the influence of distance and time of house to collection point. Ludwig et al. (1998) found that moving recycling bins from hallways to classrooms increased recycling, because classrooms were more proximal to consumption. Reducing the necessary effort is a common strategy to promote recycling. Luyben et al. (1979-1980) found that beverage can recycling among college student increased after additional bins were added in student halls. Werner et al. (2002) used field experiments at a North American university and found that increasing convenience was an effective way to increase recycling.

Witmer and Geller (1976) found that convenience is an important factor determining the participation and students whose rooms were closest to the collection centre showed the greatest participation. McCarty and Shrum (1994) found that the more individuals believed recycling was inconvenient, the less likely they were to recycle and convenience outweighed attitude towards importance of recycling. Furthermore, Pike et al. (2003) investigated the recycling behaviour of North American university students and the results indicated the willingness of students to recycle when given the recycling bins. Additional education on importance of recycling was found not necessary.

Clear, informative and persuasive signage can be very effective at increasing recycling. Williams and Taylor (2004) discovered that improved signage and provision of information at a civic amenity site were enabling the public to use the site more efficiently, yielding a higher recycling rate.

An efficient service provision is the second element of a successful recycling programme. A prompt service provision includes: reliable, timely and sometimes flexible collections; appropriate labelling; provision of recycling bins and information. A vital part of a recycling scheme is a reliable recycling contractor who provides and collects the bins and arranges customers for segregated and/or co-mingled recyclates. It is essential that HEIs' work alongside their contractors to provide support and monitor their contractors comply with recycling standards. Although this has been widely recognised, many HEIs still lack mechanisms to monitor services provided by their waste contractors (Zhang et al., 2008b), and this may result in the underperformance of contractors. Yet, there is an obvious desire amongst HEIs to improve their performance, with many now employing professional environmental managers to oversee operations.

Poor service delivery can cause concerns about hygiene, frustration and a negative atmosphere towards recycling schemes for staff and students. Such concerns can take weeks, months or even years to be resolved. HEIs need to be more proactive in preventing these circumstances from happening.

One of the most important constraints in waste management at HEIs is cost (Dahle and Neumayer, 2001, Evangelinos et al., 2009) and it is common practice is that cost outweighs other factors during a tendering process of a waste contractor. However, the evaluation of service quality should be carried out regularly and using a suitable set of agreed transparent and easily auditable Performance Indicators (PIs). In general, the development of a proper set of PIs is a fundamental prerequisite to monitor process performances including service delivery outcomes, quality and fair access (Franceschini et al., 2009).

The last element of the ISB model focuses on factors that influence students' recycling behaviour. Many of those factors have been studies and used to form different behavioural change models.

2.6.3   Knowledge

Apart from the predictors of the TPB behavioural models, other factors may influence recycling behaviour. Vining and Ebreo (1990) argued that the greatest difference between recyclers and non-recyclers is their knowledge of collectable materials. Much existing literature supports the assumption that increases in environmental knowledge will lead to changes in behaviour that favour sustainability. Knowledge about a recycling program was often found to correlate with recycling rate (Schultz et al., 1995). Environmental knowledge often includes environmental system knowledge, procedural knowledge and environmental effectiveness knowledge (Frick et al., 2004, Schultz, 2002). Lack of knowledge often means people lack of knowledge of what, how and where and why to recycle. Environmental system knowledge usually relates to the question of how ecosystems operate (Schahn and Holzer, 1990) so it is often defined as 'knowing what'. Vining et al. (1992) found that concern for the preservation of natural resources is the one of the main reason for people to engage in conservation actions. Procedural knowledge is action-related knowledge and is often defined as 'knowing how'. Evidence shows that the more information a person has about which materials are recyclable, or where recyclables are collected, the more likely that person is to recycle (Austin et al., 1993, Barr et al., 2001, De Young et al., 1995, McDonald and Oates, 2003, Schultz et al., 1995, Vining and Ebreo, 1990).

The importance of providing information on how to recycle, why to recycle and explaining where to recycle has been studied by Austin et al. (1993) and Brothers et al. (1994). At the UoS, >50% of students did not know how or where to recycle in their HoR according to the Accommodation Exit Survey 2007 (before the new schemes started). Kaplowitz et al. (2009) used a campus-wide survey at a large North American university to examine knowledge gaps as well as effective communication options as part of an effort to inform the design and implementation of a new recycling initiative. The results showed that the university community was somewhat aware of the environmental benefits of recycling but lacking knowledge of the recycling schemes. The findings suggested that those responsible for the implementation of the recycling program needed to have communication strategies that did more than just explained reasons why one should recycle. Ester and Winett (1981-1982) reviewed 41 environmental programs and argued that dissemination can lead to a high level of participation when they are delivered creatively and intrusively. Austin et al. (1993) pointed out that an individual who recycles understands the importance of recycling better than non-recyclers. Previous research findings suggest that formal education on environmental issues and participation in environmental activities fosters ecological knowledge, attitudes, and behaviours in children (Leeming, 1993).

2.6.4 Education

Education is often considered as the key to changing behaviour (Hsu, 2004, Legault and Pelletier, 2000, Schultz, 2002). It often aims to increase participation in the recycling schemes and to reduce inclusion of non-targeted materials. It fuels the three great engines of environmental knowledge:

- the environmental awareness which could potentially motivate the will for action;
- the environmental understanding that enables the formulation of action plans; and
- the environmental skill that supplies the means of achievement (Chapman and Sharma, 2001).

Many studies have shown that school environmental programmes can also impact upon the environmental knowledge, attitudes and behaviour of adults (parents, teachers and local community members) through the process of intergenerational influence (Ballantyne et al., 2001, Duvall and Zint, 2007, Evans et al., 1996, Grodzinska-Jurczak et al., 2003). However, memory has to be reinforced on a regular basis for new habits to persist (Rethink Rubbish, 2004). Therefore, university-level

education is increasingly considered as a critical component of sustainable approaches to development (Brody and Ryu, 2006).

2.6.5 Past behaviour

Ouellette and Wood (1998) suggested that past behaviour may impact future behaviour through two different paths. For behaviours that are performed in relatively stable contexts, the frequency of past behaviour reflects habit strength and has a direct effect on future performance. For behaviours that are performed in less stable contexts, the role of past behaviour is more likely to be mediated by conscious and reasoned decision making processes. Chawla (1998) also identified childhood experiences in nature as a major factor.

2.6.6 Habit

Participation in new recycling schemes involves developing new habits. A habitual action is one that is performed routinely, with the individual committing little conscious thought to the action. Past research has suggested that behaviour may be a function of both reasoned influences (e.g., attitudes) and unreasoned influences (e.g., habits) (Aarts et al., 1998, Cheung et al., 1999, Knussen and Yule, 2008, Knussen et al., 2004, Tonglet et al., 2004b). Gregory and Leo (2003) suggested that habits are not necessarily affected by beliefs about the outcomes of behaviour and actually may work outside traditional attitudinal models. Timlett and Williams (2009) highlighted that once a recycling habit is established, it is difficult to break. Many youth's behaviour is shaped and influenced by their parents (Abeliotis et al., 2010, Arnold et al., 2009, Bonnett and Williams, 1998). Littledyke (2004) reported that students claimed that the knowledge and experience they had on environmental issues had been mainly acquired through their parents. Parents often influence their children's recycling behaviour and once the habit is built they are more likely to recycle in their future life.

Chapter 3

3 Methodological approach

This chapter describes the overview of the methodological approach and sets out the mixed methods used in this study. Comprehensiveness was the main driver for using mixed methods in the current research and this approach offered the opportunity to address a wider range of questions than a single method alone would allow. The methods are combined in a range of contexts and were used in a wide range of roles. Their use was driven by pragmatism, motivated by the perceived deficit of quantitative methods alone to address the complexity of research in the topic, as well as other more strategic gains. This chapter only outlines the structure of the overall approach and the details of individual method are explained in chapter 4 to 7.

In the first part of the study, a nationwide university questionnaire survey provided background and context to the waste management issues at UK HEIs. It is a useful introduction to the rationale behind sustainable waste management. The aim was to gather data and establish a baseline for HEIs before moving onto a more in depth series of studies using the UoS as a study location. The latter parts of the 'Greening Academia' series was based on an experiment carried out at the UoS. It is known as an empirical approach that gaining knowledge through experience. Empirical evidence refers to data being collected through direct experiment and results are reported in detail so that other investigators can repeat and attempt to verify the work. Similar methods have been used by a number of researchers for the evaluation of waste management scheme at HEIs, such as Austin et al. (1993), Allen et al. (1993) and Katzev and Mishima (1992).

The first chapter of the series presented the case study of transformation of waste management at the UoS and explored the strategies and progress the University made over the last 15 years. The second chapter described how various reuse and recycling infrastructure were developed and tailored service provision were implemented at the University HoR where three halls were selected and another hall was used as a control. The schemes were tested and evaluated using waste audits and questionnaire surveys. The schemes were also supplemented by education messages

provided by posters, signage and traffic card feedback system. The schemes were enhanced and optimised by using different communication techniques such as staff and student training, assistant website and newspaper coverage. At the final stage of the 'Green Academia' study, students' recycling behaviour was examined using the Theory of Planned Behaviour (TPB) model. The model has been applied to studies to make a link among beliefs, attitudes, behavioral intentions and behaviors in various fields. In addition, an online survey was carried out to investigate factors that shaped students' recycling behaviour and also compared students' actual waste knowledge with their reported knowledge. This study set out a framework that can be used to design green projects and investigate how different factors could have direct and influential consequences for scheme design. At the core of this framework of scheme design is the so-called 'ISB model' which explains that a successful recycling scheme needs three factors – convenient infrastructure, tailored service provision and behaviour change techniques where infrastructure and service provision should always be prioritised before behavioural change techniques take place. The research also took the opportunity to investigate any encountered problems during the study; discussed and summarised them in each individual chapter.

Chapter 4

4 Waste management in UK higher education institutions

4.1 Introduction

Waste management has been well studied in residential areas in the UK (e.g. (Barr et al., 2003)), but research on waste streams from HEIs lags behind. Although there are 168 HEIs with ~2.5 million students in the UK (Higher Education Statistics Agency (HESA), 2005), there is little quantitative information on how much and what type of waste the HE sector generates every year and how much of this material is re-used, recycled or recovered. The aims of this study were to:

- Identify, quantify, summarise and evaluate the waste collection, recycling and disposal approaches in UK HEIs;
- Examine the potential for improving waste management systems in HEIs.

4.2 Methods

The study was carried out between January and May 2008. Data was collected through a self-completion questionnaire. The survey targeted 143 HEIs (from a total of 167) and 113 (from a total of 491) Further Education Establishments (FEIs) in the UK. It served both to obtain specific information concerning waste management as well as individual judgments regarding past experience. It consisted of three parts (see Figure 4.1):

- Part A was about the respondents' and their institutions;
- Part B was about waste management on campus;
- Part C was about waste management at student halls of residence.

Parts B and Part C were divided into three sub categories, namely waste collection, re-use, recycling, recovery and disposal, where part C only applied to institutions with halls of residence. The questionnaire was piloted at beginning of April 2008.

One hundred and twenty-three HEIs were contacted via the Environmental Association for Universities and Colleges' (EAUC) e-mail mailing list, and another 20

HEIs were contacted individually by e-mails. The EAUC was launched in 1996 with the aims of raising the profile of environmental management and facilitating improvements to environmental performance in member institutions. The subscribers to the mailing list are people who deal with environmental or operational activities on daily basis, such as environment managers, waste managers and heads of Estate and Facilities of their institutions. Figure 4.2 shows the coverage and different stages of the survey.
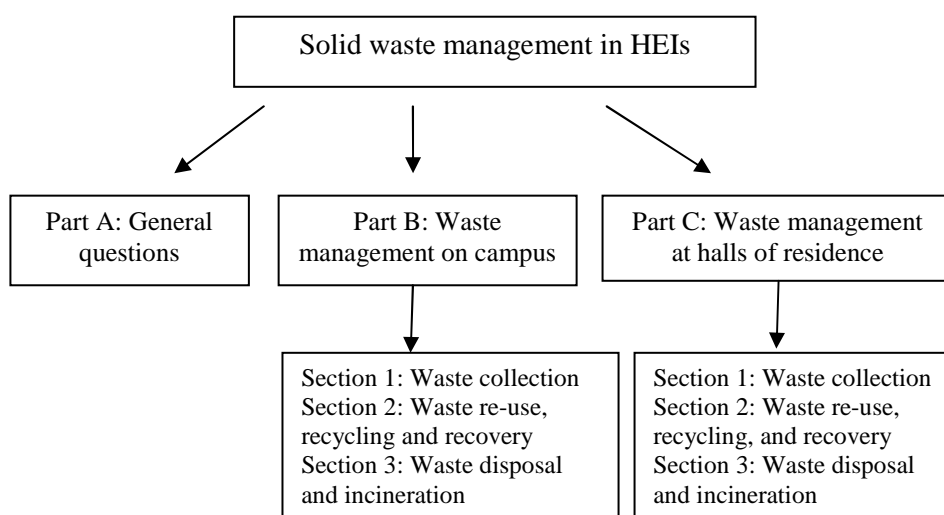

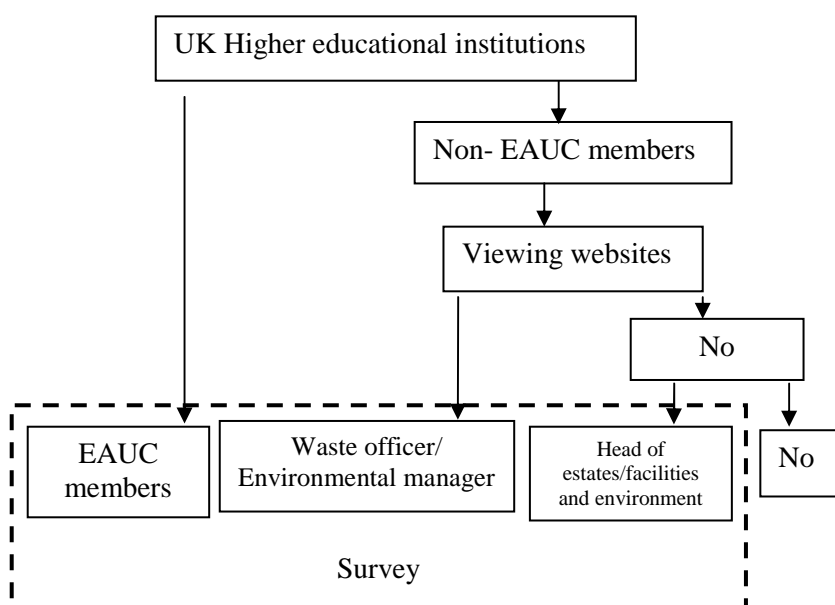**Figure 4.1** Schematic diagram summarizing the approach to the waste management survey.

Figure 4.2 HEIs and FEIs contacted as part of the waste management survey.

4.3   Results and analysis

A total of 33 questionnaires were returned, consisting of 26 HEIs (79% of all returned questionnaires) and 7 FEIs (21% of all returned questionnaires), giving an overall response rate of ~13%. Of the 33 returns, 85% of HEIs and 43% of FEIs reported employing a sustainability officer or an environment manager in their institution, and 58% of HEIs and 86% of FEIs reported completing a waste audit on their own waste during the last 5 years.

4.3.1   Waste management on campus

Figure 4.3 shows the types of organisations used to provide waste collection on campus. It seems that in the HE sector, collection services on campus are dominated by private contractors (n=31). The employment of private contractors for collection was reported as: hazardous waste (94%); WEEE (93%); construction and demolition (87%); dry recyclables (73%), bulky wastes (72%); general waste (68%); green waste (42%); and textiles (33%).

Figure 4.4 & 4.5 show that the majority of institutions had some form of re-use or recycling schemes on campus in 2006/07; 88% offered recycling on campus, 57% offered a re-use scheme, 33% offered a composting scheme but none had trialed an anaerobic digestion scheme. Fourteen institutions (58%) employed two types of schemes and 5 (21%) had 3 types of schemes. Of all the institutions with schemes, less than 50% of the institutions collected any data; in fact, only schemes 23% and 25% collected data on their re-use and composting schemes, respectively. However, Figure 3.5 highlights that institutions appear determined to divert their waste from landfill by continuing or implementing some form of alternative scheme on campus in the coming 5 years. The main drivers for HEIs and FEIs to implement schemes on campus were reported as: concern about the environment (100%); economic benefits (87%); social responsibility (87%); pressure from students (65%); pressure from staff (56%); educational purposes (48%); peer pressure from other university/college (17%).
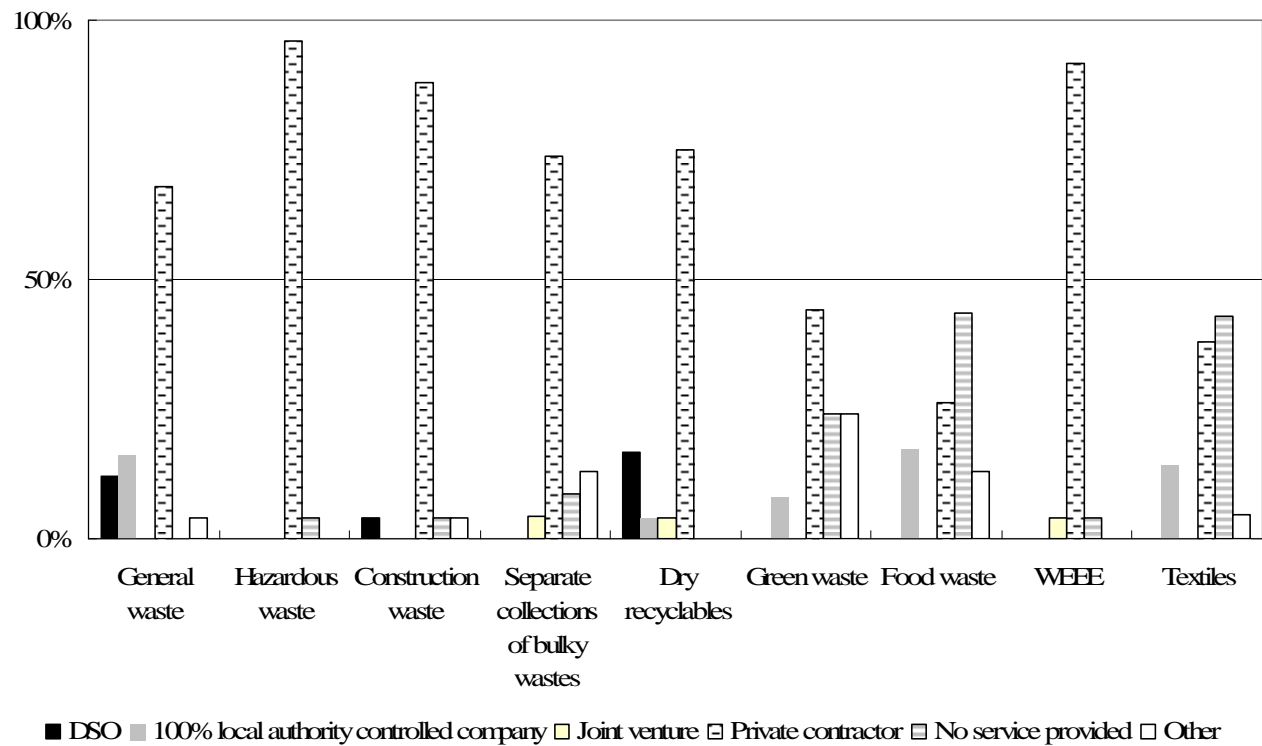
Figure 4.3 Types of organisations used to provide waste collection on campus in 2006/07.
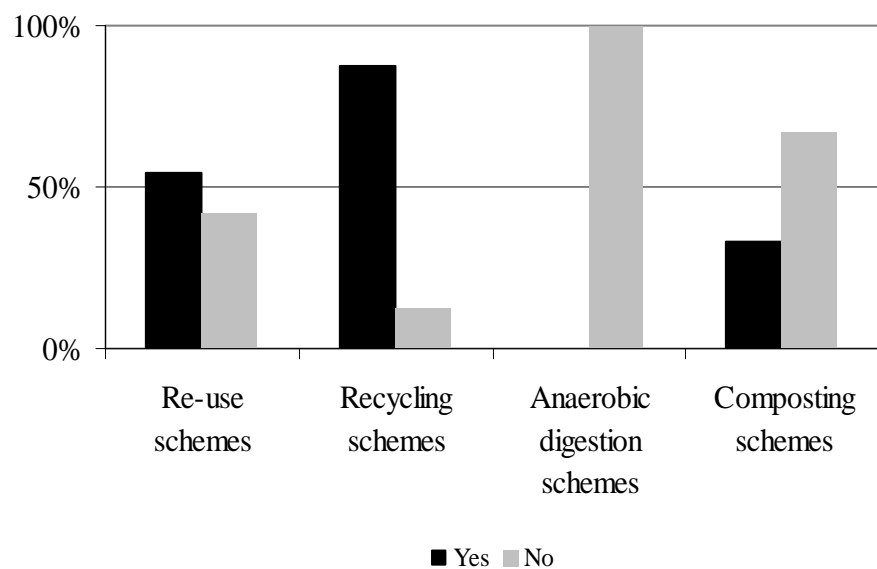
Figure 4.4 Institutions with re-use, recycling or recovery schemes on campus in 2006/07 (Left).
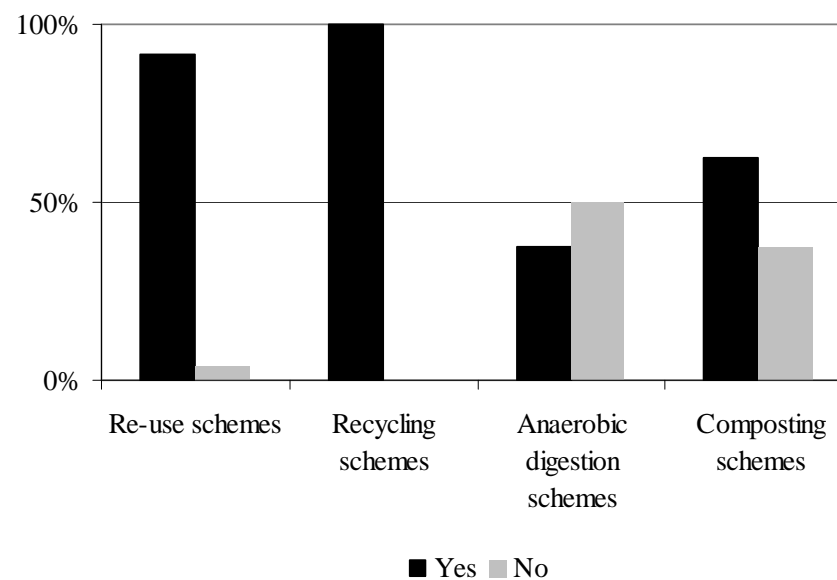**Figure 4.5** Institutions planning to carry out or continue re-use, recycling or recovery schemes on campus (Right)

Table 4.1 shows that three-quarters of the institutions with re-use and composting schemes in 2006/2007 did not collect data on their schemes. Among the three types of schemes, recycling schemes had the highest data collection rate (50%). The total cost of schemes and tonnage of material collected may be affected by the size of the institutions, number of staff and students. The cost to the institutions to recycle every tonne of their waste varied from £16-89 with an average cost of £57. Few institutions provided both cost and tonnage of their re-use and composting schemes, thus no mean of unit cost was calculated.

Table 4.1 Summary of re-use, recycling and composting schemes at HEI campuses (2006/2007).

	Re-use scheme (n=13)	Recycling scheme (n=21)	Composting scheme (n=8)
No data collected	10 (77%)	10 (48%)	6 (75%)
Collected data	3 (23%)	11 (52%)	2 (25%)
Number of staff		300 - 11500	
Number of students		5300 - 169000	
Cost of schemes (£)	100 - 1800	400 – 29000	Nil - 40000
Material collected (tonnes)	0.5 - 70	17 – 7200	160
Unit cost (£/ton)	200 - 3600	16 – 89	250
Mean of unit cost (£/ton)	-	57	-

Astonishingly, approximately half of the HEIs did not know how much they were paying for waste management. Those with data reported the total cost of disposal via landfill in the range £18,000-360,000 and the cost of landfill per ton of waste as £67-289. 12 out of 27 institutions used incineration as a method to treat their waste but the mean unit cost was not calculated due to lack of data (see Table 4.2).

Table 4.2 Summary of waste disposal via landfill and incineration at HEI campuses (2006/07).

	Landfill (n=15)	Incineration (n=12)
No data collected	8 (53%)	6 (50%)
Collected data	7 (47%)	6 (50%)
Total amount (tonnes)	270 - 1600	Nil - 16
Total cost		
Unit cost (£/ton)	67 - 289	Nil - 400
Mean unit cost (£/ton)	169	-

4.3.2 Waste management at halls of residence

Halls of residence accommodate a great number of students across the country and are often used for conferences or holiday accommodation during holiday periods as well. Table 4.3 shows that very few institutions were able to provide data on waste collection and costs associated with their halls of residence. One institution reported having difficulties in splitting figures between campuses and halls. The unit cost of landfill is at the similar range comparing to the campuses. As with campuses, private contractors are typically used for waste collection at halls of residence (see Figure 4.6). The employment of private contractors for collection was reported as: WEEE (75%); bulky wastes (75%); construction and demolition (58%); hazardous waste (55%); general waste (46%); dry recyclables (33%); green waste (17%); food waste (17%). At majority of halls, separate food waste or textile collections were not available.
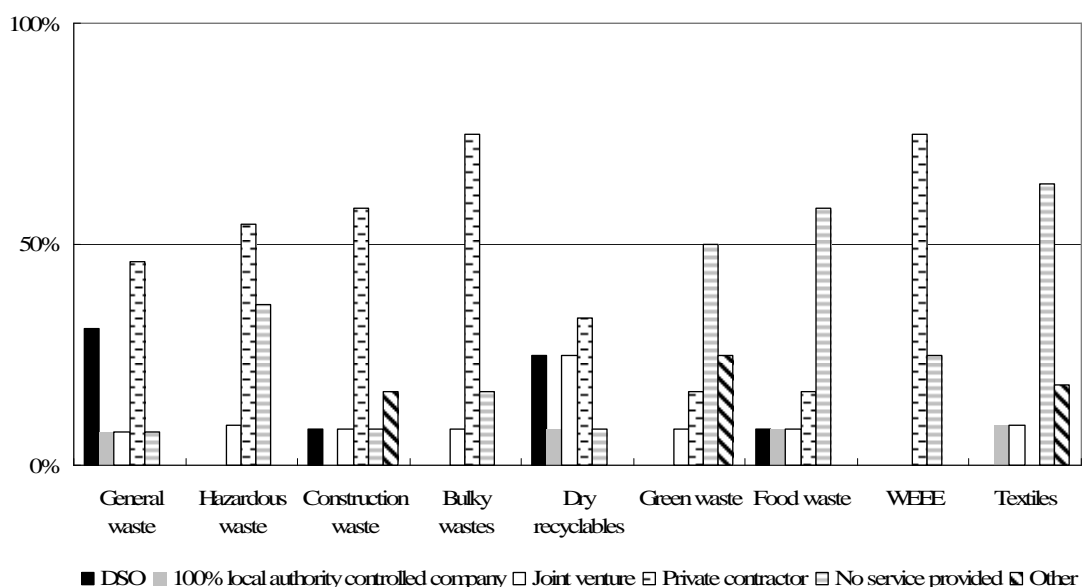

Figure 4.6 Type of organisation used to provide waste collection at halls in 2006/07.

Table 4.3 Summary of waste disposal via landfill and incineration at HEI halls (2006/07).

	Landfill (n=10)	Incineration (n=9)
Data collection		
No data	8(80%)	8 (87%)
Collected data	2 (20%)	1 (13%)
Total amount	350	
Total cost	25000	Nil
Unit cost (£/ton)	71	-

Table 4.4 shows that private contractors slightly outperformed other types of service providers in terms of satisfaction with the service provided.

Table 4.4 Service satisfaction provided by private contractors compared to other providers.

Contractor Performance / Service area	Private contractors				All other service providers			
	Excellent & Good	Fair	Poor	Don't know	Excellent & Good	Fair	Poor	Don't know
General waste	33%	67%	0%	0%	43 %	29%	29%	0%
Hazardous waste	50%	17%	17%	17%	20%	40%	0%	40%
Construction waste	43%	29%	0%	29%	20%	40%	0%	40%
Bulky wastes	0%	33%	22%	44%	33%	67%	0%	0%
Dry recyclables	50%	25%	25%	0%	29%	29%	43%	0%
WEEE	33%	56%	0%	11%	0%	50%	0%	50%

Key points to highlight are that satisfaction with collection services for dry recyclables and bulky wastes was relatively low and many HEIs admitted that they had no idea about the quality of service they received from their contractor(s). Note that the data need to be treated with some degree of caution, due to the low response rate. The most commonly stated reasons for HEIs to implement re-use, recycling or recovery schemes at halls were: concerns about the environment (100%); economic benefits (100%); social responsibility (89%); pressure from students (67%); pressure from staff (33%).

4.4 Discussion

The relatively low response rate to the survey is probably due to a complete absence of data or a lack of confidence in the existing data on waste arisings within HEIs. This is surprising given the increasing costs of waste management in recent years, and may indicate that there is a significant opportunity for cost savings for HEIs in this

area, especially as most are using private contractors for waste collection. As waste from HEIs is legally household waste, a mutually beneficial agreement with their local authority that dry recyclables can be collected at low cost and subsequently contribute to the achievement of local targets seems like a sensible option. However, it is clear that there is a lack of accurate and reliable data on waste arisings from UK HEIs, which can only be due to private contractors not collecting this information or HEIs not requesting it. As all LAs have a mandatory recycling target to accomplish on their household waste, they are obliged to collect reliable and accurate data. Waste contracts for UK business generally fall into the following four categories (WRAP, 2007):

- Pay by lifts (organisations are charged a fee when their bin(s) is emptied);
- Pay by weight (organisations are charged according to the weight of waste collected);
- Pay by containers (an uncommon contract; organisations are charged an annual flat fee based on provision of bins); and
- Reduced fee for general waste reduction (uncommon; often negotiated by big organisations who can sign a contract nationally e.g. a big chain supermarkets).

Generally there are two types of waste data used to quantify waste arisings: volume and weight. Weight data has palpable advantages, as it is more accurate and consistent than volume-based data. However, except for Pay-By-Weight contracts, weight data is often not provided by contractors and so volume/weight estimations are usually used. Conversion factors (otherwise known as densities) of waste streams have no universal standard in the UK. The discrepancy among different sources is often the cause of data divergence; the conversion factors from DEFRA for household waste are 1.6 times higher then WRAP's (see Table 4.5). Volume-based costing is often inaccurate. Different descriptions used to categorize dry recyclables probably lead to conversion factors being collectively higher then the true values; this may result in HEIs being overcharged. In addition, without accurate data it is impossible to either accurately benchmark performance or identify best practice. Gathering accurate data is fundamental to any intervention strategy for tackling poor performance. Clearly there is a need for HEIs to use more robust data collection methods such as the Pay-By-Weight system.

Waste composition data is also essential as it provides crucial information for designing and evaluating collection systems, including monitoring material quality for recycling schemes. DEFRA's waste composition analysis report – guidance for local

authorities (DEFRA, 2004) - summarized the main benefits of conducting a waste composition study:

- Monitoring and improving existing recycling schemes
- Developing and implementing new recycling or composting schemes
- Developing a waste strategy
- Benchmarking against other areas
- Examining waste arising data
- Research and waste databases
- Public education.

Table 4.5 Summary of volume/weight conversion factors of loose un-baled material.

Waste streams	DETR (2000)	DEFRA, cited by EAUC (2009)	EA (2002), SEPA (2004)	WRAP (2006)	REMADE (Baird et al., 2008)
Household waste		0.27		0.17	
Paper & card	0.21	0.6	0.21	0.21	0.05
Glass bottles	0.35	0.75	0.33	0.33	0.3
Mixed plastic	0.22		0.14	0.21	0.03
Cans				0.04	0.05
Food waste	0.16	0.75	0.2	0.2	0.24
Textiles			0.2	0.15	
Construction/demolition waste	0.55	1.2			

Unit = ton/m^3

This study indicates that only 50% of HEIs have carried out a waste composition study on their waste – identical results were found by Dahle and Neumayer (2001). Thus very few HEIs appear to have any reasonable quantitative estimates of the quantity and composition of their wastes. In mitigation, a significant issue faced by HEIs is the complexity and range of their operations, with education- and research-related activities unsurprisingly given priority. Table 4.6 highlights this diversity and provides a guide to the main sources of different types of wastes in HEIs.

Table 4.6 Sources of waste in HEIs.

	Campus	Halls
1	Canteens, pubs, shops	Kitchens, canteens, pubs, shops
2	Administrative offices, departmental offices, printing centres	Administrative offices
3	Lecture rooms, computer rooms, gyms, libraries,	Computer rooms, gyms, laundries
4	Gardens, open greens	Gardens, open greens
5	Laboratories	
6	Medical facilities	
7	Construction and demolition activities	Construction and demolition activities
8	Special events	Special events

Many HEIs reported employment of full-time environment managers, which may be viewed as a significant step forward in terms of progress towards achievement of sustainable operations.

4.5 Conclusions and Recommendations

Although the overall response rate to the survey was low, some useful information on waste management in HEIs has been obtained. The key messages from this study are:

- Whilst a significant proportion of HEIs reported some form of re-use, recycling or recovery scheme on campus and in halls of residence in 2006/07, across the sector there appears to be significant potential for increased capture of resources and substantial room for operational improvements.

- It is clear that there is a lack of accurate and reliable data on waste arisings and the associated costs which largely caused by different conversion factors. This is a significant barrier to improvements in planning, decision making and sustainable resource use in HEIs. There is a need for more robust data collection methods such as the Pay-By Weight system which HEIs can use to manage their waste effectively and monitor their performance. Moreover, there is an obvious desire amongst HEIs to improve their performance, with many now employing professional environmental managers to oversee operations.

One possibility may be for HEIs to join with the Waste Data Flow system used by local authorities to report annual data on municipal waste arisings to central government. This system has been used in England and Wales since 2004, in

Northern Island and Scotland since 2005 and 2006. It requires information on amount of waste, method of waste management, method of collection and containment, detailed recycling composition, destination of recycled and disposed material and basic cost data. It allows fast and accurate data collection and provides consistent data for planning, developing and monitoring policies and allocating resources. It also provides means to monitor performance and cost, compare methods of collection, calculate diversion from landfill, benchmark with other organisations and identify best practice (Department for Environment Food and Rural Affairs, 2007). However, this system requires certain amount of training to use the system effectively and data entry.

- It seems that in the HE sector, waste collection services are dominated by private contractors despite the fact that waste generated by HEIs is legally classified as household waste. There is clearly an opportunity for HEIs to enter into partnership with their local authority for the collection of dry recyclables, which should reduce costs for HEIs and assist the achievement of local waste management targets.

Chapter 5

5 Developing sustainable waste management at a UK University

5.1 Introduction

Universities are considered to be similar to small towns because of their large size, population, and the various complex activities taking place on campuses (Alshuwaikhat and Abubakar, 2008). As such, they not only need to maintain an appropriate physical infrastructure, they require similar services to small towns, including accommodation, transport, retail, leisure and, of course, waste management. HEIs are key sites of tertiary learning and research, major employers, economic actors and providers of cultural, recreational and infrastructure resources (Lambert, 2003) and they have substantial potential to catalyse and accelerate societal transitions towards sustainability (Stephens et al., 2008). Integrated waste management systems in particular, are one of the greatest challenges for HEIs' sustainable development (Armijo de Vega et al., 2008). HEIs generate thousands of tonnes of waste and waste generated from HEIs is classified as household waste in the UK, although in many cases, it is collected by private contractors (DEFRA, 2007a). Nevertheless, the dramatic expansion of UK HE sector in scale and scope has put even greater pressure to formally integrate sustainable development into policy and practice.

This research focuses on sustainability issues, combined with a desire to control the escalating costs and environmental impacts of procurement and waste management, prompted the UoS to 'put its own house in order' for commercial and external image purposes, as well as providing real-life exemplars of the outputs of its own research activities. This chapter critically reviews why sustainable waste management has become a key issue for the HE sector to address and describes some of the benefits, barriers, practical and logistical problems. As a practical illustration of some of the issues and problems, the four-phase waste management strategy developed over 15 years at the UoS is discussed as a case study.

5.2　Methods

The UoS has the highest number of staff and PhD students engaged in sustainable development research in England (HEFCE, 2008a). It is one of the region's largest employers with over 5,000 staff and an annual turnover of >£370 million. With a student community of >24,000, including >2,000 international students from over 100 different countries, the University has a global network of ~160,000 alumni spanning 147 countries (University of Southampton, 2009a, 2009b). It produces large volumes of waste from its residences, catering areas, laboratories, workshops and grounds and typically spends >£500,000 per year on waste disposal.

Over the last decade, the UoS has developed a comprehensive waste strategy based upon a so-called 'PESTLE' analysis, the waste hierarchy and the ISB model. A 'PESTLE' analysis is often used as a useful starting point for organisations developing new strategies and policies and stands for the **p**olitical, **e**conomic, **s**ocial, **t**echnological, **l**egal and **e**nvironmental context impacting on an organisation (Fahey and Narayanan, 1986, Farnham, 1999). The waste hierarchy is an established factor in the development of sustainable waste management practices, setting out the order in which options for waste management should be considered based on environmental impact (DEFRA, 2002). The UoS's Waste and Resource Management Strategy, and to some extent its Procurement Strategy, are based on the principles that underpin the waste hierarchy. The ISB model clusters the various motivators and barriers to waste management into situational (external) and psychological (internal) factors and recognises that they should not be considered in isolation but are interconnected.

Qualitative methods were used to evaluate the development of waste management practice at the UoS in this study. The researchers conducted 15 semi-structured interviews with staff from the Estates and Facilities Management department, halls of residence managers, the university's Environment Manager, the Students' Union and the waste contractor. The goal of the interviews was to obtain in-depth information about how waste was/is managed at the UoS and how practices have evolved over time. The approach used can be described as follows:

- Detailed notes were taken during most of the interviews; some interviews were recorded and notes were recorded afterwards from a review of audio.
- Ideas, categories or themes that helped to answer predetermined research questions were subsequently highlighted.
- These data were then compiled and arranged in themes. The themes showed how a four-phase waste management framework emerged at the UoS, shown in Table 5.1.

These data were then compiled and arranged in themes. The themes showed how a four-phase waste management framework emerged at the UoS. A four-phase waste management strategy was introduced to set a framework and a direction of travel for waste management at the UoS, shown in Table 5.1. Table 5.2 clearly set out the qualitative targets of each phase. The main objectives of the four phases were to:

- Develop a phased and practical sustainable waste management strategy for a HEI, based upon a 'PESTLE' analysis and the waste hierarchy, focusing on increasing waste reduction, re-use, recycling and composting and using quantitative targets for each phase;

- Enable the collection of accurate and reliable data using a 'Pay-By-Weight' system with information on tonnage, numbers of bins per building, size of bins, number of collections; and

- Reduce the cost of waste disposal and the amount of waste being disposed of to landfill.

Table 5.1 Staged approach to the development of sustainable waste management at the UoS.

	Year	Action	Drivers
	Late 1990s	Voluntary paper recycling schemes on campus	Active individuals
Phase 1	2003	Start of Pay-By-Weight contract Source-segregated pilot scheme on campus	PESTLE analysis Waste hierarchy
	2003	Environmental Rock Southern Universities Waste Management Consortium	Students' Union Reduced costs and increased value for money
	2004	Corporate Strategy Setting up a waste management team	Duty of Care 1991
Phase 2	2005	Recruitment of the environment manager Start of the Sustainable Procurement Project Sustainable Purchasing Policy Environment & Sustainability Policy Roll-out recycling scheme on campus	Increase of Landfill Tax Estate and Facilities
	2006	Bin and uplift audit First Environmental Awareness Week Sustainable Purchasing Policy Furniture reuse scheme	Increase of Landfill Tax Students' Union Estate and Facilities Estate and Facilities
	2007	Re-use and recycling project at the halls of residence First annual waste audit event	School of Civil Engineering and the Environment Students' Union
Phase 3	2008 2009	Environmental Champions Re-tendered for the Pay-By-Weight contract Co-mingled recycling scheme on campus Co-mingled recycling scheme at halls of residence	Environment Manager Southern Universities Waste Management Consortium Increases in Landfill Tax
Phase 4	2012 (provisional)	Separate food waste collection	Landfill Directive 1999

Table 5.2 Qualitative targets of each phase of the UoS waste strategy.

	Main initiative	Qualitative targets
Phase 1	Introduce Pay-By-Weight system	Establish baseline data by employing the Pay-By-Weight system and improve waste storage
Phase 2	Set up source segregated recycling scheme	Monitoring waste arising data Reduce the number of general waste bins and replacing them with recycling bins Pilot and Roll out source segregated recycling schemes
Phase 3	Switch to co-mingled recycling scheme	Maximising the recycling rate by introducing a more convenient co-mingled recycling scheme on campus and at HoR and increase environmental awareness amongst staff and
Phase 4	Reduce carbon emission from biodegradable waste such as food waste	Introducing separate food waste collection and off-site food waste anaerobic digestion

5.2.1 Phase One

In the 1990s, there were a number of problems associated with the way in which waste was being managed at the UoS, which was probably typical of most UK HEIs at the time. Prior to Phase One, waste was charged by volume and the University was often unexpectedly charged for extra volume. No quantitative waste management data was collected and the system did not enable the 'true' cost of waste management to be easily estimated. Consequently, the University adopted a new 'Pay-By-Weight' waste disposal contract that enabled cost savings through optimisation of collection patterns and more centralised administration. This was an innovative decision because at this time, little attention had been given to the establishment of Pay-By-Weight systems in other UK HEIs, in part because a limited number of contractors provided the service. Every wheeled bin for residual waste on campus has a unique microchip which is linked to a matching account that the Contractor created for every customer. All the vehicles have been fitted with wheeled bin weighing and identification equipment. Every time a wheeled bin is emptied, the system automatically identifies the bin and calculates the weight of the waste.

In addition, re-use and recycling facilities were provided at the University on an *ad hoc* basis. Voluntary paper recycling schemes operated in a small number of offices and the bins were emptied by voluntary officers.

In 2002, the UoS joined the Southern Universities Waste Management Consortium (SUWMC), which comprised of seven universities in the south of England. Its primary purposes were to create a forum to discuss waste-related issues and promote sustainable waste management by:

- Reducing tendering and contract management costs,

- Negotiating a consortium-based, sustainable, long-term waste management contract,

- Conducting Duty of Care audits,

- Identifying waste minimisation opportunities, and

- Sharing information with other members.

Knowing that managing waste effectively required accurate quantitative and qualitative information, in 2003, the SUWMC introduced the Pay-By-Weight system across its members to their general waste collection systems. The bins used were micro-chipped and automatically logged details such as: time/date of collection; location of bin and bin weight using a specially equipped vehicle. A standard lift price was agreed to empty the bins, but beyond this all billing was done on a per tonne rate. Prior to 2003, waste management costs were charged as part of a space charging system, but this system did not plainly show the rapid rise in waste management costs or how wasteful a particular department was. The new scheme was considered to be transparent, allowed operators to match collections with demand and improved the efficiency of the waste collection system. Crucially, it allowed the UoS to accurately identify and monitor the sources of waste on campus to avoid unnecessary costs in the second phase of its strategy. In addition, from an operational point of view, the new waste containers were easy to manage and manoeuvre, their close-fitting lids eliminated smells and spillages and discouraged vermin, and this ensured a cleaner and more hygienic service. A detailed discussion about the advantages and disadvantages of different waste collection systems at HEIs can be found in Zhang et al. (2008b).

In order to increase environmental awareness, the UoS held a music-based event dubbed –'Environmental Rock' - in April 2002 to provide a fun event that would attract a wide range of people from the University and the local community and provide information about the environment. The event was initiated by a final year Engineering student inspired by a song reflecting thoughts on the environment. The Young People's Trust for the Environment (YPTE) mentored and funded the first year event (Gunton, 2009). Environmental Rock subsequently became an annual event at the University and is usually held during April. The event is supported by environmentally-conscious

organisations that provide stalls, give away information and samples of green products, run activities or donate green prizes.

In 2004, the University adopted an Environmental Policy in its Corporate Strategy. This policy committed the University to reduce waste and pollution through responsible disposal and reinforced the need to meet and where possible exceed legislative requirements. To realise the policy statements and cope with the increasing work load, a waste management team of was set up within the Estate and Facilities department.

5.2.2 Phase Two

From the start of this phase, source-separated recycling (where all dry recyclables were sorted by students and placed into different containers/bags) became an integral part of the waste management operation. In 2005, a paper and cardboard recycling trial was set up at the University's main administration building. In the same year, the University joined a three-year EAUC/DEFRA Environmental Action Fund sustainable procurement project, which provided support to universities and colleges wanting to integrate sustainability into their procurement practices. The project involved 17 universities and colleges and a sustainable purchasing policy was developed via a 'PESTLE' and waste hierarchy analysis. The policy sets out a firm commitment to the principles of sustainable procurement through making purchasing decisions based on a balance between the relevant 'PESTLE' factors. To be eligible for consideration, suppliers were required to provide information about their environmental performance and develop corresponding assessment criteria, including whole lifecycle costing. The main theme was to consider the impacts of the product or service on the environment over its entire lifecycle, from creation to disposal. Priority was given to reducing waste upstream by choosing products made from recycled materials and/or items that can be remanufactured, recycled or composted. Staff, students and contractors were encouraged to consider the many aspects of a product, including materials used in manufacture, methods of production and embedded energy, energy use of the product over its life span, eventual disposal costs and environmental impacts and potential for re-use or recycling (NetsRegs, 2009). The University then introduced a new electronic ordering system to centralise all procurements. The environmental benefits of this exercise were threefold: it dramatically reduced the amount of resources used by the University's operations; the number of suppliers reduced from 30,000 to 7,000 based on preferred supplier agreements, significantly reducing administrative costs; substantial

cost savings were negotiated through consolidation of spending power. Furthermore, specific items, such as printing paper were targeted and policies developed to minimise the amounts wasted generated.

In 2005, the University recruited a full-time environment manager to work with the waste management team; the individual was responsible for overseeing the environmental performance of the university, and developed, implemented and monitored environmental strategies, policies and programmes that promoted sustainable development. The structure of the operational team is shown in Figure 5.1. A paper and cardboard recycling scheme was rolled out on campus during the 2006/07 academic year. Recycling containers were provided to each building on campus for recycling paper and card. They were sited in prominent areas on each floor of buildings, and emptied weekly by the University's recycling team. Waste skips were replaced with micro-chipped wheeled bins and the Pay-By-Weight data was used to improve the efficiency of the system by e.g. reducing the number of bins. Meanwhile, waste compounds to contain the wheeled bins were built on campus and at the halls in order to prevent fly-tipping and scavenging. The University purchased a cardboard compactor to deal with the large volume of cardboard from cafeterias and shops on campus and baled cardboard was taken away by the contractor for recycling (free of charge).

Figure 5.1 Organisational structure of the waste management team at the UoS.

In March 2006, an audit of existing bins and uplifts was undertaken. Wherever possible, external general waste bins were removed, downsized or shared and uplifts

were reduced. The scheme saved approximately £140k per year and allowed operators to further match collections with demand, which maximised the efficiency of collection journeys and reduced expenditure, local nuisance from large vehicle noise and vibration, and other associated environmental impacts, such as fuel consumption and emissions to atmosphere.

To echo the University's environmental initiatives, the UoS Students' Union held their first annual Environmental Awareness Week in May 2006. The week-long event featured a different environmental theme each day and was filled with activities and messages relating to living and working in a more sustainable way. Activities in the week included talks by green groups, recycling displays, alternative travel to work days, guided walks, guided cycle rides etc.

A furniture reuse scheme was introduced at the UoS in 2006 in an attempt to manage the University's assets better. The movement of staff – switching offices, buildings and campuses – as a consequence of management re-organisations generated a lot of bulky wastes, including furniture. The furniture collected was first offered to staff for reuse before being broken down and sent for recycling. The furniture redistribution 'tax' was the first attempt to reclaim the extra money associated with providing a better service for the disposal of a particular waste stream. Money generated by this scheme was put back into Estate and Facilities' waste budget and used to fund the purchase of additional recycling facilities, such as internal bins. As well as promoting sustainable asset management practices, the scheme has generated considerable cost savings; the University saved £77,000 in 2009 alone.

In 2007, the source separated recycling scheme was expanded to include plastic bottles and metal cans. Consequently, by the end of 2007, the UoS had a comprehensive campus recycling programme that serviced around 400 collection points, while employing six full-time and three part-time staff. Collaboration amongst different departments was fundamental to the programme. The Campus Services Manager and the Environment Manager now took responsibility for working with the campus community to incorporate waste reduction, reuse, recycling and sustainable practices into all aspects of University business. They also took the lead on sustainable procurement for all goods and services and trained staff at all levels in environmental issues and responsibilities.

The first annual waste audit was organised in 2007. Its purpose was to monitor the progress of the existing recycling schemes, identify recycling opportunities or opportunities to strengthen the current waste and recycling program on campus. The

samples covered all the main sites and activities across the University. The waste was then sorted into different sub-categories, and data was recorded accordingly.

Also in 2007, a two-year recycling project at HoR was initiated that aimed to identify the most user-friendly, pragmatic, cost-effective and resource efficient waste management service possible, as recycling in a high density environment is difficult (Zhang et al., 2008a). Before September 2007, a restricted number of paper recycling facilities were available at the student HoR. The recycling bins were typically situated in car parks or open areas and were often hidden away and inconveniently located. There was an incoherent communications strategy that led to low awareness and engagement. All of these factors led to poor participation in recycling and a poor (estimated) recycling rate across the HoR.

Three schemes were designed to identify the most effective infrastructure and service provision during term-time accompanied by waste audits and a survey of students' attitudes and behaviour with respect to waste management. A succession of workshops and informal talks were provided to the new students in the first week when they moved into the HoR. Information offered during these workshops and talks included: importance of recycling activities; where and how they can recycle in the halls; where they can find more information. Informative posters were provided and stickers were placed on the lid of each recycling container provided advice and location-specific guidance. During term-time, the Students' Union and resident associations (Junior Common Room (JCR) and Middle Common Room (MCR)) promoted recycling schemes on campus and at HoR by advertising the schemes on their websites and talking to students directly.

The end-of-term is a very busy period for waste management operations as students leaving university accommodation dispose of items which are no longer required or cannot be transported or stored. Therefore, the project included a trial reuse scheme at the end of each term. In June 2007, the UoS set up an in-house reuse trial to reduce the amount of waste to be landfilled. The following year, the University collaborated with a local charity to reuse and recycle any unwanted student clothing, shoes and household textiles.

5.2.3 Phase Three

Phase Three focused on maximising recycling via the establishment of a new co-mingled recycling system. Co-mingled recycling schemes (where all dry recyclables are placed into just one container/bag by students) are considered to be more convenient

than source separated schemes in terms of time and effort students need to spend on recycling. They are also easier and safer to operate, produce greater recyclables recovery rates, and are as cost-effective as alternative methods. By introducing the co-mingled system, the UoS was able to recycle more material, reduce waste disposed to landfill and hence reduce the number of general waste bins, and replace them with recycling bins. The University was subsequently able to save on collection costs and Landfill Tax associated with general waste.

In 2008, a network of Environmental Champions was set up to take forward environmental improvements in schools/departments and to encourage the campus waste recycling schemes. The Champions were trained jointly by the waste contractor and the Environment Manager and play an important role in promoting the University's sustainability initiatives. They receive support and information directly from the Environmental Manager, and the network is used to raise awareness of the recycling scheme on a departmental level; provide feedback on improvements that can be made to facilities and campaigns; and develop targets for individual departments.

In the same year, the SUWMC re-tendered for an improved Pay-By-Weight contract. The new contractor provided a Pay-By-Weight system for general waste and a co-mingled system for dry recyclables. The external contract was designed to provide recycling-led waste management services that supported the consortium's environmental objectives, reduce the impacts of waste, achieve increased levels of recycling, reduce waste to landfill and meet legislative requirements. The new contract was implemented at the UoS from January 2009.

5.2.4 Phase Four

Phase Four will continue efforts to improving recycling participation but the focus will switch to promoting food waste recycling arising from catering areas and the HoR (food waste forms a significant proportion of wastes arising from HoR). Once available commercially, the UoS is planning to implement food waste composting as the last stage of the waste management strategy beginning in 2010/2011.

5.3 Results and Discussion

5.3.1 Waste production and recycling data

Figure 5.2 shows trends in waste and recycling arisings and associated cost since 2004. The figures show a significant improvement in performance; there is a steady reduction in the amount of waste produced each year from >6,000 tonnes in 2004/05 to

<3,900 tonnes in 2007/08, despite the number of staff and students staying stable. This equates to 72 kg per person per year in 2007/08. The total waste reduction can be explained by some initial problems in collecting performance data. In the first two years, the system was only able to achieve a two-thirds data capture, despite the Contractor's claims that the weighing systems on all vehicles were regularly checked and calibrated. Recognising that the Contractor lacked experience of using the system, the UoS worked with the Contractor to monitor and improve their performance. Two years after the start of the contract, the pay-by-weight system stabilised and more complete datasets became available.

Figure 5.3 shows that in 2007/08, the UoS recycled 72% of its general waste, with a 75% reduction of waste going into landfill compared to 2004/05. By increasing the recycling rate and reducing waste production since 2004, the University has been able to save £40,000 annually and more than £125,000 in total even though the unit cost of waste treatment has increased over the last four years due to substantial annual increases in the UK's Landfill Tax. Figure 5.4 shows that general waste arising by month for the last three years using the Pay-By-Weight system. It reveals that an increase in waste production levels at the start of new terms when the students return to campus (October, January, March) and an increase in waste production towards the end of the term (May –July). The total amount of general waste produced has decreased over these three years. Figure 5.5 shows that monthly cost of waste disposal of including general, hazardous, electrical and electronic waste for the last three years.
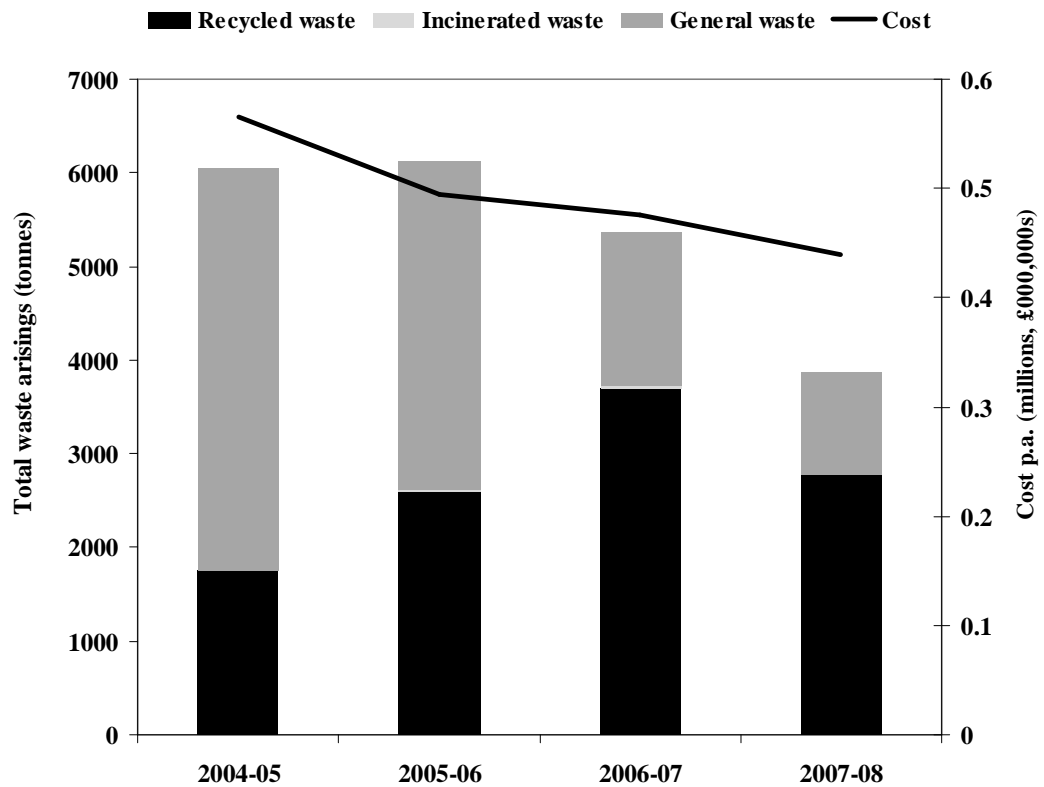
Figure 5.2 Waste and recycled material arising and cost (2004-2008) at the UoS.
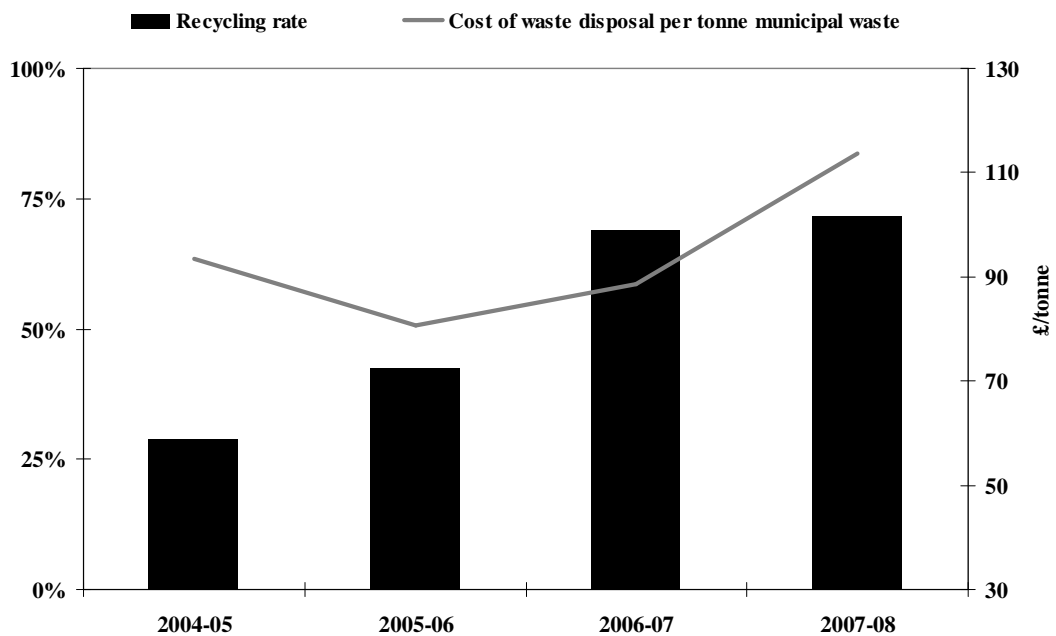
Figure 5.3 Annual recycling rate and unit cost per tonne of waste at the UoS.
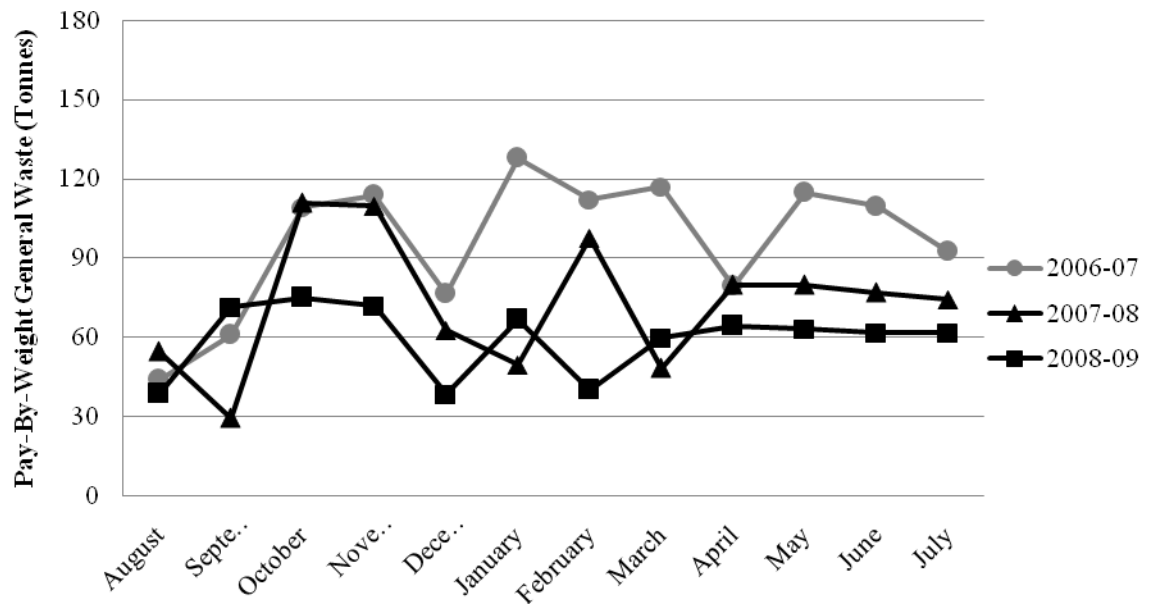
Figure 5.4 Comparison of monthly general waste at the UoS using the Pay-By-Weight system (2006-2009).
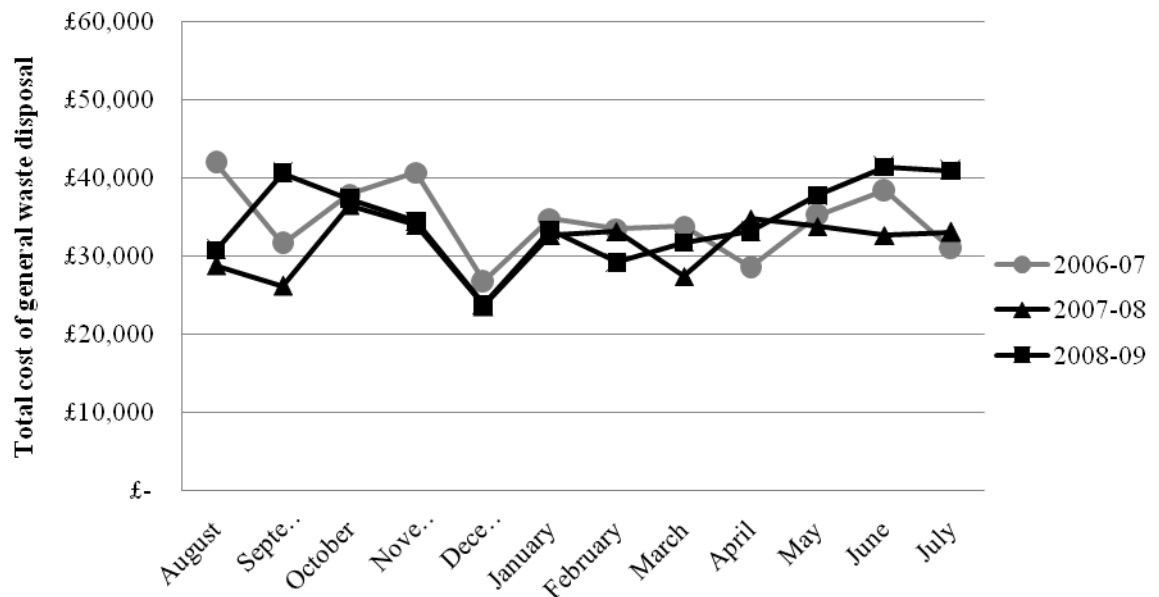
Figure 5.5 Comparison of the monthly cost of general waste at the UoS, including hazardous and electrical/ electronic waste (2006-2009).

The results clearly show the positive impact of introducing appropriate infrastructure, service provision and techniques to encourage positive behaviour change at the UoS' HoR. Providing recycling bins in each kitchen achieved an average 25% recycling rate with the lowest contamination level, which supports the theory that successful recycling programmes require a convenient and easily usable infrastructure. Convenience in this case incorporates two features: the distance to the collection spot

where recyclables are carried to and the time spent on recycling activities. The end-term re-use scheme resulted in collection of 1.85 tonnes of reusable textiles by the end of September 2008.

5.3.2 Implementation issues of recycling facilities and service provision

However, there have been several hurdles to overcome during the course of Phase Three. At the beginning, contamination by non-recyclable materials was regularly found in recycling bins. Several techniques were used to reduce contamination, including using larger labels for internal recycling bins, notifying staff/students of the consequences of contamination and providing clear recycling instructions on the University's website.

When source-segregated recycling schemes were introduced to HoR in September 2007, a number of issues arose, including poor quality service by the contractor and insufficient support from the hall managers. The service provided by the contractor suffered from an array of problems, including: unreliable and irregular collections; movement of the recycling bins without consultation with the University; late and poor quality data provision; false and misleading labeling of infrastructure; and poor communication practices. The unreliable and irregular collections had a particularly detrimental influence on the new scheme, with negative impacts including: overflowing and unsightly recycling bins; breeding of flies and vermin; operational and logistical difficulties for the halls staff; de-motivation of students and consequent reductions in participation; and disagreements with the University. The contractor initially denied any poor performance, but was obliged to agree to significantly improve performance at a 'crisis meeting' in which it was confronted with irrefutable (photographic and other) evidence of unacceptable practices.

5.3.3 Behaviour change methods

Once a comprehensive recycling infrastructure and a reliable service provision were in position, different methods of communication that aimed to change students/staff behaviour were used. Resistance to change is a common occurrence in organisations and has been a major obstacle in many sustainability projects. (Dahle and Neumayer, 2001, Jahiel and Harper, 2004, Velazquez et al., 2005). Although some previous studies have recognised the importance of engaging the student group, there is a lack of research on behaviour change interventions targeting transient groups such as university students (Robertson and Walkington, 2009, Timlett and Williams, 2009,

Williams and Gunton, 2007b). The approaches in this project were designed to engage the students in thinking about how and what might increase their awareness and interest in recycling by using both 'traditional' and 'creative methods. The campaign targeted students before they moved into HoR by e-mailing them with customised information about waste management in their welcome package from the UoS. It is recognised that managing and taking responsibility for waste recycling is not top of a student's agenda when they first arrive at university, so the messages need to be repeated quite frequently. Towards the end of each academic year, student satisfaction surveys were carried out to provide an opportunity for feedback, including problems/issues and potential future improvements.

5.4 Conclusions

This chapter has critically reviewed and identified why sustainable waste management has become a key issue for the global HE sector to address. The UK HE sector has generated increasingly large amounts of waste as a consequence of fast expansion and consequently faced spiralling costs, accelerated by the annual increase in Landfill Tax. The sector has struggled to deal with these and related environmental issues for many reasons, including a lack of university-wide coordination, institutional bureaucracy and lack of planning. The case study outlined in this chapter has provided a comprehensive appraisal of some of the key issues, problems and successes that have arisen during the four-phase waste management strategy developed over the last 15 years at the UoS. There is no doubt that the UoS has significantly developed and improved its management/operational practices and facilities for waste management into a more sustainable, cost-effective and user-focused system. The holistic approach taken - recognising the PESTLE factors and the importance of a concerted ISB approach - provides a realistic, successful and practical example for other institutions wishing to effectively and sustainably manage their waste.

Chapter 6

6 Development of a result and recycling programme at university halls of residence in England

6.1 Introduction

The previous chapter critically reviewed and identified why sustainable waste management has become a key issue for the global HE sector to address and outlined the four-phase waste management strategy developed over 15 years at the UoS, England. This follow-on chapter describes in detail the development of a recycling project at HoR using a so-called ISB model.

Although some campus greening programmes have been set up at individual institutions, there remains a dearth of research on waste management at HEIs. Studies have tended to focus on recycling behaviour, but development of effective infrastructure and service provision at HEIs has been largely neglected. Effective recycling programmes can be particularly difficult at HoR because there are often densely populated by young people who only live in them for a relatively short period of time – a few months – and who have little or no experience or interest in waste management activities. Other reasons for low recycling rates at HoR include: lack of storage space; difficult door to door collections; high contamination rates; poor or absent infrastructure; high population turn-over; and set-up costs (Zhang et al., 2008a). Lack of appropriate management skills and resistance to change from staff may also hinder the development of new recycling schemes, so the development of accompanying training programmes and 'ownership' of the scheme by HoR staff is vital.

The aim of this study was to establish that carefully designed recycling facilities, service provision and communication strategies at high density housing (university accommodation) can reduce waste sent to landfill whilst increasing the cost-effectiveness of the waste management system. The UoS, located on the south coast of England, was an ideal location for this case study. It has >24,000 students and 5,000 staff and with 20 HoR. It is one of the 10 largest providers of student accommodation in the UK University sector, providing accommodation for >5,000 students. The objectives were to:

- Identify, quantify, summarise and critically evaluate the waste disposal and recycling approaches and practices typically used at university HoR;

- Investigate the opportunities for and barriers to reuse/recycling by university students;

- Estimate the potential for improving reuse and recycling at university HoR;

- Develop a convenient, easy-to-use recycling system for HoR by identifying, designing, implementing and evaluating different recycling schemes for students;

- Evaluate a series of reuse and recycling trials at HoR during end-term and move-out period in June when extra waste is generated; and

- Examine the potential for collaborating with third sector organisations.

6.2 Methodology

6.2.1 Approach and timescales

The project was devised and funded by three groups within the UoS: the School of Civil Engineering and the Environment; Estate and Facilities and Accommodation Services. A Steering Group, which included representatives from the Students' Union and relevant waste contractors, was formed to oversee all aspects of the project, including planning, management, communication, training, organisation, implementation and evaluation. The methodological approach and timescale for this study is shown in Table 6.1; readers are also referred to the overall long-term approach outlined in Zhang et al. (in review a).

Table 6.1 Overview of project activities and schedule.

| Timeline | Activity | Name of Student HoR | | | |
		Hall A	Hall B	Hall C	Hall D
June 2007	End-of-term reuse and recycling trial 1				
September 2007	------------------Staff training and student awareness events--------------				
	Scheme no. (S)	S1	S2	S3	S4
	Scheme name	bedroom bin	bedroom bag	In kitchen twin bin	Control
November 2007	Waste quantification	------------------------- Waste audit----------------------------------			
March 2008	Waste quantification	------------------------- Waste audit----------------------------------			
April 2008	Waste quantification	------------------------- Waste audit----------------------------------			
May 2008	Waste quantification	------------------------- Waste audit----------------------------------			
May 2008	Attitude survey				
June 2008	End of term reuse and recycling trial 2				
July-August 2008	Evaluation of infrastructure and service provision; selection of best scheme (Sb)				

6.2.2   Development of infrastructure and service provision

To identify the most effective infrastructure and service provision, four student halls (A-D) were selected to test three different schemes and one hall was used as a control. Students were given a 13-litre recycling bin for their bedrooms at A (referred to as the 'bedroom bin scheme'), whereas students were provided with a reusable recycling bag for their bedrooms at B (referred to as the 'bedroom bag scheme'). At both halls, the students were expected to recycle paper, cardboard, plastic bottles, metal cans, glass bottles and jars and empty and sort their recyclables at a central external recycling point. A general waste bin was provided in each communal kitchen and emptied daily by the university cleaning staff. At the third hall a twin-bin system was implemented at C (referred to as the 'kitchen bin scheme'). Two 60-litre colour coded bins were supplied to each kitchen to recycle paper, cardboard, plastic bottles and metal cans and they were situated next to the existing general waste bins (see Appendix A). The university cleaning staff emptied the general waste bins three times a week (on Mondays, Wednesdays and Fridays) and recycling bins twice a week (on Tuesdays and Thursdays) and were responsible for carrying the recycled materials to a central recycling point for sorting (see Appendix B). No recycling facilities were provided inside the control hall (D). However, a range of re-use/recycling facilities supplied by Southampton City Council were available locally (within a 1 mile radius), including 17 bottle banks, 1 textile bank and 2 recycling centers with facilities to recycle paper, glass, plastic, cans and textiles.

The selected HoR were all self-catered and provided accommodation for about 750 students, approximately 15% of the students living in halls. The HoR were shared by 6-8 students and had communal kitchens and similar floor plans. The different schemes were designed and monitored during term-time and were accompanied by waste audits (see Appendix C, D & E) and a survey of students' attitudes and behaviour with respect to waste management.

The study also addressed the so-called 'end-of-term clear out'. The end-of-term is a busy period for waste management as students leaving the University dispose of items which are no longer required or cannot be transported or stored. At the end of the academic year (May - June), a special re-use and recycling scheme was run in parallel with the regular scheme in order to tackle the wastes arising during and after student move-out period. In June 2007, the University set up an end-of-term reuse and recycling trial to reduce the amount of waste sent to landfill. The trial was hastily planned and, unfortunately, was not used very much by the students. Three temporary recycling

centres were established for the duration of the summer and the students were asked to separate their waste into different categories, including paper and cards, textiles and bric-à-brac.

A subsequent trial was carried out in May 2008 in collaboration with a charitable organisation. Bag It Up was launched in 2005, and its operation relies entirely on voluntary donations, with financial proceeds donated to charity. Good quality items (unwanted clothing, shoes and household textiles) which can be reused are sold to second-hand clothing traders in the UK and worldwide. 'End of life' garments are recycled into industrial wipers and cloths, mattress filling, insulation and new fibres. The textile banks were delivered to dedicated central points at each student hall at the end of May 2008. They were fully managed by Bag It Up free of charge. The banks were emptied weekly, then fortnightly after 4 weeks of the start date, and all textiles were weighed on collection.

6.2.3   Communication techniques

6.2.3.1   Training, awareness-raising and stakeholder consultation

A number of training and awareness raising events were designed and organised at the beginning of the 2007/08 academic year, including:

- Three compulsory training and consultation events were provided for the hall staff in order to explain how the recycling schemes worked and their consequences.

- The Students' Union provided online assistance on their websites with project details and contact details.

- An article about the project was published in the university's newspaper to raise awareness of the students and staff.

6.2.3.2   Education message and signage

It was important to educate and inform students of how the scheme would operate and why it was being introduced, as well as encouraging students to maximise recycling and minimise contamination by non-recyclables. When students moved into halls at the beginning of October 2007, they received a 'welcome pack' (see Appendix F). The pack provided a uniform means of notifying all participants about the definition of recyclable materials and the locations of bins at their halls (Note that at the beginning of the study, students were assumed to have a roughly equal awareness of waste management activities regardless of their age and nationality).

An A3 size poster (see Appendix G) was designed and made available in each kitchen explaining the new facilities, including contact details if the students needed further assistance. The posters were accompanied with concise instructions of the schemes in each hall and were put up on each kitchen's notice board (see Appendix H). In addition, a succession of workshops and informal talks were provided to the new students in the first week when they moved into the halls. Information offered during these workshops and talks included: importance of recycling activities; where and how they can recycle in the halls and where they can find more information. Eye-catching stickers were also provided on the lid of each container summarising the recycling instructions and guidance (see Appendix I).

Four weeks before the end-term clear-out started, all relevant staff and students were informed by internal communication that the project was run with the collaboration of a charitable organisation. Noticeable posters were placed at receptions, communal kitchens, block entrances and common rooms to promote the maximum potential usage of the scheme (see Appendix J).

6.2.3.3 Traffic light system

A 'traffic light system' was used to provide feedback to the students at the middle of the academic year (see Appendix K) in order to maintain awareness and interest in the recycling schemes and reduce contamination. Cards were issued monthly to each student to indicate the level of recycling bin contamination in their hall, and to generally raise awareness about, and promote use of the schemes in order to stimulate long-term behavioural change. (see Table 6.2).

Table 6.2 Traffic light system used to promote recycling schemes and reduce contamination.

Colour of Card	Contamination level
Green means:	No contamination to minor contamination
Amber means:	Minor to medium contamination
Red means:	Significant, serious contamination

6.2.4 Scheme monitoring

6.2.4.1 Waste audits

Periodic waste audits on residual waste were conducted to monitor waste compositions and to build up a representative overview of the typical waste types being

generated. Waste was chosen from multiple kitchens and rooms in order to obtain a representative sample from each hall. The audit days were chosen to reflect the collection schedules and the typical waste generation of students at HoR. Twenty kilograms of waste was randomly selected from each hall for each audit. Collections of the sample waste were timed to occur before the cleaning staff emptied the general waste bins. For example, if the cleaners started to empty the bins from 09:30, the waste was collected at 09:00. To take into account seasonal differences, waste audits were carried out four times during the academic year, from November to May.

6.2.4.2   Student surveys

A questionnaire survey was conducted in May 2008 at HoR A-D. The questionnaires were delivered to each student's bedroom followed by one reminder letter. The survey asked respondents' personal opinions on their level of satisfaction on the recycling schemes. It included a set of items designed to evaluate the use of the existing recycling facilities and questions on demographic factors including participants' sex, year of college, ethnicity and degree.

6.3   Results

6.3.1   Term-time recycling schemes

The training and awareness events were well received. Feedback from stakeholders was generally very positive and a number of useful operational suggestions were provided by staff, particularly relating to practical and logistical issues such as placement of bins and posters and timing of events. These were incorporated into the design of the study.

A week's waste was weighed at each hall between March and May. It was found that per capita waste generation can vary from hall to hall. Although the University has been trying to get a wide range of students in each hall, there were fewer UK students proportionally at Hall B. Hall C and Hall D had higher percentage of UK students, students generated 0.36 and 0.33 kg waste per day respectively comparing with 0.25 kg per day at Hall B.

Table 6.3 Monitoring data

Name of the Hall Number of Students	Hall A 190	Hall B 80	Hall C 157	Hall D 240
Weekly weight of recyclables waste in March	46	26	74.63	
Weekly weight of residual waste in March	411.55	133.7	303.22	
Weekly weight of total in March	457.55	159.7	377.85	553.08
Recycling rate in March	10%	16%	20%	
Recyclables in residual waste	25.9%	34%	11%	38.3%
Weekly weight of recyclables waste in April	46.74	24.43	112.87	
Weekly weight of residual waste in April	369.49	114.8	291.43	
Weekly weight of total waste in April	416.23	139.23	404.3	519.05
Recycling rate in April	11%	18%	28%	
Recyclables in residual waste	46%	38%	17%	42%
Weekly weight of recyclable waste in May	26.994	17.644	85.28	
Weekly weight of residual waste in May	365.45	107.51	306.21	
Weekly weight of total waste in May	392.444	125.154	391.49	571.7
Recycling rate in May	7%	14%	22%	
Recyclables in residual waste	52%	25%	6%	40%

Unit = kilogram

The different schemes yielded different material recycling rates. Students recycled less regularly at halls where recycling took them more effort than those where materials could be more conveniently recycled. The student hall C with the 'kitchen twin bin' scheme achieved an average 25% recycling rate with the lowest contamination level from March to May 2008 (see Figure 6.1). This result supports the underpinning theory that successful recycling programmes require a convenient and easily usable infrastructure.
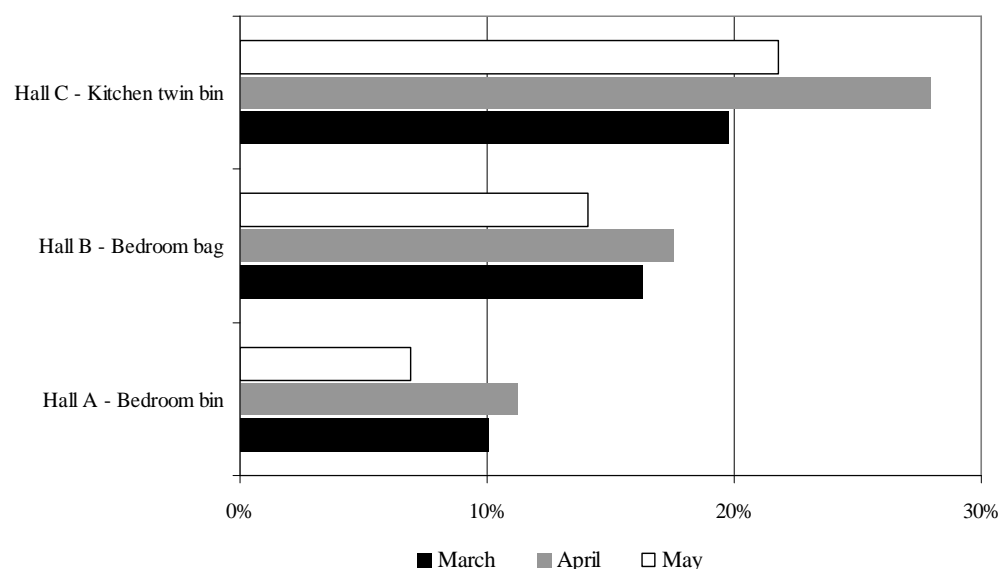
Figure 6.1 Recycling rates at UoS HoR by weight.

The residual waste composition by hall is shown in Figure 6.2a-d. The five major recyclable materials collected were: paper, cardboard, metal cans, plastic bottles, and glass containers, which represented approximately 40% of the waste before recycling by weight. This indicated that about 40% of the HoR waste was available for recovery and diversion from landfill. Paper made up the largest dry recyclable fraction in the waste stream at 16% of the total, and was also the most successfully recovered material in this study. Glass was the second largest fraction of recyclable material (15%), with metal cans and plastic bottles at 4% and 6%, respectively. Only specific plastic products were targeted, including PET and HDPE bottles. As the study was only concerned with dry recyclables, certain types of plastic and textiles were considered to be non-recyclable for the purpose of these audits. The composition of the non-recyclable materials was similar in all HoR. The high recovery rates of dry recyclables resulted in a putrescible-rich residual, with food waste making up a large percentage of the waste. The compositional analyses of the student hall with the 'kitchen twin bin' scheme showed a great consistency throughout the year, while some noticeable fluctuations appeared at other halls. The 'kitchen twin bin' recycling scheme was the most convenient and effective way of recycling at the HoR without escalating the labour cost in this study.
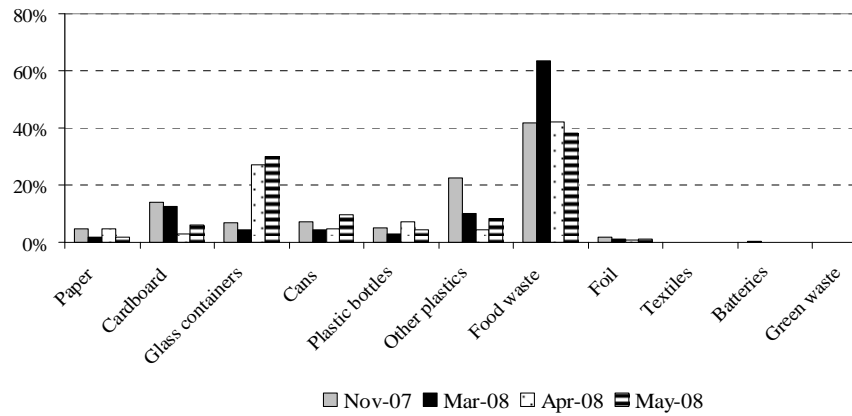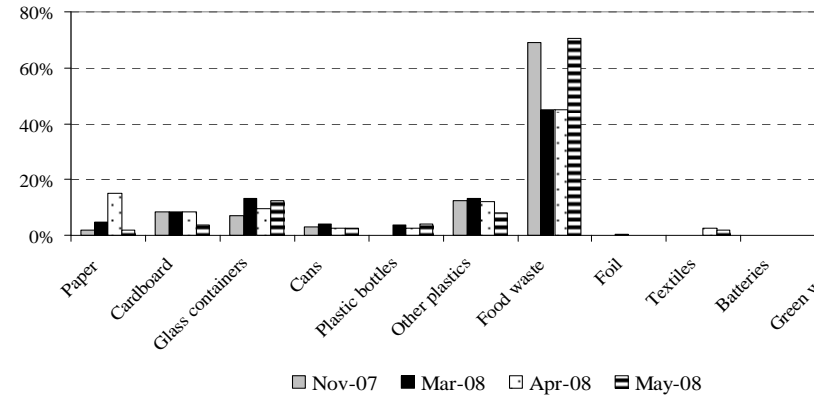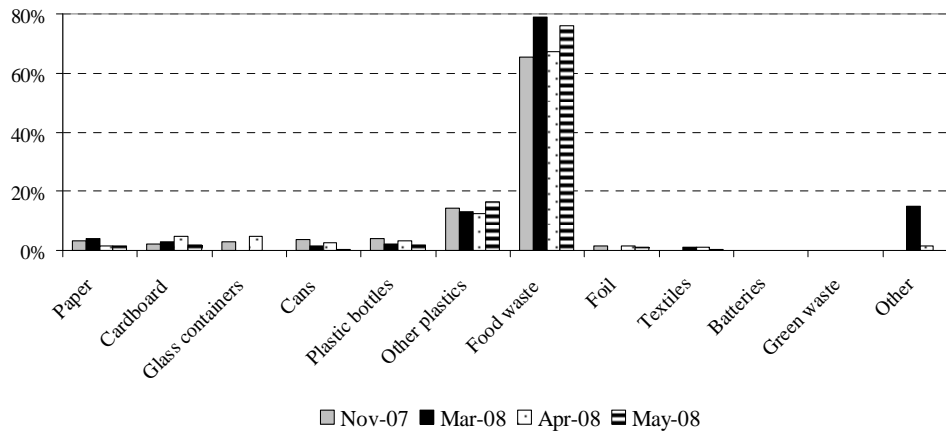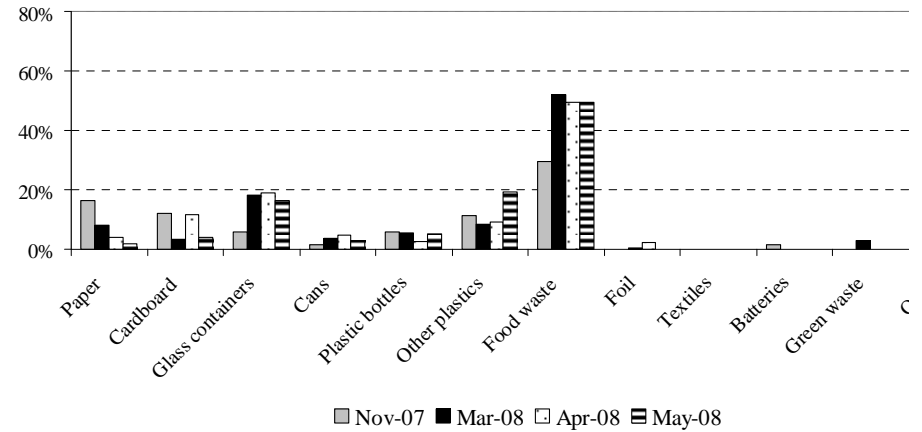
Figure 6.2 a-d Waste audit results by category at HoR.

6.3.2   Students' satisfaction survey

A total of 106 students returned their questionnaires (26 from the control hall), a response rate of 15%. The demographic composition of the sample, shown in Table 6.3, was broadly representative of students in HoR, although female students were over-represented. The respondents represented a variety of majors, ethnicities and years of study, with first year students dominating, as expected. It shows that of the 80 respondents that lived at HoR where recycling facilities were provided; a total of 77 (95%) reported themselves to be recyclers; and all respondents from student Hall B ('bedroom bag' scheme) and student Hall C ('kitchen twin bin' scheme) self-reported as recyclers (see Figure 6.3).

Table 6.4 Profile of students who responded to the satisfaction survey (2007/08).

	N	%
Sex		
Male	36	34
Female	70	66
Total	106	100
Year		
First year undergraduate	76	71
Second-fourth year undergraduate	7	7
Postgraduate	23	22
Total	106	100
Major		
Art	23	22
Social science	24	23
Science and engineering	46	43
Law	6	5
Medicine	8	8
Total	106	100
Ethnicity		
UK student	77	73
EU student	10	9
Overseas student	19	18
Total	106	100

Figure 6.3 Self-reported participation rates in the recycling schemes at HoR.

Figure 6.4a-d show that of the 77 participants, 84% reported that they recycled on a daily or weekly basis, 7% recycled fortnightly, and 9% reported to recycle less often than fortnightly. Amongst the five recyclables, paper and cards were recycled the most often, followed by plastic bottles, cans and glass bottles and jars. Students from Hall C with the twin-bin system in their kitchens reported using the recycling bins more often compared to students from the other two halls with in-building recycling facilities. Of the 26 students living at HoR without bespoke recycling facilities, 35% reported participation in some form of recycling during the year. When asked about their likelihood of participating in future recycling schemes at their halls, 70% stated that it was extremely likely and 30% responded very likely.
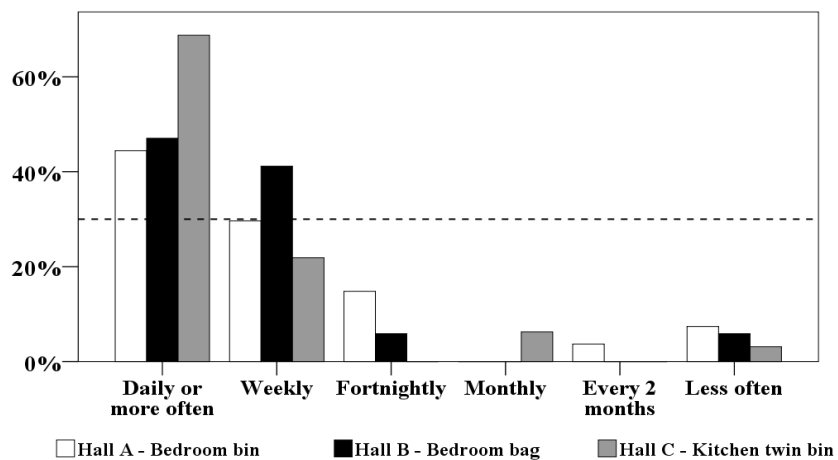
a) Frequency of paper and card recycling.
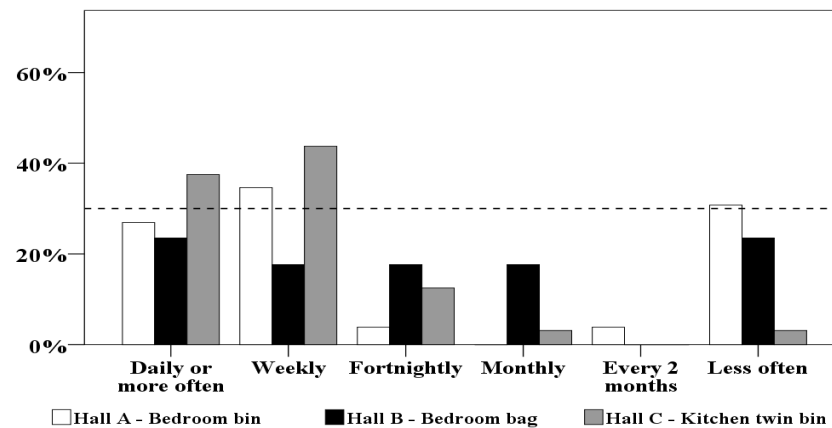
b) Frequency of can recycling.
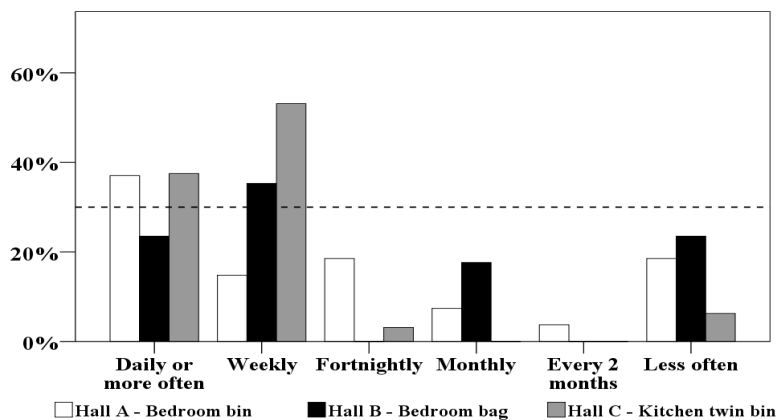
c) Frequency of plastic bottle recycling.
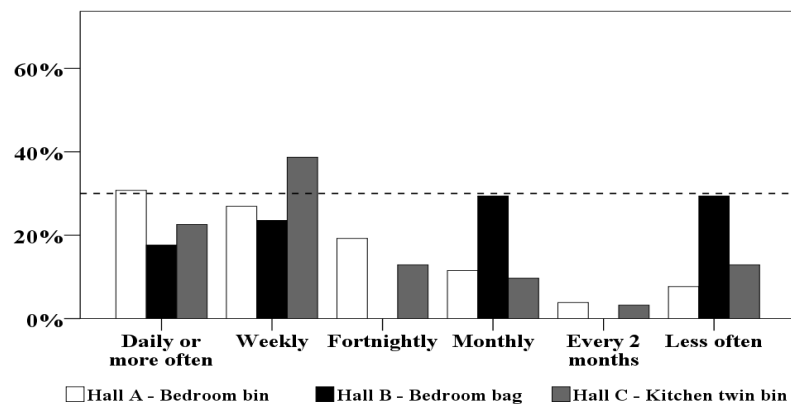
d) Frequency of glass bottles and jars recycling.

Figure 6.4 a-d. Response of the participants to the question ''How often do you recycle the following items?''

Self-reported behaviour by respondents showed impressive shifts towards increased recycling in HoR with recycling facilities (see Figure 6.5). 67% of respondents from the three halls with recycling facilities who also lived at halls in 2006/07 academic year claimed that they recycled more in 2007/08. The survey results showed a striking decrease in recycling at the control hall, where 40% of respondents who lived at halls in 2006/07 claimed that they recycled less in 2007/08. All respondents at the control Hall D who lived at private housing and 90% of respondents who lived at home in 2006/07 stated that they recycled less in 2007/08.
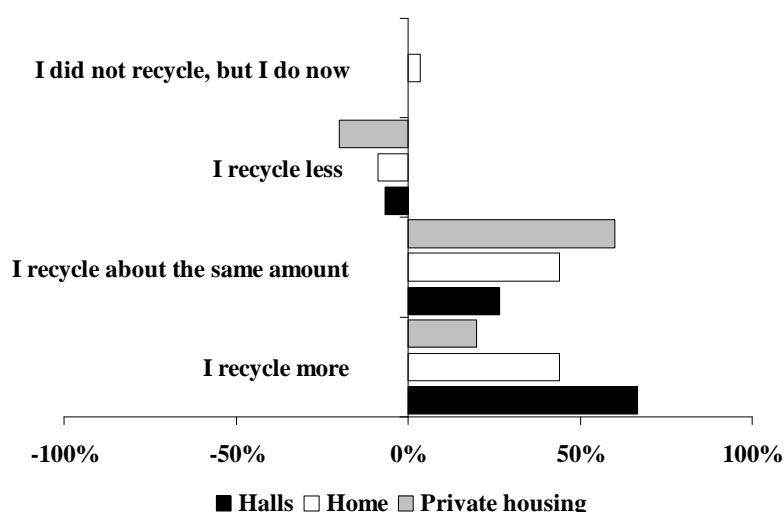
a) Changes in claimed recycling behaviour in 2006/07 to 2007/08 academic year at halls where students had recycling facilities.
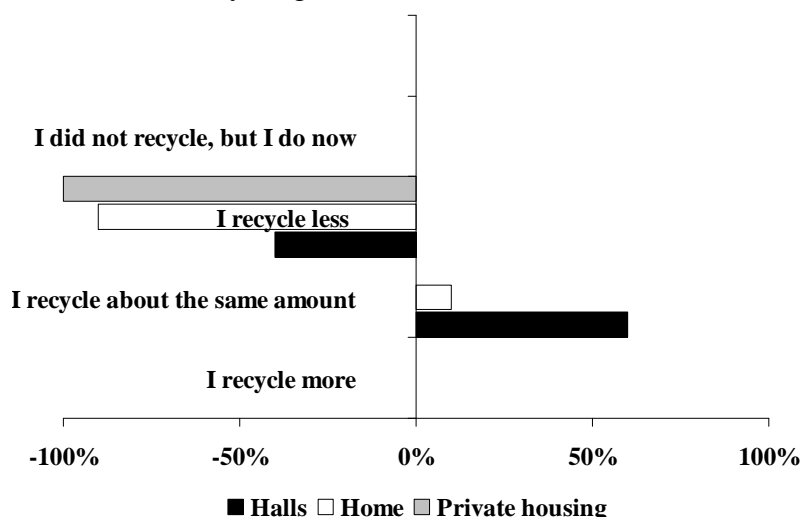
b) Changes in claimed recycling behaviour in 2006/07 to 2007/08 academic year at the hall where students had no recycling facilities (control hall).

Figure 6.5 a&b. Changes in claimed recycling behaviour in 2006/07 to 2007/08.

Overall, the level of satisfaction with key elements of the recycling schemes was consistently high. Figures 6.6a-c show that respondents from Hall C ('kitchen twin bin scheme') were generally more satisfied with the convenience of the scheme and the size and location of the recycling bins compared to Hall A ('bedroom bin scheme') and Hall B ('bedroom bag scheme').

Despite students' awareness and participation being relatively high, there is clearly still room for improvement to the scheme (Table 6.4). Between 44-59% of students felt that they did not recycle everything they could and they also reported on what would encourage them to recycle more, as shown in Table 6.5. An average of 34% students agreed that knowing what to recycle would encourage them to recycle more, even though they were informed about the recycling schemes by several mechanisms at the beginning of the academic year (see Section 6.2.3).
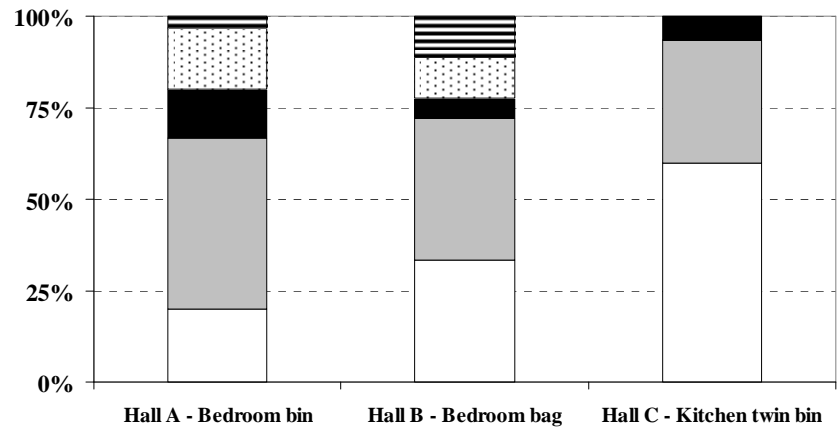
Extremely satisfactory ☐ Satisfactory ▨ Neutral ■ Unsatisfactory ⊡ Not at all satisfactory ☰

a) Satisfaction with the location of the internal recycling bins/bags.
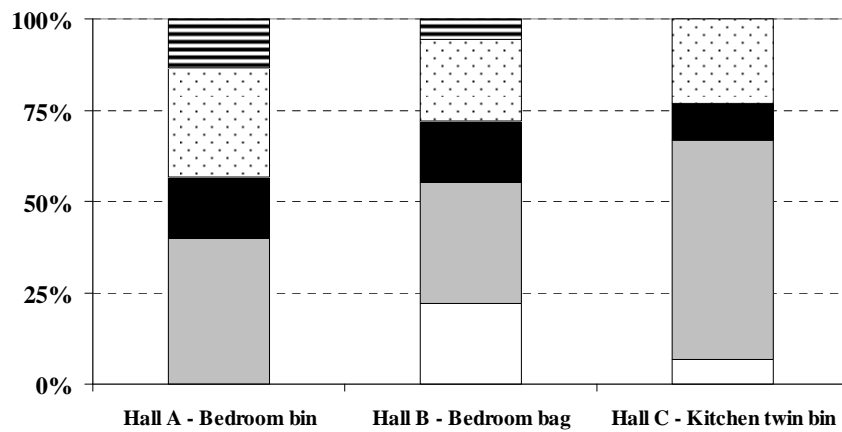
☐ Extremely satisfactory ▨ Satisfactory ■ Neutral ☐ Unsatisfactory ☰ Not at all satisfactory

b) Satisfaction with the size of the internal recycling bins/bags.
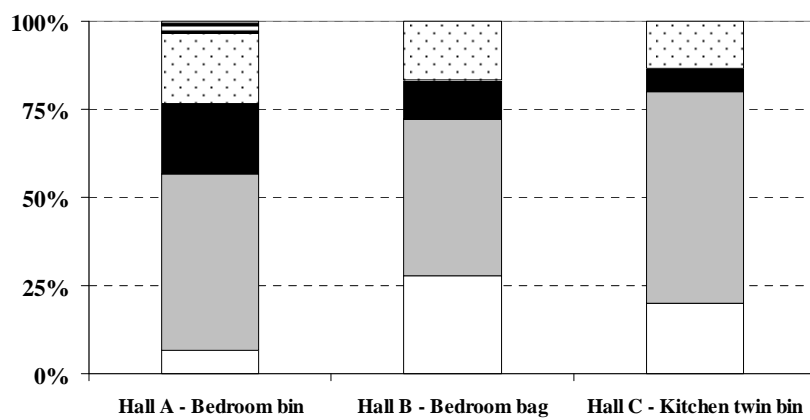
☐ Extremely satisfactory ▨ Satisfactory ■ Neutral ⊡ Unsatisfactory ☰ Not at all satisfactory

c) Overall satisfaction with the convenience of the scheme.

Figure 6.6 a-c. Satisfaction with the elements of the recycling schemes.

Table 6.5 Response of students to 'Do you feel you recycle as many recyclable items as you can?'

Response	Category of response by HoR (%)			
	Hall A Bedroom bin	Hall B Bedroom bag	Hall C Kitchen twin bin	Hall D Control
Yes	40.7	53.3	55.6	7.5
No	59.3	46.7	44.4	92.5

Table 6.6 Response of students to 'What would encourage you to use the recycling facilities more often?'

Response	Category of response by HoR (%)			
	Hall A Bedroom bin	Hall B Bedroom bag	Hall C Kitchen twin bin	Average
Knowing what to recycling	20.8	37.5	43.8	34.0
Knowing how to recycle	4.2	6.2	0	3.5
Knowing where to recycle	0	18.8	3.1	7.3
More information on the impact of rubbish	16.7	0	0	5.6
Rewards	29.2	18.8	12.5	20.2
Not having to wash items before putting them in the recycling bins	12.5	6.2	15.6	11.4
Nothing	12.5	6.2	12.5	10.4
Other	4.1	6.2	12.5	7.6

6.3.3 End-of-term reuse and recycling

The 2006/07 academic year trial was not a great success, partially due to heavy rainfall in the summer. All of the potentially re-useable materials collected, such as shoes, clothing, mattresses and electronic equipment, were rain-damaged and unsuitable for reuse. In addition, food waste, cigarette butts, takeaway boxes and other food packaging were dumped in the recycling skips. Valuable lessons were learned from this trial. Lacking a suitably detailed project plan left a communication gap between the project planners and the contractors. The contractors should have been more involved in the planning stage so that they were clear what services were needed and when. An earlier and more comprehensive communication strategy with the students should also have been developed and implemented.

The lessons learned led to a re-think of the approach needed and led to the involvement of a charitable organisation in the 2007/08 academic year 'end of term clearout' event. This proved much more successful; and a total of 1.85 tons of reusable textiles were diverted from the HoR by the end of September 2008.

6.4 Discussion

6.4.1 Term time recycling schemes

The results show that paper and card made up the highest proportions of the recyclable material followed by glass, plastic bottles and cans. The average percentage of food waste - >40% - is much higher than reported by recent studies of household waste composition (DEFRA, 2009a, 2009b). This highlights that the lifestyles of young adults tend to be more consumer-oriented and 'throwaway' than the wider population and suggests that a food waste prevention campaign that targets students may be required. A comparison of recycling rates from different halls suggests that the recycling schemes have helped to improve recycling at the UoS. However, there were clear differences in the effectiveness of the schemes. The kitchen twin bins system achieved the highest recycling rate of 25% amongst the different schemes. This result is better than the average dry recycling rate of 22% in England in 2007/08 (DEFRA, 2009c). The waste composition analyses highlighted that a 'convenient recycling infrastructure' is a key factor in a successful recycling scheme. Student Hall C, with the twin bin system, had the smallest percentage of recyclable materials in its general waste compared to the other three halls. Addressing convenience is an important factor for a

successful scheme start up and it needs to be given a high priority at the scheme planning stage. Communal kitchens proved to be the most convenient location for bins as students produced most of their dry recyclables during cooking, and it is relatively easy for the university's cleaning staff to empty the bins regularly and take the material to a recycling point. Another benefit of the scheme is that there is no increase in workload for the halls staff therefore there is no extra labour cost.

Convenience appeared to be the main influencing factor for recycling materials in certain locations. Figure 6.2 clearly showed that paper (including newspapers, white paper, magazines, junk mails etc.) was recycled most effectively in students' rooms whereas cardboard, metal cans, plastic bottles and glass containers, which tend to be generated when cooking, were collected better where recycling bins were located in kitchens. However, glass posed a significant problem in a few flats. Some students played an informal, inter-flat competition that used window displays of collected empty wine and beer bottles in their communal kitchens as evidence of their ability to consume alcohol rather than recycling them (see Appendix L). Since glass containers are relatively heavy, students were subsequently reluctant to carry the accumulated glass to recycling points and so it often built up in some kitchens and eventually needed to be removed by the university's cleaning staff. This again shows how some students' lifestyles are detrimental to effective waste management operations, particularly in high density accommodation.

A convenient scheme may also help to maintain a low contamination level. Relatively high contamination levels were found at Hall A with the 'bedroom bin scheme' and Hall B with the 'bedroom bag scheme' in comparison to Hall C with the 'kitchen twin bin scheme'. Plastic bags and bagged general waste were found to be the main source of contamination in recycling loads. At the start of the schemes, when recycling bins were distributed to the halls, each student was given a USB flash drive with detailed instructions on the items that could and could not be placed in their new recycling bins. The 'kitchen twin bin scheme' hall achieved the lowest contamination level was possibly because as here the University's cleaning staff manually picked out any obvious contaminants before they placed recyclables into external recycling bins. They also ensured that the black bin bags being used to carry the recyclables were reused or disposed of in general waste bins.

Contamination can be either 'innocent' or 'deliberate'. Innocent contamination is often from students who are not sure whether an item should or should not be recycled. This type of contamination can be reduced by more effective communication and education. Deliberate contamination is from students who have little concern about recycling and/or contaminate recyclates on purpose. An effective way to reduce contamination is to place recycling bins next to general waste bins, where space allows.

The collection service suffered an array of problems in the first five months, including: unreliable and irregular collection service; movement of the recycling bins without consultation with the university; poor data provision; false and misleading labeling of infrastructure and poor communication. The unreliable and irregular collection service had a significant impact on the project, with negative impacts including: overflowing and unsightly recycling bins; breeding of flies and vermin; operational and logistical difficulties for the halls staff; de-motivation of students for participation and disagreements between project partners. The schemes were monitored (by the research team) on a regular basis – although the contractor was unaware of this. The situation was partially remedied by a 'crisis meeting' in which the waste contractor agreed to significantly improve performance. However, the failure of the contractor to provide a reliable service significantly reduced the students' enthusiasm for recycling. It is highly likely that a better quality service from the contractor would have resulted in higher recycling and participation rates.

A combination of methods were used in order to raise students' awareness and tackle contamination of recycling bins, including posters, feedback cards, training and meetings. From April 2008, 'traffic light cards' were also issued to students periodically in order to ease contamination. Nonetheless, no significant improvements were observed at Hall A and B with bedroom recycling facilities by the end of the academic year. This is because behaviour change tools should be backed up by an appropriate recycling infrastructure. Without a convenient recycling infrastructure in place, these techniques alone have very little effect.

The success of a recycling service is highly dependant on the number of people who participate in the service and the frequency of its use (Bolaane, 2006, Davis et al., 2006, Perrin and Barton, 2001). Despite students' awareness and self-reported participation rates being relatively high, the results of the student satisfaction survey should be interpreted with caution in view of the low response rate of 15%. Recent

experience at the UoS suggests that an online survey would be more attractive to students, as well as being more environmentally friendly, cheaper and faster to return. There is still room for improvement to the scheme according to the residual waste composition data; some aspects of students' lifestyles are detrimental to effective waste management operations even thought students are often very pro-environment in attitude - the so-called attitude-action gap. However this phenomenon has been largely ignored in previous research on student recycling behaviour. Previous research shows that university students claim greater concern for recycling (Cheung et al., 1999, Kaplowitz et al., 2009, Kelly et al., 2006a), but older people are more likely to participate in recycling activities (Vining and Ebreo, 1990). The results of the student survey in this study suggest that rewards maybe a solution. However, some previous studies showed that financial incentives do not produce long lasting changes in behaviour (Oskamp et al., 1991, Pardini and Katzev, 1984).

Monitoring is a key part of the development of any recycling scheme but often absent from HEIs' waste management activities. Monitoring enables an assessment of whether schemes are performing as expected, diagnosis of problems, design of new approaches and improvements in efficiency and effectiveness. At least four areas should be monitored regularly: 1) reliability of the service provided by your waste contractor; 2) scheme usage and participation rate; 3) recycling rate analysis; and 4) contamination assessment. The UK's Waste and Resources Action Programme has published useful guidance for monitoring recycling schemes (WRAP, 2006).

6.4.2 End-of-term reuse and recycling

A study by the UK's Department of Food and Rural Affairs (DEFRA) indicated that reuse of clothing showed a large and positive benefit over recycling or disposal and recycling textiles showed a significant benefit over landfill and energy recovery in terms of its CO_2 emission benefits (DEFRA, 2006b p. 10). In the UK, the third sector (TS) plays an important role in reuse and recycling activities, especially in niche areas such as textile reuse and recycling, and it includes voluntary and community organisations, charities, social enterprises, cooperatives and mutuals (Cabinet Office, 2009). Another recent DEFRA (2009d) study recommended separate textile collections similar to the one tested in this study to avoid contamination. It also showed that although 11,000 textile and clothing banks are scattered in the UK, the barriers to increased deployment

are comparatively low. This study demonstrates that there are sound reasons for HEIs to collaborate with the TS. The TS sector not only fills the gap between HEIs and their contractors but also facilitates mutually beneficial exchange between HEIs. It helps the TS uses its resources more efficiently by allowing them placing textile banks on campus/in halls where population is concentrated. Alexander and Smaje (2008) highlighted that schemes provided by the TS may help divert reusable items from the waste stream using inputs that would be uneconomic for mainstream waste contractors. They are able to tap into local resources more effectively than public or private sector organisations and they also create work and volunteering opportunities to local communities.

6.5   Conclusions and Recommendations

This study has demonstrated that Timlett and Williams's ISB model can be used as a practical tool for the development of a successful recycling programme. The key lessons from the study are set out below:

- Different types of infrastructure and service provision resulted in different recycling rates.

At the best-performing student hall (with the kitchen twin bin system), the infrastructure and service provision were considered to be the most convenient of those tested. Recycling bins were provided in communal kitchens where most of the recyclables were produced. The University cleaning staff emptied the bins twice a week and took materials to the external recycling points. At the other two halls, recycling bins were provided in bedrooms and students were responsible for emptying their own recycling bins and carrying them to external recycling points. The results indicate that more convenient and higher quality infrastructure and service provision resulted in higher recycling rates.

- Students have lifestyles that impact significantly on waste arisings and consequently on waste management operations at HoR (and probably at HEIs and student-dominated residential areas).

A 'high consumption' culture - fast fashion, fast food, drinking contests, IT dominated, high turnover of goods and services – generates pressures on waste management operations, particularly at certain times of year such as end of term periods and especially at the end of the academic year. Students were found to waste more food than

typical UK households; this suggests that food waste prevention campaigns specifically targeting students might be required at HEIs. The evidence suggests that in order to achieve higher recycling rates, the student population needs easy-to-use, convenient and tailored infrastructure and service provision, and regular, carefully timed and tailored communication and feedback.

- A waste contractor that can provide a tailored, reliable, regular and consistent collection and disposal service supported by regularly provided high quality waste management data is essential for HEIs.

Without a quality service from waste contractors, recycling schemes cannot run successfully. The evaluation of service quality should be carried out regularly – preferably independently - and using a suitable set of agreed transparent and easily auditable performance indicators (PIs).

- There are sound reasons for HEIs to collaborate with TS organisations that specialise in reuse and recycling, particularly for material streams that would be uneconomic for mainstream waste contractors.

Chapter 7

7 Understanding university students' recycling behaviour

7.1 Introduction

Public sector organisations in the UK – national and local authorities, government agencies, hospital trusts, education establishments, etc - are often expected to adopt and embed sustainable management and operational practices early as an example to other sectors and also because it is generally assumed that they should be inherently economically, environmentally and socially responsible. Such organisations are increasingly being required to meet specific targets, set internally by management and externally by government e.g. the UK's Sustainable Operations on the Government Estate (SOGE) targets.

HEIs are often considered to be similar to small towns because of their large size, population, infrastructure and the various complex activities taking place (Alshuwaikhat and Abubakar, 2008). HEIs thus require similar services to small towns, including accommodation, transport, retail, leisure and waste management. In the last two decades, the provision of a cost-effective and sustainable waste management service has become increasingly important to UK HEIs. This is the last chapter in the 'Greening Academia' series to address this issue. The first chapter (Zhang et al., in review a) critically reviewed and identified why sustainable waste management has become a key issue for the global HE sector. It outlined the four-phase waste management strategy developed over 15 years at the UoS, England. The second chapter (Zhang et al., in review b) described in detail the development of a recycling project at HoR using a so-called the ISB. This chapter focuses on behavioural change issues by exploring:

- Why students recycle (or not); and
- What factors influence students' recycling behaviour and serve as initiators for behavioural change.

It investigated if and how an established behavioural model – the TPB model - can help to develop the design of a recycling scheme at a HEI. The study also investigated different factors that might significantly impact university students' recycling behaviour e.g. environmental knowledge and attitudes towards recycling.

The aims of this study were to investigate if and how the TPB can help to develop the design of a recycling scheme at a HEI and to investigate what factors significantly impact university students' recycling behaviour. The objectives were to:

1. Develop and test the TPB on a university student population;
2. Identify specific influencing determinants of recycling behaviour;
3. Examine other factors that may shape students' recycling behaviour;
4. Test students' knowledge of waste management; and
5. Compare students' self-reported knowledge of waste management issues with actual knowledge.

7.2 Methods

During the study, two separate surveys were carried out. The first survey was completed in April 2008 using the TPB model and specifically addressed objectives 1 and 2. The second survey, completed in May 2009, investigated other factors that may influence recycling behaviour and addressed objectives 3-5.

7.2.1 TPB survey

From October 2007, a set of recycling trials were set up at the UoS. Four student halls were selected in this study. Three of them were provided with recycling facilities by the University and one was used as a control and consequently no recycling facilities were provided at this hall. The targeted population was students who lived at the four student HoR. The questionnaires were delivered to each bedroom in these halls and students returned the completed questionnaires to the receptions at their hall.

As the determinants of behaviour are expected to vary amongst different populations, (von Haeften et al., 2001), additional parameters were added to tailor the TBP model for this study. The questions were measured using Likert scales that ranged from one (strongly disagree) to seven (strongly agree); only the endpoints were anchored. It also included questions on demographic factors such as sex, year of

college, ethnicity residence and major subject studied. The questionnaire contained the following sections:

- Attitude towards recycling (ATR)

Participants rated their overall opinions about recycling. Two items assessed attitude: 'Recycling is important to me; recycling is rewarding to me'.

- Subjective norms (SN)

Two items served as indicators of the subjective norms: 'People who are important to me would approve of me recycling; People whose opinion I value would think I should recycle'.

- Perceived behaviour control (PBC)

Two items were used to assess PBC: 'There are plenty of opportunities for me to engage in recycling; If I want to, it would be easy for me to engage in recycling during the next fortnight'.

- Moral obligations (MO)

Three items were used to assess moral: 'I would feel guilty if I did not recycle my waste; it is everyone's duty to recycle in the UK; to engage in recycling is an important part of who I am'.

- Intention (INT)

Two behavioural intention questions were included: 'I intend to participate in the recycling scheme at my hall within the next fortnight' and 'I will try to participate in the recycling scheme at my hall within the next fortnight'

7.2.2 Recycling attitude survey

The second survey was completed in 2009 using web-based self-completion questionnaires. The link to an online questionnaire was posted on the notice board of the University's website for three weeks during April-May 2009. A covering letter that explained the purpose of the survey and encouraged participation formed the front page. After completion, students sent their responses to a centralised database.

The advantages of electronic surveys include: relatively low cost; rapid response and wider coverage compared to conventional survey methods (Thomas, 2003 p.118). Internet-based surveys can also achieve high response rates from university-based populations because this group often has easy access to the Internet and students are regarded as largely or entirely computer literate (Fricker and Schonlau, 2002).

The survey included a set of questions to assess students' knowledge of waste management, including knowledge of systems, procedure and effectiveness. This was assessed in three areas: 1) general knowledge about waste and recycling; 2) specific knowledge of recycling, including waste separation, renewable materials, recyclability and biodegradability; and 3) current UK policies and strategies for recycling. In order to provide a standard from which to compare each student, students who answered:

- ten out of ten questions correctly were classified as extremely knowledgeable about waste issues;

- between seven and nine out of ten questions correctly were classified as very knowledgeable;

- between four and six out of ten questions correctly were classified as moderately knowledgeable;

- between one and three out of ten questions correctly were classified as little knowledgeable; and

- zero out of ten questions correctly were classified as not at all knowledgeable.

The results were then compared against the students' self-assessment of their knowledge. It also assessed the sources of information and ways of learning they prefer.

7.3   Results

7.3.1   TPB survey results

A total of 106 students returned their questionnaires after one reminder, giving an overall response rate of ~15%, in which 80 students had recycling schemes and 26 had no recycling schemes at their halls. The demographic composition of the sample is shown in Table 7.1. There was a bias in the sample towards females (66%). A comparable trend has been observed from similar behavioural research (Davis et al., 2006, Hagger and Chatzisarantis, 2006, Tonglet et al., 2004b). The respondents included a variety of majors and first-year undergraduate students were over-represented, mainly because most students living at student HoR are first-year undergraduate students.

Of the 80 respondents where recycling facilities were provided, 77 (95%) reported themselves to be recyclers, and of these, 84% reported that they recycled on a daily or weekly basis, 7% recycled fortnightly, and 9% recycled less often. Paper and card were recycled most frequently, followed by plastic bottles, cans and glass bottles

and jars. This can be explained by the natural frequency of usage of materials that paper and card are used everyday and cans and bottles are often consumed during cooking only. Of the 26 students without recycling facilities, 35% reported participating in some form of recycling during the year. When they were asked about the likelihood of participating in future halls recycling schemes, all stated that it was extremely or very likely.

Table 7.1 The demographic composition of the sample for the TPB survey.

	n	%
Gender		
Male	36	34
Female	70	66
Total	106	100
Year		
First year undergraduate	76	71
Second-fourth year undergraduate	7	7
Postgraduate	23	22
Total	106	100
Major		
Art	23	22
Social science	24	23
Science and engineering	46	43
Law	6	5
Medicine	8	8
Total	106	100
Ethnicity		
UK student	77	73
EU student	10	9
Overseas student	19	18
Total	106	100

A factor analysis was carried out in order to group the variables into factors that represent independent underlying dimensions of this study. It grouped the variables into four independent factors and Cronbach's alpha was used to indicate the internal consistency of each measure. These factors and their corresponding reliability coefficients are shown in Table 7.2 which shows that they evinced good internal consistency ($\alpha > 0.75$). Significant correlations were found among the TPB predictors expect subjective norm. PBC showed the highest correlation with intention.

Table 7.2 Correlation between individual components of the TPB model and factor reliability (Cronbach's alpha coefficients)

Variable	α	1	2	3	4
1. Intention	0.893				
2.Attitudes	0.845	0.389**			
3.Subjective norm	0.892	0.058	0.529**		
4.PBC	0.871	0.522**	0.349**	0.188**	
5. Moral obligation	0.802	0.361**	0.755**	0.494**	0.372**

**p < 0.01

A hierarchical multiple regression analysis was conducted to examine the proposed predictors of intention to recycle and to determine which factor had the greatest impact on the intention to recycle. The original TPB variables were entered in the first step of the regression analysis and the measure of moral obligation was added in the second step. As depicted in Table 7.3, the TPB variables accounted for 33.1% of the variance in intention, with attitude and PBC reported as significant. PBC had the greatest influence (β = 0. 444), followed by attitude (β = 0.337). When moral obligation was added to the analysis, the model explained 34.3% of the variance in intention.

Table 7.3 Multiple regression analysis: intention to recycle

Step and variable	B	SE B	B
Step1			
Attitude	0.334	0.100	0.337*
Subjective norm	-0.210	0.096	-0.202
PBC	0.439	0.086	0.444**
Step2			
Attitude	0.283	0.130	0.286
Subjective norm	-0.210	0.097	-0.211
PBC	0.429	0.088	0.434**
Moral obligation	0.180	0.131	0.179*

R^2 = 0.331 for step 1; R^2 = 0.341 for step 2;

*p<0.5; **p<0.001

7.3.2 Recycling attitude survey

A total of 826 responses were received of which 90% completed the whole questionnaire. 44% were males and 56% were females. As expected, the majority (45%, n=371) of the respondents were first year undergraduate students, 70% (n=578) were UK students, and 80% (n=661) were <25 years old.

7.3.2.1 Perception of environmental issues

Respondents were asked to comment on the priority they felt the Government should place on environmental issues compared with other issues. The 'economy' was considered the most important issue (57%), followed by 'environmental issues' and 'future energy supplies' (both at 38%), 'unemployment' (33%), and 'rising cost of living' (25%). When asked about environmental issues specifically, 'climate change' was considered to the most important issue (63%), followed by 'waste management' (59%), 'using up natural resources' (50%) and 'air pollution' (23%).

The questionnaire included a number of attitude statements relating specifically to environmental issues and waste management, and the respondents were asked if they agreed or disagreed with them (see Figure 7.1). The majority of students reported that they were concerned about waste management and recycling. However, opinion was divided on whether 'Waste issues remain a low priority in their life'; similar responses were observed for: 'Tackling waste issues should not come at the expense of the British economy'.
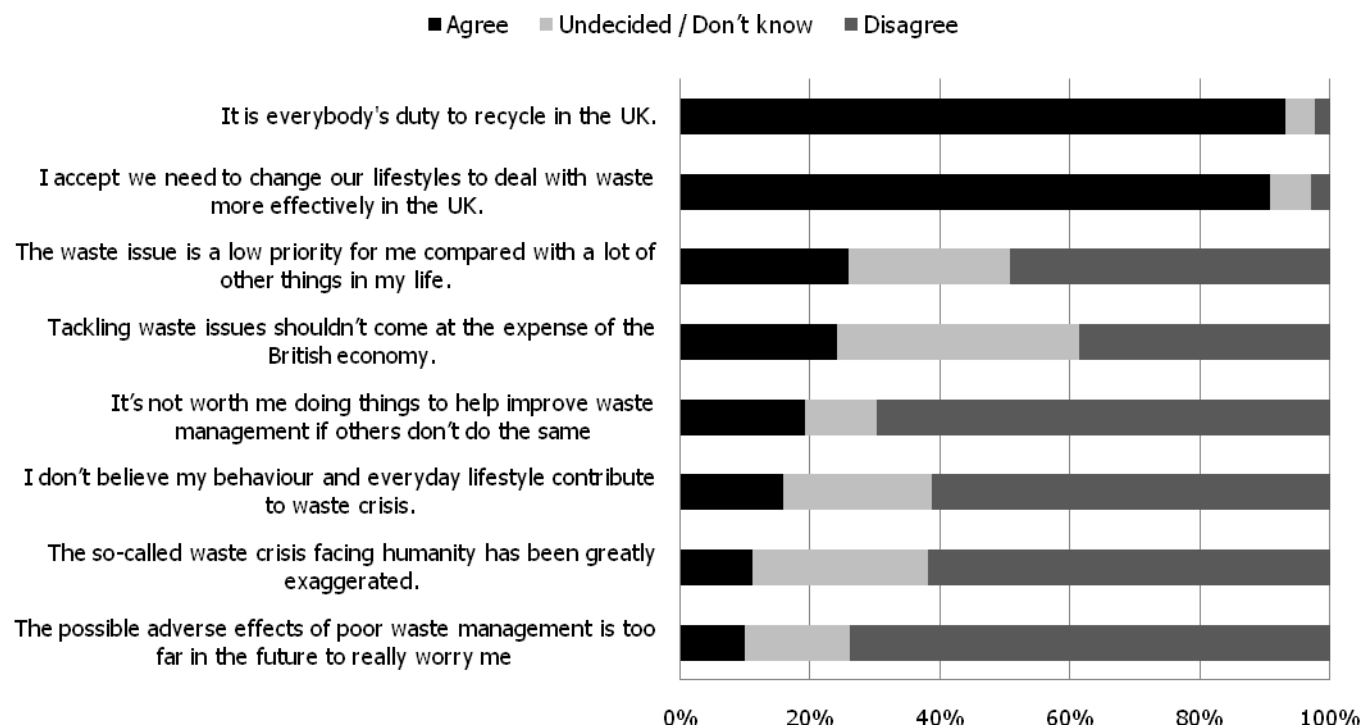
Figure 7.1 Students' attitude towards environmental issues and waste management.

7.3.2.2   Knowledge of waste management and recycling

Respondents were asked to indicate how much they know, if anything, about a range of environmental terms and concepts. Figure 7.2 shows that the top three out of ten most well-known waste management terms and concepts were: 'greenhouse gas', 'composting' and 'hazardous waste'. However, more than half (53%) said they had never heard of or heard but do not understand 'source segregated collection'. More than one third of respondents had never heard of or heard but do not understand 'waste electrical and electronic equipment (WEEE)' (39%), 'landfill tax' (34%) and 'biodegradable waste' (33%).

The questionnaire then assessed students' knowledge of waste management issues and the questions are reproduced in Figure 7.3. It consisted of a number of statements where students were asked to indicate if the statement was right or wrong. Table 7.5 shows the results of the assessment. Only 38% of students knew that 'the UK generates around half a ton of household waste per capita per year'. The majority of students (67%) did not understand why people should recycle and less than half understood concepts such as renewable material, recyclability and biodegradability. When students were asked about national targets, only 8% recognised that the national target is to recycle and compost 40% of household waste and 53% of municipal waste by 2010 (DEFRA, 2007b). The average number of items that students answered correctly was 4.1 out of 10 with a standard deviation of 2.2. The findings clearly show that the students had limited knowledge of current waste issues and policies.
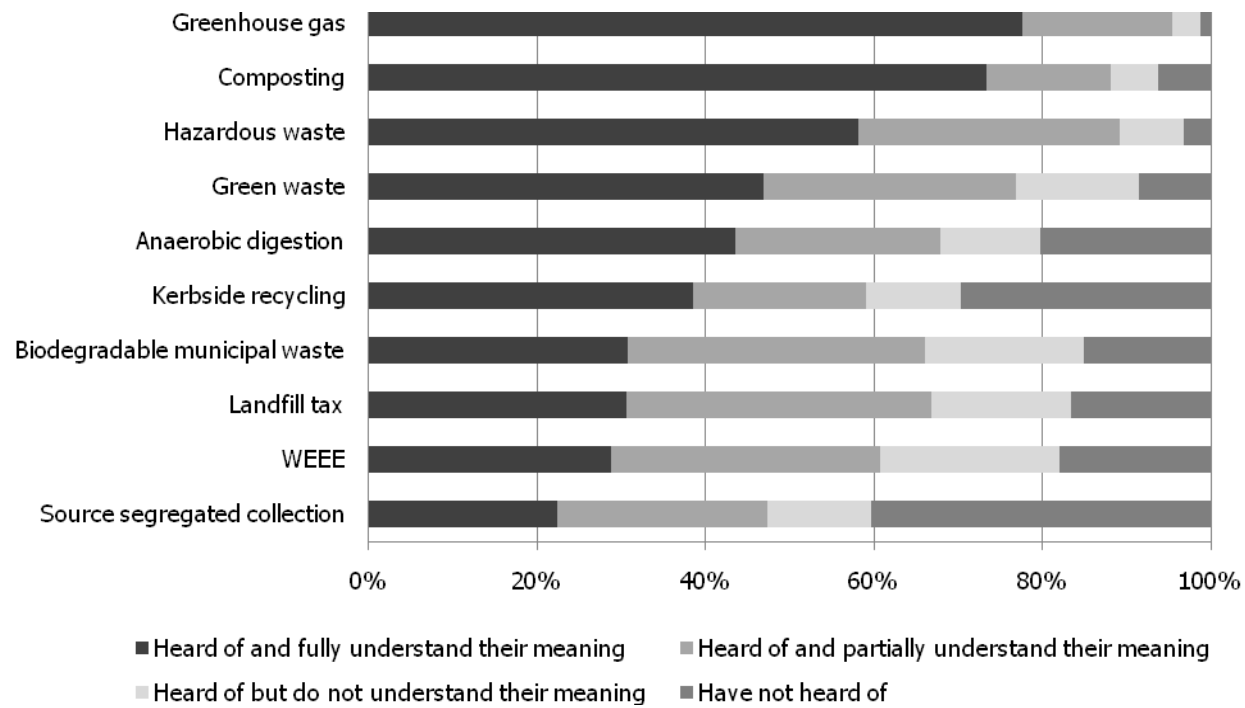
Figure 7.2 Students' knowledge of environmental concepts.

1 The most common method of waste disposal in the UK is incineration.

2 More plastic is recovered for recycling than paper every year in the UK.

3 When waste decomposes in a landfill, it mainly releases carbon dioxide which is
    harmful for the natural environment.

4 By 2010, the national target of the UK is to recycle and compost 20% of household
    waste and 30% of municipal waste.

5 The UK generates around half ton of household waste per capita per year.

6 Wood is a renewable raw material. This is because paper made out of wood is
    recyclable.

7 Paper can be recycled. This is because paper is biodegradable.

8 The mixing of waste at a dumping site makes some materials (e.g. paper & card)
    unfit for recycling.

9 Shredded glass can be used for making new glass (e.g. for bottles). That's why
    making new glass from sand is not necessary any more.

10 People throw away one third of all the food they buy in the UK.

Figure 7.3 Questions used to assess students' knowledge related to the waste issues**.**

Figure 7.4 displays students' self-reported knowledge against their actual knowledge level (results from Table 7.4) and their self-reported parents' knowledge on selected topics. Students who answered >7 out of 10 questions correctly were classified as 'extremely' or 'very knowledgeable'; using this definition, a total of 10% were deemed to be extremely or very knowledgeable about environmental issue, with 54% and 36% deemed to have moderate or no knowledge, respectively. The graph shows that many students clearly over-estimated their actual environmental knowledge. There is a very weak correlation of 0.22 between student claimed knowledge level and tested knowledge level. It means that students reported knowledge was unreliable and many students possess less knowledge than they think.

7.3.2.3   Environmental education

There are many sources that today's students use for news and information. The results shown in Figure 7.5 reveal that although television remains one of the major sources of information, the number of students who use conventional media (television, newspaper, magazines) has been overtaken by Internet users. Environmental education at school is ranked only sixth as a source of knowledge. This result is consistent with other responses: when students were asked about environmental knowledge received in school, only 5% of them thought they learned 'a lot' from school, and large numbers of students reported learning 'only a little or practically nothing' (47% and 15%, respectively). When asked about the quality of environmental teaching at school, more than one third (35%) thought that environmental education they received from school was 'poor' or 'very poor'. Just over 2% thought their environmental education at school was 'excellent' and 19% thought their environmental education was 'good'.
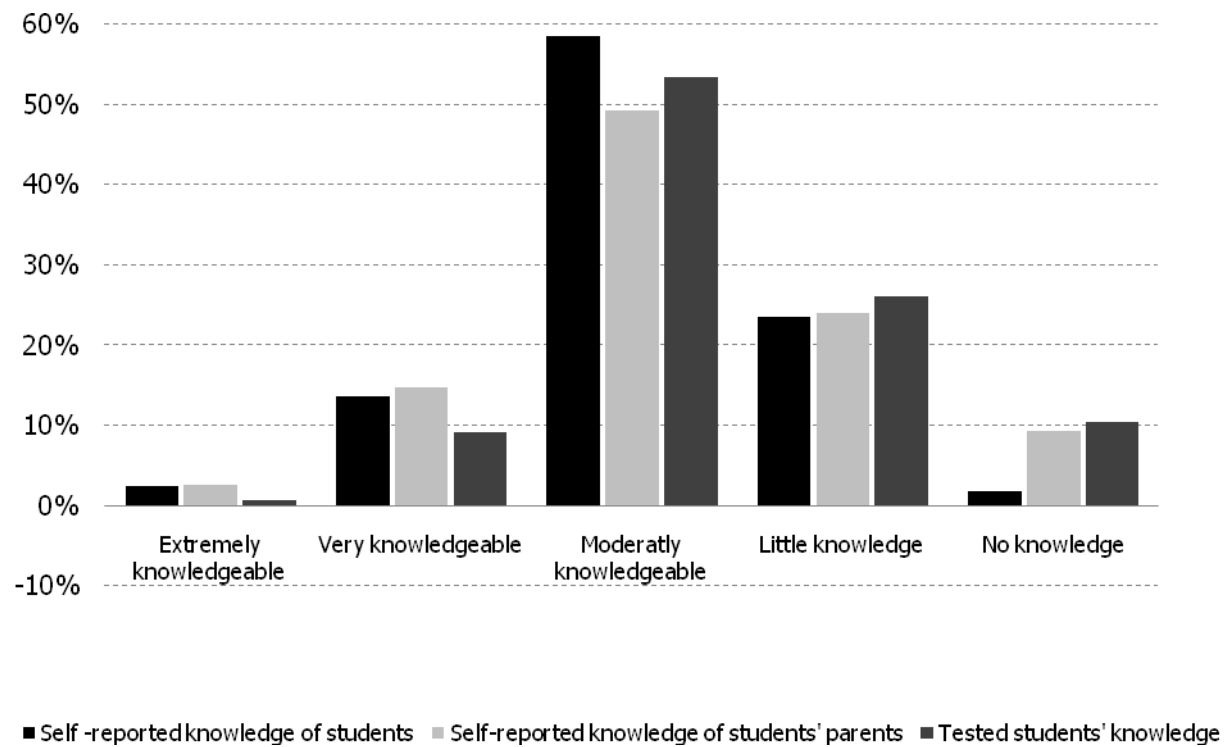
Figure 7.4 Students' level of knowledge about waste management
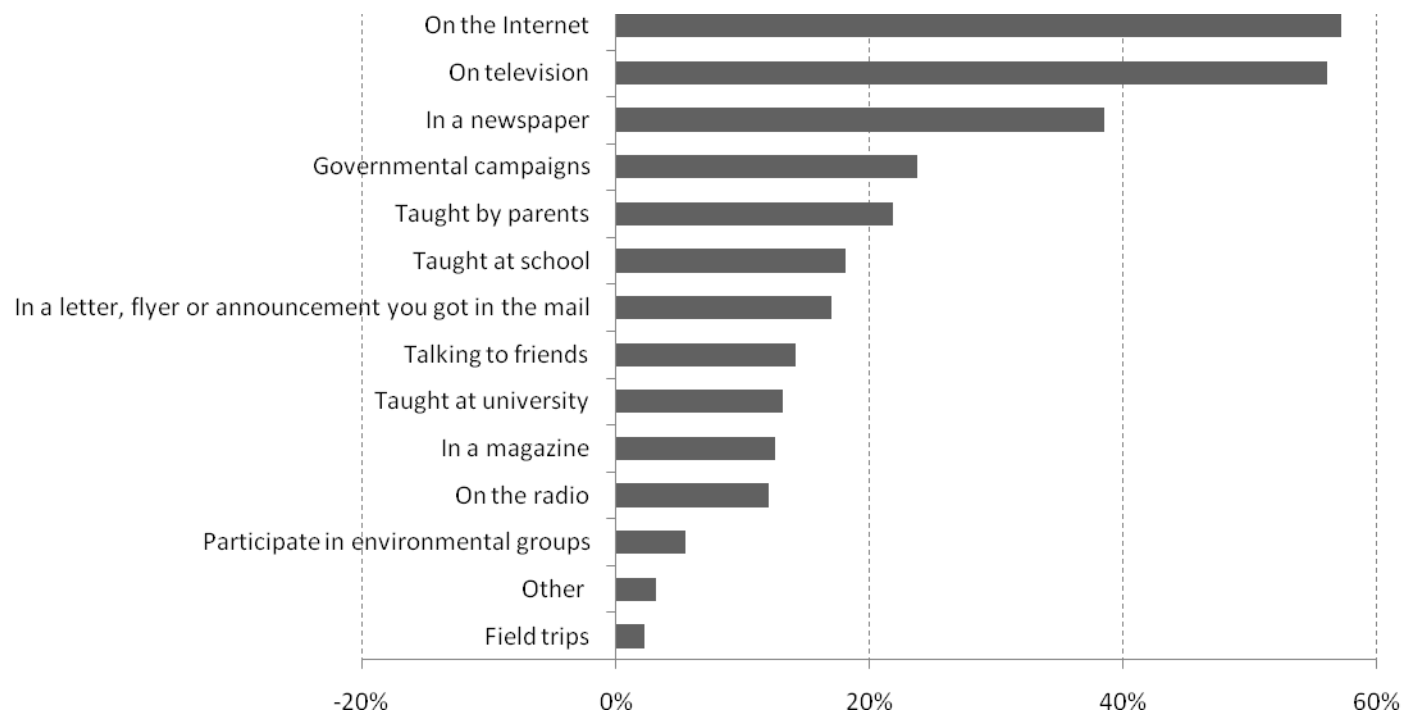
Figure 7.5 Students' main sources of information about environmental issues.

Table 7.4 Students' specific conceptual problems related to the waste issue (n=770): R = the percentage of students giving correct answers; W = the percentage of students giving wrong answers; DK = the percentage of students that do not know the answers.

Correct answer	Indication of knowledge	R (%)	W (%)	DK (%)
1 Wrong	Procedural knowledge	40	18	42
2 Wrong	Environmental effectiveness knowledge	33	24	44
3 Wrong	Environmental system knowledge	33	47	21
4 Wrong	Environmental effectiveness knowledge	8	32	60
5 Right	Environmental system knowledge	38	13	49
6 Wrong	Environmental system knowledge	49	36	15
7 Wrong	Environmental system knowledge	39	47	14
8 Right	Procedural knowledge	71	10	18
9 Wrong	Procedural knowledge	22	52	25
10 Right	Environmental system knowledge	75	5	20

Students were also asked whether their school-based environmental education had helped them to behave in a more environmentally friendly way. More than half (59%) of the students believed they had benefited fully or to some extent and ~20% thought their school environmental education did not assist them to behave in a more environmentally friendly manner. Furthermore, the vast majority of students (81%) believed that universities should provide their students with further environmental education in order to help them understand better environmental issues.

Students were also asked to name the restrictions they encountered during their school environmental education. Figure 7.6 illustrates that almost half of the students (49%) believed that 'Lack of hands-on activities' is the biggest limitation followed by 'Pupils aren't interested in environmental education' and 'Lack of information about available opportunities', both at 45%.

7.3.2.4   Reported barriers and motivations

The survey investigated factors that might prompt students to start recycling. Respondents were presented with a list of options but also given the chance to provide their own response. Figure 7.7 shows that the top three answers were: 'being taught through good practice from an early age at school' (70%); 'council provide better facilities within each household to help separate waste' (59%); 'rewarding good practice through financial incentives' (40%).

Student recyclers (n=521) were asked to state the main reasons for and barriers to recycling, as shown in Figure 7.8 Respondents reported that the most important six

reasons to recycle were: 'concern about the environment' (70%), 'social responsibility' (68%), 'habit' (58%), 'want to make an impact' (29%), 'pro-environmental values held by the family' (19%) and 'childhood experience in nature' (19%). The top six barriers were: 'lack of recycling facilities locally' (56%), 'shortage of storage space' (29%), 'having to wash recyclables before recycling' (23%), 'not in the habit of recycling' (18%), 'no one around me recycles' (15%) and 'I don't know what to recycle' (14%).
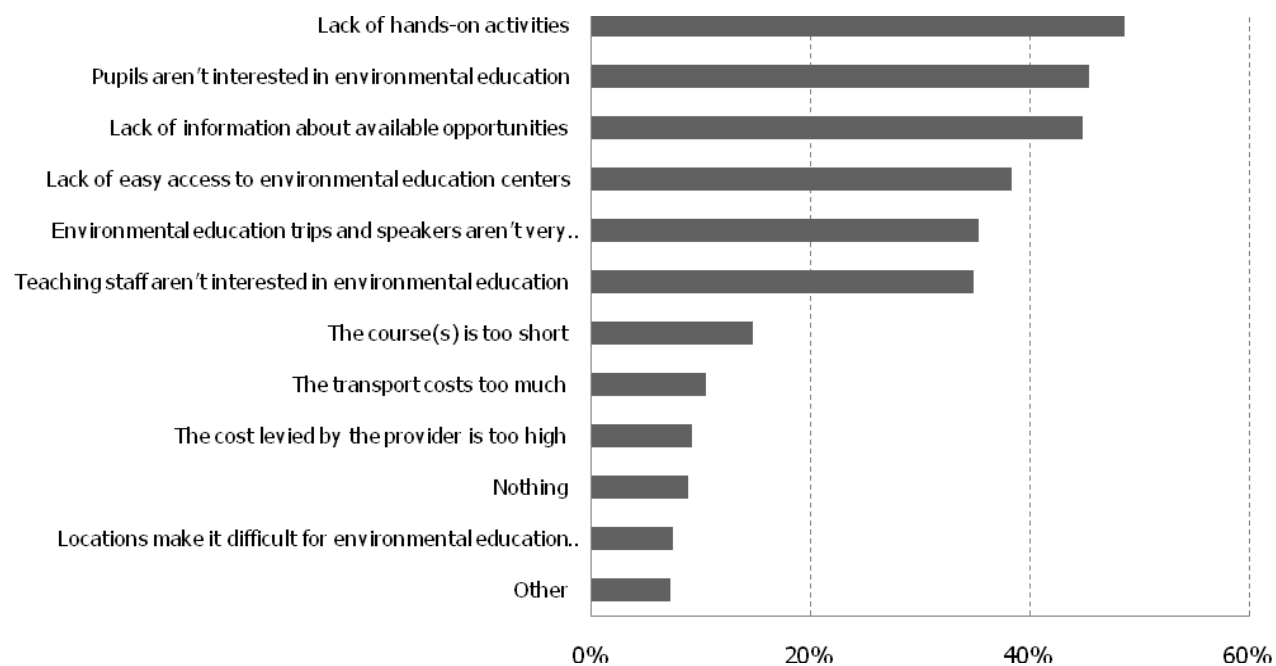
Figure 7.6 Students' perception of restrictions of environmental education opportunities in school.
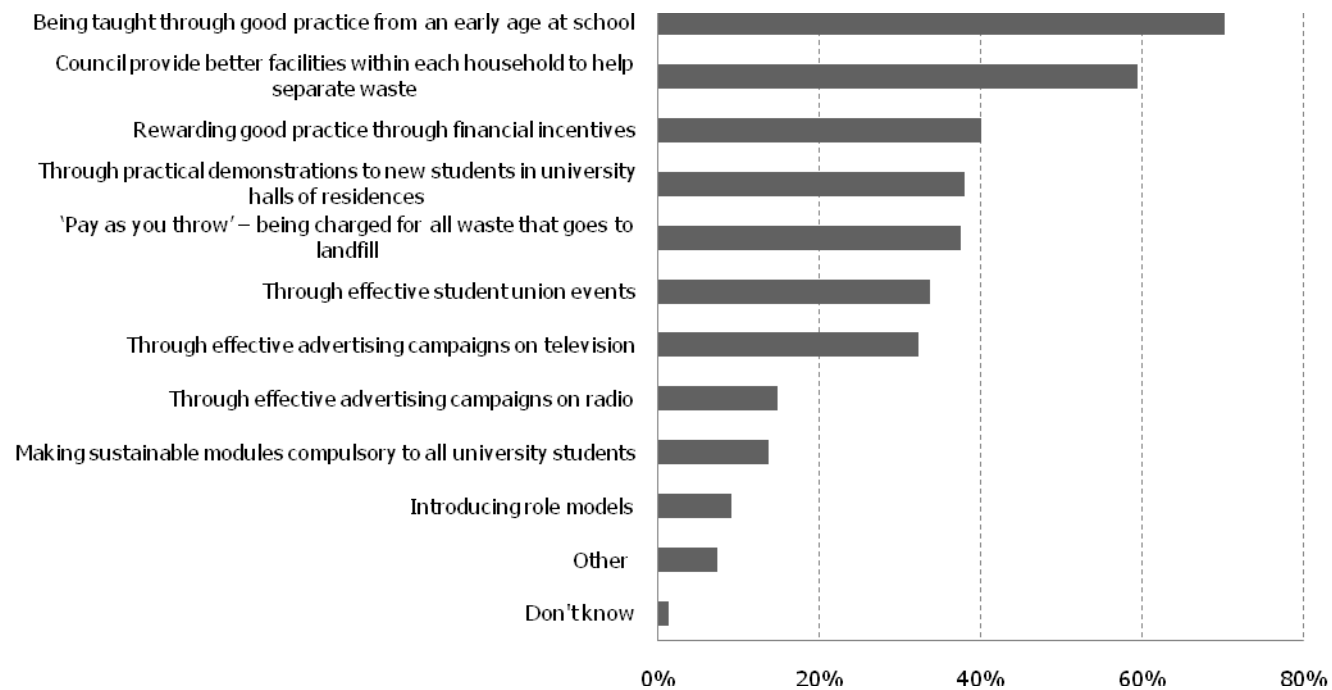
Figure 7.7 Students' perception of how to encourage them to recycle more.

Resistance forces		University Students		Driving forces

Resistance forces ← University Students → Driving forces

Lack of recycling facilities locally   Concern about the environment

Short of storage space   Social responsibility

Having to wash recyclables before recycling   Recycling habit

Not in the habit of recycling   Want to make an impact

No one around me recycles   Pro-environmental value held by the family

I don't know what to recycle   Childhood experience in nature

Figure 7.8 The forces influencing the recycling attitudes and behaviour of the students.

7.4 Discussion

7.4.1 TPB survey

The results of this study have both theoretical and applied implications for the development and implementation of recycling schemes. The TPB variables – attitude, subjective norm and PBC - explained just 33.1% of the variance of students' intention to recycle, increasing only 1% when moral obligation was included. The outcomes corroborate with some previous studies where attitude and PBC were also found to be the strongest determinants of recycling behaviour (Davis et al., 2006, Knussen et al., 2004, Tonglet et al., 2004a). Ajzen (1991) accepts that additional variables may be required but argues that they should contribute significantly to the explanation provided by the model. On this basis, future applications of the TPB to students' recycling behaviour should not include the additional measure of moral obligation. However, the results also showed that subjective norm is relatively insignificant in predicting students' recycling intention. Ajzen (1991) simply argued that subjective norms have less influence on intention than attitude and PBC.

The results of this study have a number of important implications. Firstly, behavioural determinants are not limited to attitudes, subjective norms and PBC. Secondly, many previous studies concentrated on inputs and outputs of psychological models and simply ignored the complex mechanisms of people's mind by dumping all the psychological variables into a mathematical model. However, no single theory seems adequate in all circumstances of the complex process of decision-making because the process varies according to different population and situation factors. Thirdly, to understand recycling behaviours fully, instead of relying on a single mathematical model, the following survey in 2009 examined 'people' factors that specific related to university students population. This study found that students' opinion is vastly supportive of recycling. However, the consumerist lifestyle adopted by university students has made them particularly infrastructure and service provision-sensitive. Once the logistics is in place, recycling does not become a drastic lifestyle choice, but a simple and efficient way to dispose of waste. Without convenient infrastructure and effective service provision, individual concern and individual resources such as education can not easily overcome contextual barriers to action. As a result of the transient nature of the student population, any interventions taking place as part of the

integrated behavioral changing programme should be informative and repeated periodically.

7.4.2 Recycling attitude survey

Consistent with research undertaken previously, in this study students held overwhelmingly positive attitudes towards environmental issues, including waste management, but had low levels of knowledge of basic environmental concepts (Alp et al., 2006, Chapman and Sharma, 2001, Kuhlemeier et al., 1999, Makki et al., 2003). Zhang et al. (in review b) showed that a positive attitude did not always lead to positive behaviour at many HoR; the translation of a positive attitude into positive behaviour needs to be facilitated. The key to unlocking behaviour change lies in the provision of appropriate infrastructure and effective service provision alongside a targeted behaviour change programme.

The study shows that 'environmental issues' was the second most frequently mentioned answer after the 'economy in general' when respondents were asked what were the most important issues facing the UK government. These results are consistent with those of contemporary studies such as DEFRA (2009b) and Scottish Environmental Attitudes and Behaviours Survey (SEABS) (2009). It is not surprising that the climate change is considered the most important environmental issue, because the mass media has a significant role in the development of public environmental knowledge and attitudes (Brothers, 1990). For example, Boykoff and Roberts (2007) reported that there has been a steady increase in mass media coverage of climate change in the UK from 1988 through 2006, and coverage quadrupled in 'quality' newspapers in 2006 as compared to 2003.

Mass mediated messages are often considered as equally important socialising agents as parents and schools in the lives of contemporary youth (Chan and Fang, 2007); watching television is one of the largest categories of media use among youth in post-industrial societies (Larson and Verma, 1999). Similarly to previous studies (Tung et al., (2002); Hausbeck et al., (1992), this study found that mass media is a very significant source of information for today's students. Nevertheless, some evidence shows that the media can be highly selective in their presentation of environmental issues (Bonnett and Williams, 1998) and only raise public awareness temporarily (Sampei and Aoyagi-Usui, 2009).

Besides the traditional elements of media, the Internet plays an increasingly role in children and adolescences' daily life (Katona et al., 2008) and it was found to be the most popular tool for acquiring environmental knowledge in this study. According to the UK National Statistics (National Statistics, 2009), 18.31 million UK households had Internet access in 2009, and this represented 70% of households and the number is increasing every year; 37.4 million adults (76% of the UK adult population) accessed the Internet in the three months prior to the survey, of which the youngest age group (those aged 16-24) had the highest level of access, at 96%. Given the high level of computer literacy amongst today's university students and easy access to the Internet, it may be assumed that online learning systems have the potential to encompass and synthesise a fragmented information base. However, more research is needed in the future to search for effective methods of online learning.

National campaigns in the future need to keep mass media attentions on waste management issue and work together with HEIs to target university student audiences. Kitzinger and Reilly (1997) indicated that a lack of policy events leads to a lack of media interest. It is clear that mass media raised students' awareness on waste management issues however university students still generally show a lack of specific waste management knowledge. To ensure that effective mass media coverage on waste issues, the Government should consider what and how information should be provided by the mass media. Results from this study show that concerns about the environment and social responsibilities are the major driving force of positive attitude towards recycling. The media coverage therefore should cover the relevant information. Previous research show that high levels of media coverage did not last for a long time (Sampei and Aoyagi-Usui, 2009), therefore the message needed to be broadcasted periodically.

The results show that many students think that environmental education at school is poor. However, over the past 30 years, there has been growing national and international recognition that the challenges associated with environmental degradation and sustainable development have important implications for, and connections with, education and schooling (Rickinson, 2002). The concept of environmental education is now widespread in national educational policies, curriculum documents, curriculum development initiatives and conservation strategies. In England, for example, one of the requirements of the revised National Curriculum is for schools to: develop (pupils')

awareness and understanding of, and respect for, the environments in which they live, and secure their commitment to sustainable development at a personal, local, national and global level (National Curriculum, 2010).

Lack of practical experiences in environmental education may be the reason for a perception of poor environment education. A curriculum may provide students with lots of information, but present information in ways that do not foster creativity, interest, and student involvement, resulting in lack of motivation and little meaningful learning (Makki et al., 2003). However, personal connection to a natural setting is an important prerequisite for environmentally responsible behaviour (Vaske and Kobrin, 2001). For example, hands-on activities and challenge tests enhanced student's interest, motivation, and ability to think critically about contemporary environmental issues in the region (Poudel et al., 2005). This type of activity was found to be missing among the respondents, and almost half of the respondents think that lacking of hand-on activities is the biggest restriction of environmental education in their schools. This missing component may have significantly affected the quality of environmental education in many schools in the UK.

This study suggests that other factors such as parents may be an influence of their children's attitude and behaviour. Social marketing campaigns aimed at children often target parents as a secondary audience and this technique has been widely used in social research such as physical activities, drinking and tobacco use (Chassin et al., 1998, Griffin et al., 1999, Price et al., 2008). Various authors put forward the idea that past behaviour and habits are important predictors of recycling behaviour (Cheung et al., 1999, Knussen and Yule, 2008, Knussen et al., 2004, Tonglet et al., 2004a), and the results of this study also reveal that habit is a major driving force of recycling behaviour. Following this line of reasoning, once recycling habits are established at home, it is likely that they will participate in recycling schemes at university. Furthermore, media coverage was found to be a key influence to people's concerns.

This study revealed that many students possessed less waste knowledge than they thought. This finding suggests that the university students had a limited comprehension of waste issues and lack necessary knowledge to recognise the consequences of the issue. Although some universities have set up greening projects on campus or student HoR and these projects are often a student's first experience with social change, promoting greater consciousness and awareness (Breyman, 1999), many

of the schemes deliver poor results. Therefore communication campaigns are vital to the success of recycling schemes and should be provided for all recycling schemes at HEIs. In order to be effective, the campaigns need to be informative and repeated periodically; annually in the case of University students. Electronic methods such as electronic newsletters and notices on universities' notice board are fast, cheap and were found to be desirable by the students in this study. This study indicated that there was a gap between students' perceived and objective knowledge measures. It also supported the ISB model that recycling does not occur unless each of the three parts is completed. Infrastructure and service provision need to be supplemented with effective behavioural change interventions.

7.5   Conclusions

The main goal of this research was to examine recycling behaviour of the students of the UoS. It is the third step towards effective design of recycling schemes at HEIs. It used the TPB theoretical model within a wider framework to gain an in-depth understanding of individual and composite factors which impact on students' decisions to engage in recycling activities. The second survey of this study investigated factors that influenced students recycling behaviour; tested their waste management knowledge and compared the results with their reported knowledge.

- Previous studies have indicated that the TPB has proven to be effective in predicting recycling behaviour. This study shows that even with additional variables, the TPB does not adequately explain recycling behaviour for young adults (university students in this case). Our study revealed that although perceived behavioural control and attitude are significant factors for this population, the model only explained 33.1% of the students' behaviour.

- The key to unlocking behaviour change lies in the provision of appropriate infrastructure and effective service provision alongside a targeted behaviour change programme. The study showed that although an overwhelming majority of university students reported a positive attitude towards recycling, this did not guarantee pro-environmental behaviour. Students were much more likely to engage in the UoS HoR recycling program when a convenient infrastructure and tailored service provision was in place. In addition, since students are a highly

transient group, regular (annually repeated) information campaigns are crucial to the success of a recycling scheme at an HEI.

- This study found that many students believed that environmental issues were very important to them. The most important factor that shaped students recycling behaviour was mass media. The Internet especially has become the most popular method for university students to acquire their environmental knowledge. On the other hand, the results also showed that many students thought that environmental education at school was poor and there was a general perceived requirement for hands-on activities at school. Importance of parental influence and habits gained from home were also found to be important factor

- This study also compared students' self-reported knowledge of waste management issues with their actual knowledge. The results revealed that students generally had poor understanding of waste management issues and they possessed less knowledge than they reported. Although mass media raised university students' awareness of environment issues, but it did not increased the students' knowledge significantly. Results of this survey can be used to guide mass media-buying strategies for public health education.

Chapter 8

8   General discussion

The current chapter provides an integrated statement on the outcomes of this research study. Landfill has traditionally been the UK's main waste disposal method. An over reliance on landfill has caused environmental damage and the UK is facing shortages of landfill sites. The country is under pressure to use more sustainable waste disposal methods as required under the EU landfill directives and Waste Hierarchy. Since the first Waste Strategy published in 2000, the Government has been making continuous effort to monitor, suggest, support and implement ways for sustainable waste management. It set ambitious interim targets and measures. For example, the landfill tax is being implemented to increase awareness among businesses and the industry to reduce waste. The Government in England has sought to introduce a range of strategies aimed at making the concept of 'sustainability' a corner stone of its waste management policies. There have also been a number of initiatives aimed at certain sectors to encourage a more sustainable approach to waste management. Several public bodies were set up to help LAs and businesses such as Waste & Resources Action Programme (WRAP), Local Authority Recycling Advisory Committee (LARAC), Envirowise, National Industrial Symbiosis Programme (NISP), Construction & Resources Waste Programme (CRWP), Centre for Remanufacturing & Reuse (CRR), and the Business Resource Efficiency and Waste Centre for local authorities (BREW Centre).

Whilst the focus has been on the household, large institutions such as HEIs in the UK have not kept pace with their waste management. Throughout the 1990s and up until fairly recently, the view of many universities was that greening HEIs would simply cost too much, taking precious funds away from teaching and research. The escalating cost of waste deposal became the catalyst to review the old ways of dealing with waste and develop more sustainable methods of managing waste. Although in recent years, there has been growing realisation that large organisations can make a significant impact on the natural environment (Davis et al., 2009), prior to this project, little information existed as to the waste treatment and disposal methods used by HEIs in the UK. The rapid expanding of the HE sector means that the sector has major responsibilities on sustainable waste management and is under increasing pressure to

minimise and reduce its environmental impact. Therefore in the future, HEIs like local authorities should be held accountable for sustainable waste management and regulated in a similar way.

In a time faced with increasing challenges, the economic and social responsibility drivers are compelling for the HE sector to recognise and take on the leadership for waste management. Since 2010, UK universities have been hit with cuts as the Government introduces stringent measures to reduce the budget deficit. Many HEIs will be affected by unprecedented cuts to funding and many have to save every penny.

In addition, the Government is changing the approach the UK takes to calculating the targets on reducing the amount of biodegradable municipal waste sent to landfill included in the Landfill Directive. The revised approach will include much more waste than currently and will bring the UK approach more closely into line with the approach adopted by a number of other EU Member States. The new interpretation of municipal waste based on the classification of waste using the European Waste Catalogue expands the definition of MSW. If the definition is changed, a lot of commercial waste, currently handled by the private sector including waste collected from HEIs by private contractors, will come under the scope of the Landfill Directive.

Furthermore, the cost of landfill tax is rising by £8 per tonne every year. By 2014/15 the landfill tax will reach £80 per ton in the UK. By greening their own campuses and HoRs, HEIs can teach and demonstrate the principles of awareness and stewardship of the natural world, as well as achieve significant economic savings.

This thesis makes a significant contribution to knowledge and understanding of waste management at high-density housing of HEIs, which can be divided into two parts. The first part of the study was intended to give a national picture of waste management in UK HEIs and undertook a critical analysis of some of the current practice. A nationwide survey was carried out in order to identify, quantify and evaluate HEIs approaches to waste management. According to the survey results, in the majority of the HEIs, waste management information systems were weak and there was a lack of good baseline data at the institutional level. The study then identified specific gaps in knowledge and data collection, and gave particular attention to good practice examples to highlight successful strategies. It was argued that many waste collection services at HEIs could be improved. Many universities used the system of charging by volume or paying a flat fee every year. These systems often did not reflect the true picture of the waste that produced by HEIs. They provided very little data such as tonnages and the

numbers of lifts that HEIs received. However, these are the crucial information to create sustainable waste management systems at HEIs.

The findings from the first part of the study lead to an in-depth investigation of effective waste management at HEIs building on a case study that was undertaken at the UoS. The resolution spelt out three areas to be addressed in the second part of the study:

- Presented and evaluated the development and experience of sustainable waste management at the UoS over the last 15 years;

- Integrated three key components in a practical and representative theoretical model of effective recycling schemes design;

- And tested and evaluated the model and function of each component using data from the case study of the UoS.

Under the increasing pressure and costs of waste management in recent years, the UoS realised that the way its waste was treated was not only unsustainable, but also not effective. The sustainability movement emerged in the early 1990s at the University and over the last 15 years, the awareness of the importance of sustainable waste management has increased significantly. Throughout the 1990's and early into the new millennium, the UoS experimented with a few greening projects such as office recycling schemes. However, along the way it was noticed that while the University was amassing project successes in a piecemeal fashion, it was not achieving the kind of deep organisational transformation which was fundamentally necessary. In recognition of the need to go beyond showcase-projects, from 2003 the University recruited an environment manager; joined the SUWMC; and introduced the Pay-By-Weight system. These efforts were aimed at moving the University beyond the little victories of single projects, toward sustained progress aimed at reaching larger environmental goals, supported by a professional capacity that could ensure ongoing progress.

Since the recruitment of the environment manager in 2005, the University has build its team of full-time and part-time sustainability professionals to carry the enormous workload associated with supporting wide-scale engagement, ownership, and leadership across a decentralised and complex institution of 30,000 staff, faculty, and students. The separation of different disciplines, arenas of responsibility and tiers of management generally prevent staff and students from understanding the broader context or the overall systems that operate across the institution. This structure became a barrier of designing and implementing reuse and recycling schemes when dealing with waste management at HoR, because the demands of sustainability are system-wide and involve changing organisational culture, behaviours and the entire institutional context.

Future organisational structure models and decision-making processes must enable effective interdepartmental and interdisciplinary engagement within the institution. If the responsibility and leadership for sustainability is under just one group or department, in the long term it can create a variety of undesirable tensions and issues resulting from a lack of effective coordination and integration. Therefore, developing new governance structures and decision-making processes that distribute and co-ordinate ownership and responsibility for a university sustainability agenda requires the leadership of university senior management.

One of the major contributions of this research is the establishment of the ISB model at the HoR. Many greening projects at HEIs only concentrated on campuses and ignored high density housing such as student halls which were considered hard to achieve high recycling rates. Participation in recycling schemes involves developing new habits. Many previous studies showed that attitudes towards recycling have to change for recycling to become a habit and become 'normalised' behaviour. However, this research showed that changing a person's attitude towards recycling can not alone translate into the students' action.

This study argued that the more transient population is more strongly motivated by convenience of infrastructure and service provision, or de-motivated by the lack of them. In order to achieve high reuse and recycling rates and change students' behaviour, HEIs must provided adequate infrastructure and convenient service provision to facilitate students' recycling behaviour. This research demonstrated that strong infrastructure and service provision resulted in a better recycling rate and weak infrastructure and service provision resulted in a much low recycling rate at the HoR of UoS. As transient population, the student population living at HoR changes every year. Information and education programs are an integral part of the success of the recycling schemes. Therefore interventions need to be timed carefully and repeated periodically. Educational campaigns of the UoS were designed to stimulate the 'perceived behavioural control' of the students, through increasing both waste knowledge procedural knowledge and by improving the facilitating conditions. Students also need to be better engaged and educated in order to make schemes running smoothly and avoid abusing the system such as collecting beer bottles after drinking games.

It is widely accepted that the HE sector will have to deliver significant infrastructure capacity over the coming year in order to successfully recycle, re-use, treat and disposal of its waste. Therefore, waste contractors have a vital role to play in ensuring the service provision working. However HEIs and previous research often

overlooked their importance. Consideration and getting buy-in of waste contractors during early stage is essential in designing effective recycling schemes. Without co-operation and reliable service of waste contractors, the whole system can not work. It is also vital to manage the contractors effectively and monitor their performance regularly in order to encourage their engagement and performance. These problems and constraints of waste management associated with high density housing such as HoR can be resolved, by providing adequate infrastructure at student halls, implementing effective recycling collection system, monitoring contractors performance, defining clear roles of management staff at student halls, improving their coordination with contractor and Estate and Facilities of the HEIs; understanding students' recycling behaviour and raising awareness of the staff, students and universities' senior management etc, which are explained in detail in Chapter 5 to 7.

The following section summarises the lessons learned and practical recommendations from this study. The purpose is to bring together any insights gained during the study that can be usefully applied to future schemes at other HEIs.

- Planning

1) Secure project funding

Unlike other projects described in the literature review, the current schemes were funded internally. The hall managers were the budget holders and it was crucial to get their total support of the schemes before setting up any reuse and recycling projects at HoR.

2) Obtain management buy-in

Senior management support was identified as an essential ingredient for success. It is important to have complete management buy-in before proceeding to the planning stages.

3) Form a steering group

It is useful to form a Steering Group with key decision makers and keep the members fully aware and updated on every development. Representatives from the following parties are recommended to be included for a recycling program: Estates and Facilities, HoR, Student services, Students' Union; waste contractors.

- Operation

1) Have clear communication channels

The Estates and Facilities department managed the waste and recycling contract and liaised with the waste contractor on behalf of the HoR on a recharge basis. It is vital

to build robust communication channels between the Contractor, the hall managers and the operation manager at Estate and Facilities with one point of contact.

2) Use a Pay By Weight System.

The system allows interrogation of statistics on a route basis either per day or week or per location. Generally speaking this system provides more accurate data compared with the use of conversion factors or volume based data.

3) Choose a reliable contractor

Reliable contractors are vital to the success of recycling schemes; under-performing contractors could potentially cause even carefully designed schemes to fail.

4) Work with third sector organisations

HEIs should explore ways of taking into account the value of third sector providers in reuse and recycling schemes. Third sector organisations are often able to include new services in the existing contract, and are able, or willing, to do more for a small charge.

- Communication and promotion

1) Address negative responses swiftly

When the twin-bin system was introduced at Hall C, the initial plan was to empty the recycling and general waste bins daily. However, many cleaning staff believed that two bin bags were heavier than one although the waste content was the same. Some staff also thought emptying two bins would take them significant longer than emptying one bin. In order to manage the staff's negativity, the hall managers called for a staff meeting. The alternative collection was agreed with the staff with the consequence that the general waste bins were emptied three times a week (on Mondays, Wednesdays and Fridays) and recycling bins were emptied twice a week (on Tuesdays and Thursdays).

2) Send feedback information to students via university email accounts and the university Blackboard

Universities normally provide all students with a university email account and email is used regularly in the University as an 'official' form of communication between staff and students. Students are required by the University to check their University email accounts, Blackboard and any other electronic methods of communication on a daily basis during term-time, and reply as necessary to messages received. Although only a limited number of emails maybe allowed sending to all students via the University's account, electronic means of communication with students are fast, easy to use, and cheap.

- Scheme monitoring

1) Data collection

Provision of good quality data is key for monitoring purposes. For most HEIs the preferred method of data gathering is via waste contractors. The performance of contractors needs to be monitored closely especially if the contractor is new to the Pay By Weight System. It can take some time for the system to stabilise therefore, it is advisable to manually weigh a representative portion of sample every two to four weeks and compare the data with the system's output.

2) Use a digital camera

There are many ways that recycling schemes can be monitored. The Contractor's performance should be monitored on the agreed basis. Where actions need to be taken on site i.e. missing collections and overflowing bins, it is vital that objective evidence exists to show that actions need to be taken. In many cases, the use of 'before and after' photographic evidence will be a key method of demonstrating improvements.

Chapter 9

9 Conclusions

HEIs are often the size of small municipalities. Since the 1960s, the United Kingdom UK higher education system has expanded six fold to >2.4 million students. The overall production of waste at HEIs is therefore very large and presents significant challenges as the associated legislative, economic and environmental pressures can be difficult to control and manage. This thesis aimed to investigate and evaluate recycling arrangements in medium and high density housing, specifically at HoR. In doing so, a comprehensive understanding of recycling practice has developed. In summary, the work described in this thesis made the following contributions:

1. increased the knowledge of national waste management systems of HEIs;
2. critically reviewed why the HE sector has struggled to deal with their waste;
3. presented the case study of the UoS and its staged approach of sustainable waste management;
4. and in particular, the thesis argued that effective waste management at HEIs can only be achieved by (i) providing convenient infrastructure and adequate service provision, and (ii) understanding students' recycling behaviour and using behavioural change tools.

A recent survey that carried out by Nottingham City Council indicated that many LAs across England rovided extra resource to deal with waste issues located in areas where students are concentrated. Most of the information used to educate the students about waste management and how to deal with it was primarily sourced from LAs. Some LAs had to issue extra large bags at the end of the academic year to accommodate the extra waste generated by the departure and some use skips to clear away the large amounts of waste. However, these need to be monitored and removed very quickly to avoid any abuse or becoming the target for general fly-tipping.

HEIs and LAs should work together more closely to unlock the potential to tackle waste issues at HEIs. In order to design and deliver such a wide range of services, long-term relationships of genuine collaboration between the parties is crucial.

9.1 Research findings

The main findings of this study can be summarised as follows:

- This study highlighted significant potential for increased capture of resources and substantial room for operational improvements; a lack of accurate and reliable data on waste arisings and the associated costs; and an opportunity for partnership with local authorities.

- The case study outlined in this research provided a comprehensive appraisal of some of the key issues, problems and successes that have arisen during the four-phase waste management strategy developed over the last 15 years at the UoS. Results show that waste produced from campus and student halls can be significantly reduced when convenient recycling facilities and targeted education are provided.

- There is potential for significantly improving reuse and recycling at university HoR and more convenient and higher quality infrastructure and service provision resulted in higher recycling rates. The study clearly shows that students have lifestyles that impact significantly on waste arisings and consequently on waste management operations at HoR (and probably at HEIs and student-dominated residential areas).

- A 'high consumption' culture generates pressures on waste management operations, particularly at certain times of year. Students were found to waste more food than typical UK households, perhaps suggesting that food waste prevention campaigns specifically targeting students might be required at HEIs.

- Reliable contractors are vital to the success of recycling schemes; under-performing contractors could potentially cause even carefully designed schemes to fail. The performance of contractors needs to be monitored closely using performance indictors (PIs). In addition, there are sound reasons for HEIs to collaborate with Third Sector organisations that specialise in reuse and recycling, particularly for material streams that would be uneconomic for mainstream waste contractors.

- Many students' lifestyle that values convenience, inexpensiveness and high levels of consumption has fuelled the waste issue. The key to unlocking behaviour change lies in the provision of appropriate infrastructure and effective service provision alongside a targeted behaviour change programme.

- Mass media coverage especially the Internet has a rising influence on university students' environmental knowledge while environmental education at school has

become the secondary source of information. The results also revealed that university students possessed less knowledge than they believed which makes informative behavioural interventions a vital component of effective recycling schemes at HEIs.

9.2   Limitations of the current research

Although the research has reached its original aims and objectives, nevertheless it is important to note that the research is also constrained by some limitations. The major limitation is the low response rates of the surveys. Despite all the effort made, the HEIs national survey carried out between January and May 2008 had a relatively small number of responses. Unlike the compulsory survey of WasteDataFlow for LAs, the responsible officers of many HEIs considered answering the survey a low priority. Secondly the TPB survey carried out in May 2008 did not reach the expected response rate. This could due to returning the questionnaires to the receptions were considered to be inconvenient by many students at the halls. Subsequently an electronic survey was used in May 2009 and a higher response rate was achieved.

9.3   Opportunities for further research

Recycling activities investigated as part of this research generally focused on dry recyclables - paper, card, metal cans, plastic and glass bottles, however food waste formed a large part of the waste composition. Extension of this work could provide further understanding and insight into waste management at HoR by investigating potential food waste collection and treatment.

The current study also offers opportunities for other branches of future research. The boom in student numbers in many cities and towns in the UK is fuelling a housing revolution. The influx of students has injected new life into these cities' local economies, but it has also brought its share of problems including waste management issues. Whilst studying at university, most students either live in HoR, privately-rented accommodation, with their family, or a combination of these. Many students spend their first year of university at HoR and then move into the private housing over the summer; it is the first time for many students to live independently.

1) Very little research has been done on students' recycling behaviour in private housing and whether the behaviour pattern changes amongst different age groups of students i.e. first year undergraduate students, last undergraduate students or postgraduate students.

2) At towns and cities with a high influx of students, how could the LAs work with the universities to encourage students' recycling behaviour and improve their infrastructure, service provision and communication tools to target university students?

3) As described in Section 7.4.2, the potential of using the Internet to engage students in recycling needs to be explored. Emphasis could be placed on comparing different electronic communication methods such as mass e-mails, e-bulletins, social network sites and the cost and environmental benefits of these methods.

10 Appendices

Appendix A 60-litre twin bin system at Hall C

Appendix B An example of a recycling station at Hall C

Appendix C An example of a waste audit of residual waste collected from one of the targeted student halls
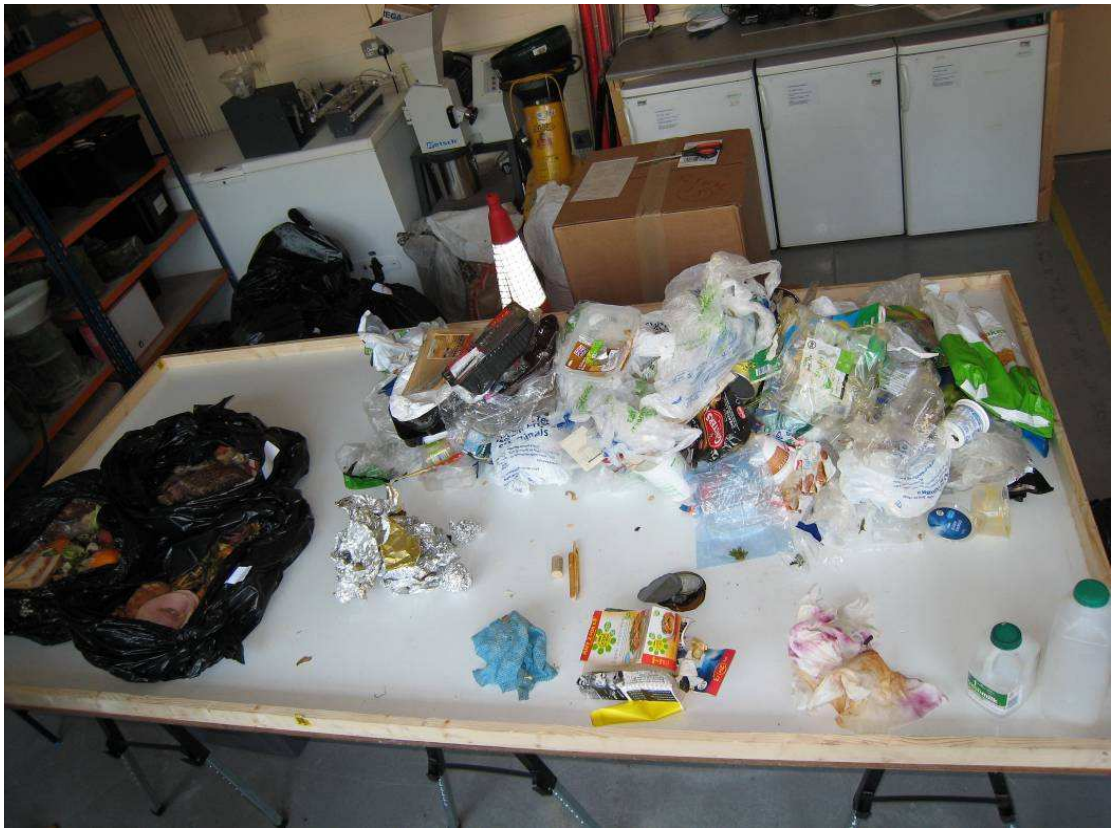
Appendix D List of Equipment

1 Berkley digital fishing scale

Black bin liners for sorting into categories

Steel-toed boots

High-visible jacket

Puncture-proof PVC gloves

Knife for cutting boxes

Datasheets and pen

Dust masks

Appendix E Waste Audit Data Record Sheet

Waste Bag Code: …………………………………………………………………….

Waste Bag Location: …………………………………………………………………..

Auditor Names: …………………………………………………………………………

Waste Bag Weight: …………………………………………………………………….

Primary Waste Categories	Secondary Waste Categories	Present	Weight (kg)	Percentage of total waste
	News & PAMS			
	White Paper			
Paper	Other Paper			
	Card			
	Packaging			
Cardboard	Corrugated cardboard			
	Clear Glass			
Glass bottles and jars	Brown Glass			
	Green Glass			
	Steel Cans			
Cans	Aluminum Cans			
Plastic Bottles	PETE Bottles			
	HDPE Bottles			
Sub Total	Sub Total			
Other glass	Window, vase etc			
Other plastics	PVC, LDPE, PP,PS other types of plastics			
Food waste	Food waste			
Stationery	Stationery			
	Batteries			
Hazardous	Paint tins / pots			

Electrical equipment (please record type)	Electrical equipment (please record type)
Textiles	clothing
	bedding
	shoes
Metal	Metal
Wood	Wood
Green (garden) waste	flowers
Other	Materials that either have little recovery potential or are of low fraction in waste, such as rubber, bricks, rock, etc.

Good news !!!

Dear All,

You might have noticed that from this year the University has provided recycling facilities in your halls. It's easy to take part in the recycling scheme and great for the environment. At the University of Southampton, you can recycle most of your waste simply and conveniently.

Students living in the following halls will be able to recycle:
- o   Beechmount Hall
- o   Bencraft Hall
- o   Gateley Hall
- o   Monte 3
- o   St. Margaret House

Why should I recycle?
UK Universities produce millions of tonnes of waste every year and the majority is landfilled rather being recycled or reused. Many of the materials we throw away have a value and can be used again. Also, landfills produce methane, a potent greenhouse gas that contributes to climate change.

What CAN I put in the recycling bins? √ Yes

Paper/ Cardboard	White and coloured paper, fliers, leaflets, brochures, envelopes, magazines, newspapers, shredded paper, packaging papers (for example from the photocopier paper, sugar, flour), boxes from tissues, frozen food, etc	
Cans	All food and drinks cans made of steel and aluminium	
Plastic Bottles	PET bottles (i.e. drink bottles), HDPE bottles (i.e. milk cartons), The lids should be put in the general waste bin.	
Glass	Clear glass bottles and jars, brown glass bottles and jars, green glass bottles and jars.	

Please wash out any bottles, cans and glass containers and remove lids before putting them in the bin.

What CANNOT put in the recycling bins? **X No**

- **Paper/cardboard**
  - contaminated pizza boxes
  - coke or coffee cups
  - contaminated kitchen towels
  - paper contaminated by food (e.g. chip paper or kebab wrappings)
  - plastic coated paper
  - photographs
  - soiled napkins or tissues
  - takeaway boxes

- **Plastic**
  - PVC (i.e. tubing, rubber gloves)
  - LDPE, (i.e. wash bottles, carrier bags)
  - PP, (i.e. flower pots, auto parts)
  - PS, (i.e. cafeteria trays, toys)
  - other unidentified plastics,
  - cling film,
  - packaging (for example, crisp packets, biscuit, chocolate or bread wrappers)
  - yogurt pots

- **Cans**
  - empty aerosol cans

- **Glass**
  - window glass
  - drinking glasses
  - dishes
  - light bulbs

How do I recycle?

- If you have a recycling bin or a recycling bag in your bedroom, please use it to collect recyclable items. It is your responsibility to take this out to the recycling points outside your building. These are clearly sign posted and marked up for the different waste streams:

  Red wheelie bin – paper/cardboard
  Yellow lidded wheelie bin – plastic bottles and cans
  Purple lidded wheelie bin – glass

- If you have two recycling bins in your kitchen, you can recycle paper and cardboard in one bin, and plastic bottles and cans in the other. These will be emptied twice a week by the hall porters. Please do not put glass bottles or jars in these bins. Any glass bottles or jars need to be taken to the recycling point outside your building. Please use the general waste bin for non-recyclable items, such as food waste. Again, these will be emptied by the hall porters.

Please use the general waste bin in the kitchen for your non-recyclable items, such as food waste. These will be emptied by the Hall porters.

What do I do if the outside bins are full?
Please tell a member of hall staff or your JCR, who will arrange for it to be emptied.

Where are the recycling points in my hall?
Please see the schematic building plans on the following pages.

Where do I go if I want more information?
If you have any questions about the recycling schemes or any suggestions about how it could be improved, please contact Mr. Andy Wilson (Projects Manager, Business and Community Services) on Ext. 24003 (internal), or alternatively send him an email at amw1@soton.ac.uk. (I would suggest first point of contact is their JCR and possibly Candy before Andy?)

Thank you for helping us to save the environment.

Schematic plan of Gateley Hall (not to scale)

Flat 5,12&19

Flat
4,11&18

Flat
6,13&20

Flat
2,7,9,14&
16

Flat 1,8&15

Archers Road
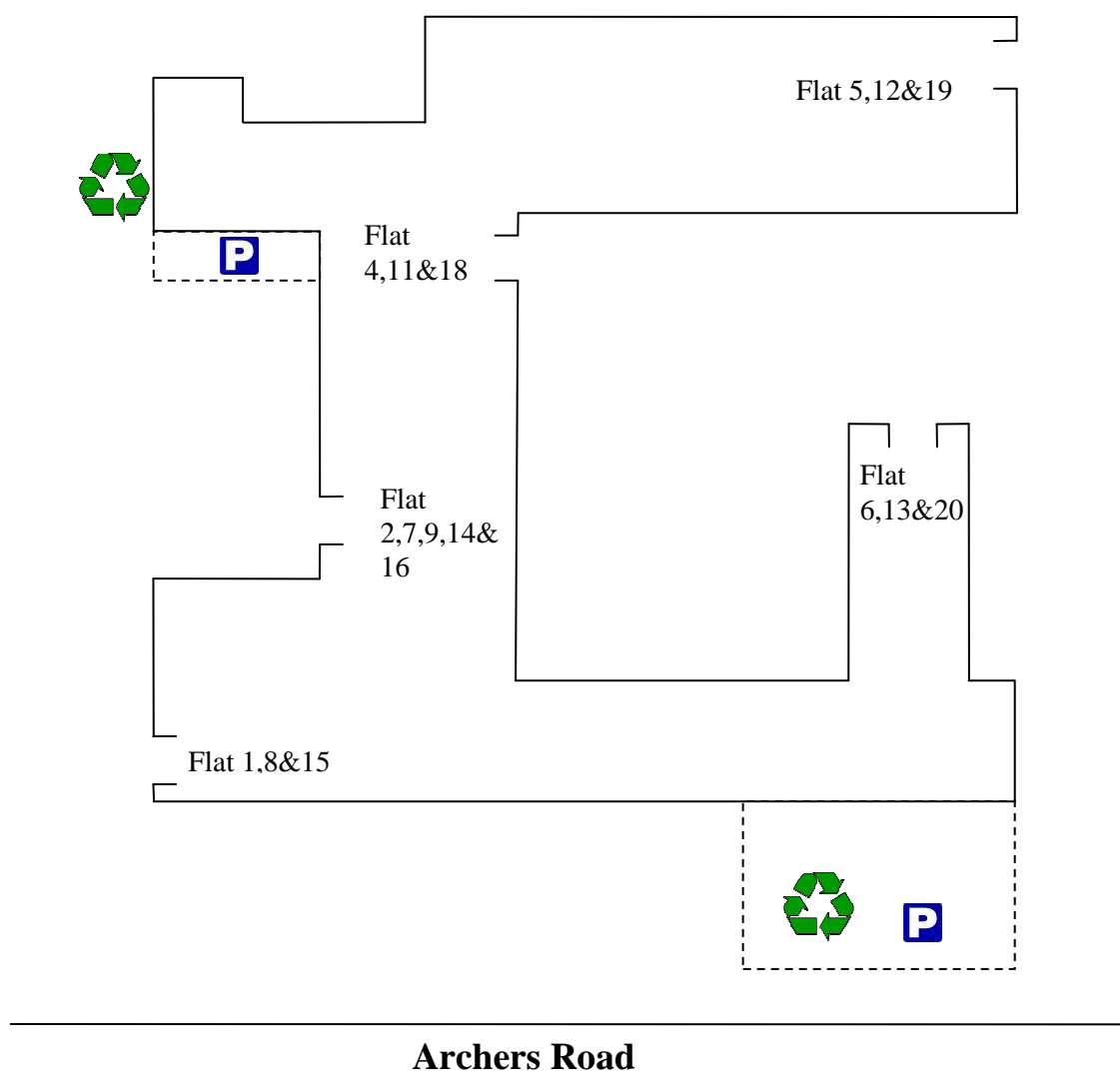
Keys: Entrance

P Car parking

Recycling point

B Bike shed

Schematic plan of Bencraft Hall (not to scale)
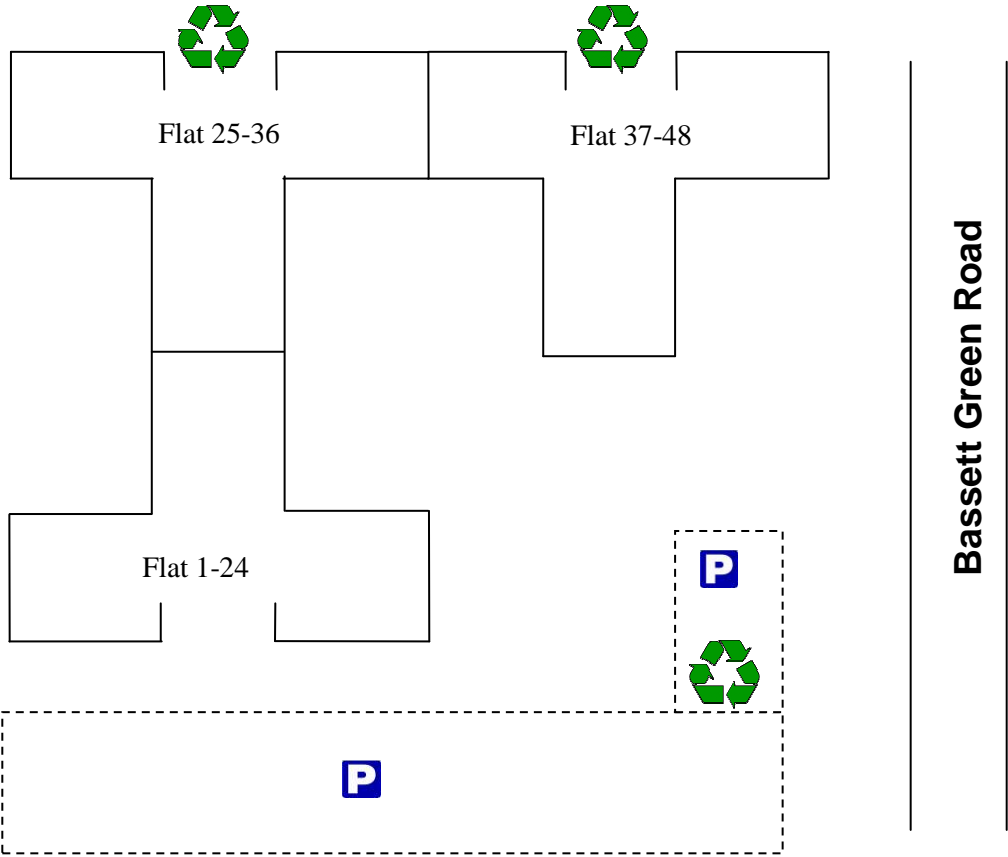
Schematic plan of St. Margaret Hall (not to scale)

Hulse Road
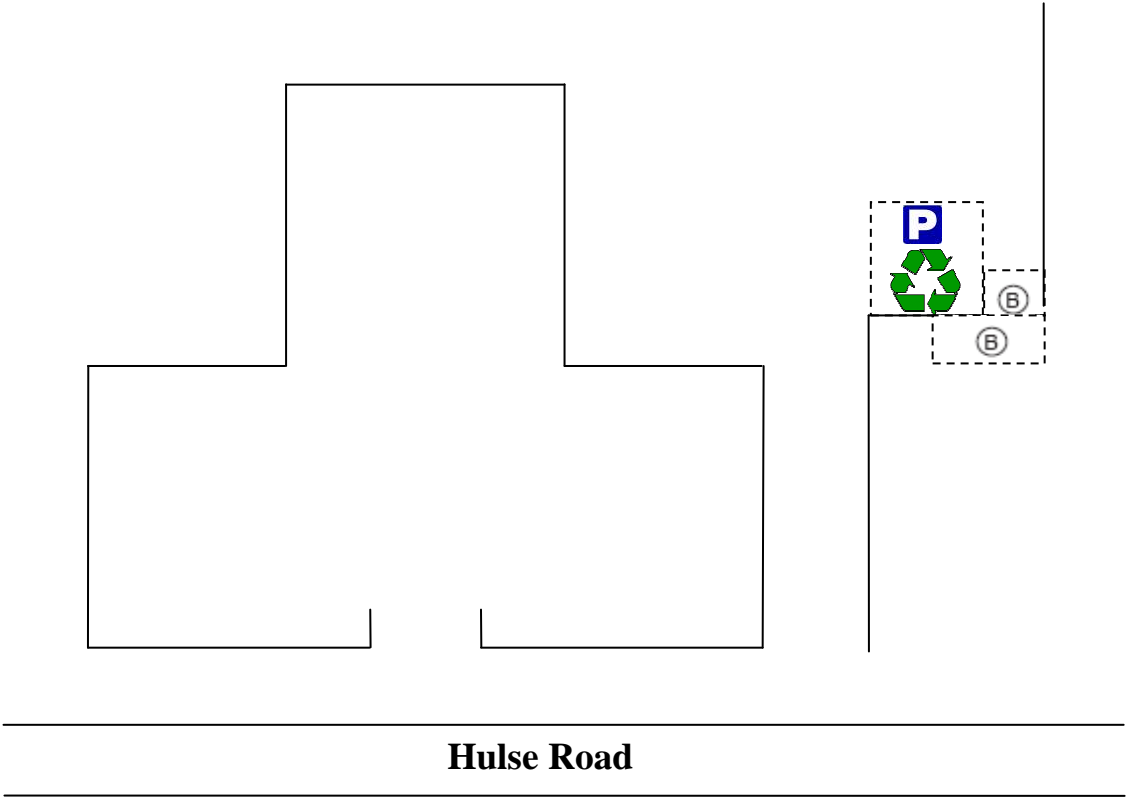
Schematic plan of Beechmount House (not to scale)

148
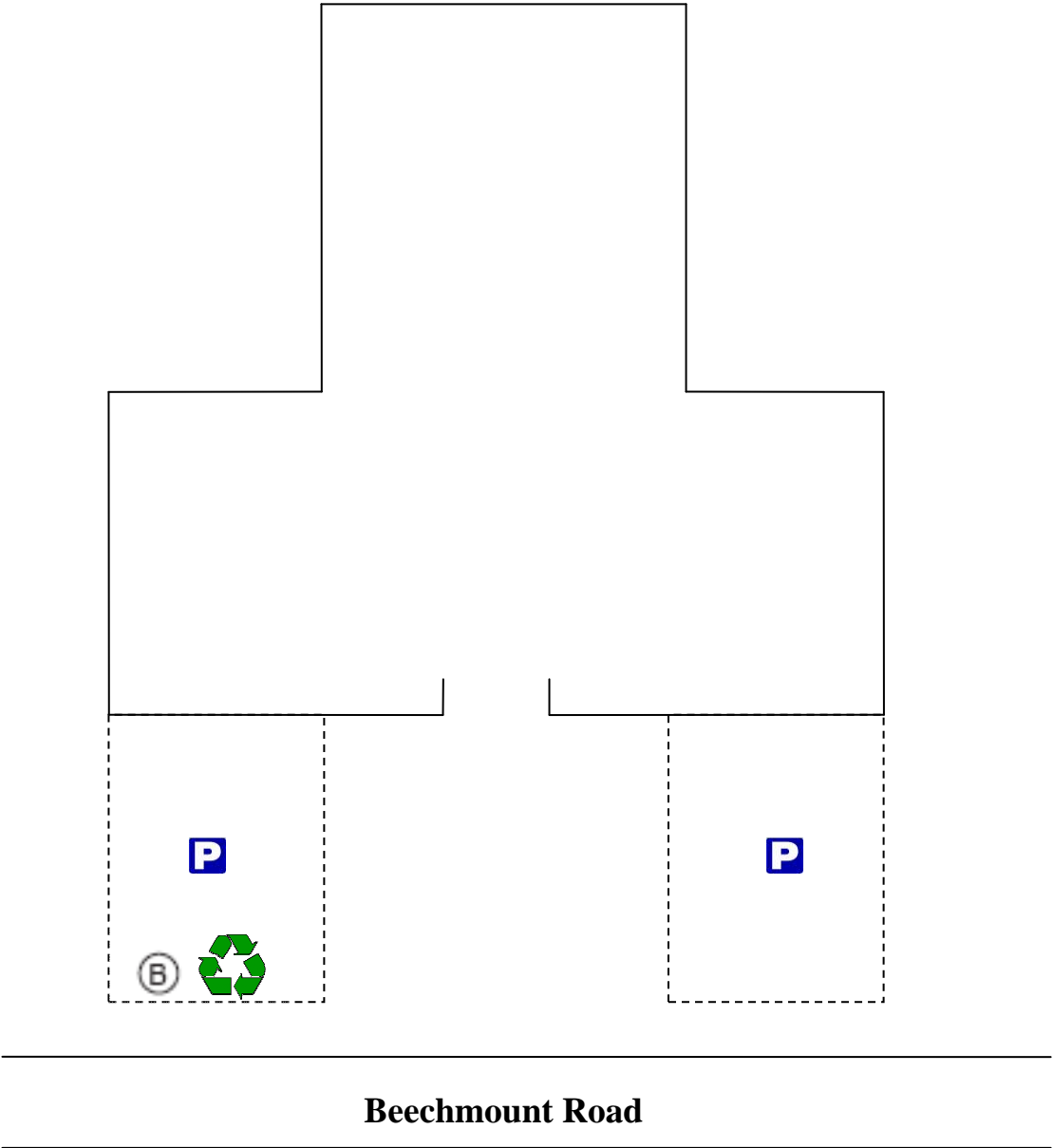
Schematic plan of Monte 3 (not to scale)
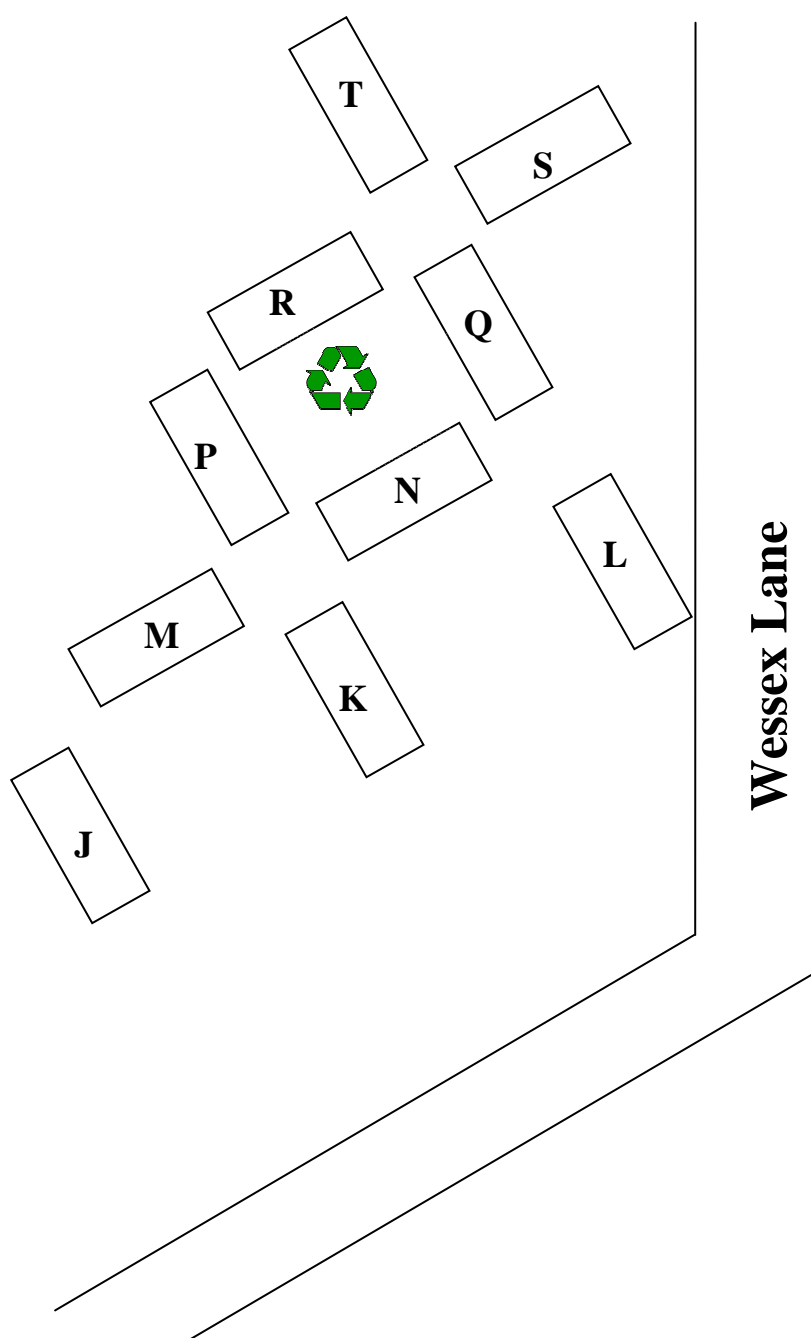
Wessex Lane

Recycling is Easy

Yes

Please do not put items in plastic bags. Plastic bottles and metal cans need to be washed out.

Plastic bottles with codes △△ (without lids)

All food and drink cans made of steel or aluminium

Glass bottles and jars (without lids)

White and coloured paper

Newspaper

Flattened cardboard

No

No other types of plastics with codes △△△△△

No empty aerosol cans

No drinking glass/dishes

No food contaminated napkins/packaging boxes

No photographs

No plastic coated paper

No food waste

No textiles

Please see your WELCOME PACK for a comprehensive list of what can and cannot be recycled

Glass

Paper and Cardboard

Plastic Bottles and Cans

For more information please contact: halls@soton.ac.uk

University of Southampton

bucs

Simple Guide of Recycling at Gateley Hall

Step 1: Please put your paper and card in the blue-lid recycling bin in your kitchen.

Step 2: Please put your cleaned cans and plastic bottles in the green-lid recycling bin in your kitchen.

Step 3: Please <u>make sure</u> you take your glass bottles and jars to the recycling points outside your building. There is one in the front car park and one in the rear car park. The glass recycling bins are purple lidded.

Step 4: University cleaning staff will empty your general waste bin on Monday, Wednesday and Friday, recycling bins in your kitchens will be emptied Tuesday and Thursdays.

For further information about recycling in halls please contact
halls@soton.ac.uk

Appendix I Examples of 'do's and don'ts' stickers

✓ **YES**

Please DO NOT put items in carrier bags or black bin liners. Please rinse bottles and cans; discard lids and caps.

✓ Aluminium cans/tins (paper label is okay)

✓ Steel cans/tins (paper label is okay)

✓ Clean foil

✓ Look for ♻1 ♻2 (PETE, HDPE) on the bottom of your plastic containers

✗ **NO**

✗ Scrap metals

✗ Aerosol cans

✗ Any other types of plastics. (all plastics containers or packaging labeled with ♻♻♻♻♻)

✓ **YES**

Please DO NOT put items in carrier bags or black bin liners. Please rinse bottles and cans; discard lids and caps.

✓ **Clear glass bottles and jars**

✓ **Green glass bottles and jars**

✓ **Brown glass bottles and jars**

✓ **Blue glass bottles and jars**

✗ **NO**

✗ **Window glass**

✗ **Pyrex dishes**

✗ **Light bulbs**

✗ **Mirrors**

✗ **Porcelain**

✗ **Ceramic**

✓ **YES**

Please DO NOT put items in carrier bags or black bin liners. Please rinse bottles and cans; discard lids and caps.

✓ Aluminium cans/tins (paper label is okay)

✓ Steel cans/tins (paper label is okay)

✓ Clean foil

✓ Look for ♻1 ♻2 (PETE, HDPE) on the bottom of your plastic containers

✗ **NO**

✗ Scrap metals

✗ Aerosol cans

✗ Any other types of plastics. (all plastics containers or packaging labeled with ♻♻♻♻♻)

Appendix K The 'traffic light system' cards

Thank You for Recycling

Your recycling bins contain a **LARGE** quantity of items that **SHOULD NOT** be placed in recycling bins. We need your help to **ELIMINATE** contamination.

Please **MAKE SURE** you separate your recyclables correctly. Please **DO NOT** put the following in your recycling bins.

- Food waste
- Plastic bags and bin liners
- Takeaway boxes or food contaminated tissues and packaging boxes
- Drink cartons, such as fruit juice cartons
- Textiles

Please remember that every load of paper recycled in your hall saves **380 kilograms** of timber and **25,000 litres** of water; every load of cans recycled in your hall saves energy to power a TV for **11 months**; every load of plastic bottles recycled in your hall saves energy to power a **60 watt** bulb for **3 months**; every load of glass bottles recycled in your hall saves energy to power a computer for **25 days**.

However, ALL contaminated loads end up going to landfill !!!!

UNIVERSITY OF
Southampton

Appendix L Window displays of collected empty wine and beer bottles
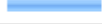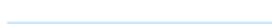
Appendix M Student attitude survey questionnaire 2008

1. What do you see as the main pressing issues that the UK is facing today? (Please tick THREE boxes below).

	Response Percent	Response Count
Terrorism	14.0%	116
National Health Service	21.1%	174
Future energy supplies	37.7%	311
Environmental issues	37.9%	313
Drug abuse	5.7%	47
Alcohol abuse	16.1%	133
Foreign policy	7.0%	58
Economy in general	57.0%	471
Unemployment	33.4%	276
Education	14.5%	120
Rising cost of living	25.1%	207
Immigration	11.4%	94
Crime	16.3%	135
Other (please specify)	2.8%	23
answered question		826
skipped question		0

2. What do you see as the main pressing environmental issues that the UK is facing today? (Please tick THREE boxes below).

	Response Percent	Response Count
Climate change	62.6%	517
Vandalism and graffiti	6.7%	55
GM food	8.1%	67
Flooding	15.7%	130
Damage to ozone layer	14.9%	123
Overfishing	10.7%	88
Air pollution	23.5%	194
Pollution of rivers and seas	17.7%	146
Loss of plants, animals and habitats	19.4%	160
Waste management, i.e. recycling	58.8%	486
Water shortages	10.8%	89
Using up natural resources such as coal, oil or gas	50.2%	415
Other (please specify)	1.0%	8
answered question		826
skipped question		0
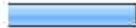
3. To what extent do you agree or disagree with each statement?

	Agree	Undecided / Don't know	Disagree	Response Count
I accept we need to change our lifestyles to deal with waste more effectively in the UK.	90.6% (748)	6.3% (52)	3.1% (26)	826
Tackling waste issues shouldn't come at the expense of the British economy.	23.8% (197)	37.4% (309)	38.7% (320)	826
The waste issue is a low priority for me compared with a lot of other things in my life.	25.9% (214)	24.8% (205)	49.3% (407)	826
I don't believe my behaviour and everyday lifestyle contribute to waste crisis.	16.6% (137)	22.6% (187)	60.8% (502)	826
The so-called waste crisis facing humanity has been greatly exaggerated.	10.7% (88)	27.5% (227)	61.9% (511)	826
It's not worth me doing things to help improve waste management if others don't do the same	19.2% (159)	10.8% (89)	70.0% (578)	826
The possible adverse effects of poor waste management is too far in the future to really worry me	9.9% (82)	16.2% (134)	73.8% (610)	826
It is everybody's duty to recycle in the UK.	93.2% (770)	4.5% (37)	2.3% (19)	826
			answered question	826
			skipped question	0

4. How knowledgeable would you say you are about waste issues in the UK?

		Response Percent	Response Count
Extremely knowledgeable (4)		2.3%	18
Very knowledgeable (3)		13.6%	105
Moderately knowledgeable (2)		58.6%	451
little knowledgeable (1)		23.6%	182
Not at all knowledgeable (0)		1.8%	14
		answered question	770
		skipped question	56

5. How knowledgeable would you say your parents are about waste issues in the UK?

		Response Percent	Response Count
Extremely knowledgeable (4)		2.6%	20
Very knowledgeable (3)		14.7%	113
Moderately knowledgeable (2)		49.5%	381
little knowledgeable (1)		24.0%	185
Not at all knowledgeable (0)		9.2%	71
		answered question	770
		skipped question	56

6. Have you heard of and do you understand the following terms?

	Heard of and fully understand their meaning (3)	Heard of and partially understand thier meaning (2)	Heard of but do not understand thier meaning (1)	Have not heard of (0)	Response Count
Kerbside recycling	38.4% (296)	20.6% (159)	11.2% (86)	29.7% (229)	770
Source segregated collection	22.3% (172)	24.9% (192)	12.3% (95)	40.4% (311)	770
Landfill tax	30.8% (237)	35.3% (272)	18.8% (145)	15.1% (116)	770
Biodegradable municipal waste	30.6% (236)	36.1% (278)	16.6% (128)	16.6% (128)	770
Greenhouse gas	77.5% (597)	17.8% (137)	3.4% (26)	1.3% (10)	770
Anaerobic digestion	43.5% (335)	24.4% (188)	11.8% (91)	20.3% (156)	770
Composting	73.4% (565)	14.7% (113)	5.7% (44)	6.2% (48)	770
Waste electrical and electronic equipment legislation	28.8% (222)	31.8% (245)	21.3% (164)	18.1% (139)	770
Green waste	46.9% (361)	30.0% (231)	14.5% (112)	8.6% (66)	770
Hazardous waste	58.1% (447)	31.2% (240)	7.5% (58)	3.2% (25)	770
				answered question	770
				skipped question	56

7. Please answer True (T), False (F) or Don't know to the items below.

	T	F	Don't know	Response Count
The most common method of waste disposal in the UK is incineration.	17.9% (138)	39.7% (306)	42.3% (326)	770
More plastic is recovered for recycling than paper every year in the UK.	23.8% (183)	32.7% (252)	43.5% (335)	770
When waste decomposes in a landfill, it mainly releases carbon dioxide which is harmful for the natural environment.	46.6% (359)	32.6% (251)	20.8% (160)	770
By 2010, the national target of the UK is to recycle and compost 20% of household waste and 30% of municipal waste.	31.8% (245)	8.2% (63)	60.0% (462)	770
The UK generates around half ton of household waste per capita per year.	38.3% (295)	13.1% (101)	48.6% (374)	770
Wood is a renewable raw material. This is because paper made out of wood is recyclable.	35.7% (275)	49.0% (377)	15.3% (118)	770
Paper can be recycled. This is because paper is biodegradable.	46.9% (361)	39.2% (302)	13.9% (107)	770
The mixing of waste at a dumping site makes some materials (eg paper & card) unfit for recycling.	71.4% (550)	10.3% (79)	18.3% (141)	770
Shredded glass can be used for making new glass (e.g. for bottles). That's why making new glass from sand is not necessary any more.	52.3% (403)	22.3% (172)	25.3% (195)	770
People throw away one third of all the food they buy in the UK.	75.5% (581)	4.8% (37)	19.7% (152)	770
			answered question	770
			skipped question	56

8. How much general knowledge of environment issues, including waste management, did you learn in school?

		Response Percent	Response Count
A lot (3)		4.8%	37
A fair amount (2)		33.2%	256
Only a little (1)		46.9%	361
Practically nothing (0)		15.1%	116
		answered question	770
		skipped question	56

9. Overall, how would you rate the environmental knowledge you learnt in school?

		Response Percent	Response Count
Excellent (4)		2.3%	18
Good (3)		19.4%	149
Fair (2)		43.9%	338
Poor (1)		25.6%	197
Very poor (0)		8.8%	68
		answered question	770
		skipped question	56

10. Do you think the environmental education you received in school has assisted you to behave in a more environmentally friendly manner?

		Response Percent	Response Count
Yes, absolutely (3)		9.0%	69
Yes, to some extent (2)		49.9%	384
Not sure / Don't know (1)		18.9%	145
No, not at all (0)		22.2%	171
		answered question	769
		skipped question	57

11. What, if anything at all, restricted the amount and range of environmental education opportunities in your school? (Please tick ALL that apply).

		Response Percent	Response Count
Lack of information about available opportunities		45.2%	347
Lack of easy access to environmental education centers		38.5%	296
Lack of hands-on activities		**48.6%**	373
Our location makes it difficult for environmental education speakers to visit us		7.6%	58
The transport costs too much		10.8%	83
The course(s) is too short		14.8%	114
The cost levied by the provider is too high		9.2%	71
Environmental education trips and speakers aren't very relevant to the curriculum		35.2%	270
Many of our teaching staff aren't interested in environmental education		34.6%	266
Many of our pupils aren't interested in environmental education		45.3%	348
Nothing		8.9%	68
Other (please specify)		7.2%	55
	answered question		768
	skipped question		58

12. Do you think universities should do more / continue environmental education from school to help their students to gain further knowledge of environmental problems, including waste management?

		Response Percent	Response Count
Yes		81.4%	625
No		10.4%	80
Don't know		8.2%	63
	answered question		768
	skipped question		58

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13. How often do you produce the following material?

	Daily or more often (5)	Weekly (4)	Fortnightly (3)	Monthly (2)	Yearly (1)	Never (0)	Response Count
Paper and card	65.8% (493)	24.7% (185)	4.1% (31)	2.0% (15)	1.1% (8)	2.3% (17)	749
Food or drink cans	35.1% (263)	44.6% (334)	8.4% (63)	8.3% (62)	0.9% (7)	2.7% (20)	749
Plastic bottles	18.6% (139)	49.3% (369)	17.8% (133)	10.5% (79)	0.9% (7)	2.9% (22)	749
Glass bottles and jars	9.2% (69)	40.5% (303)	21.6% (162)	22.6% (169)	2.4% (18)	3.7% (28)	749
						answered question	749
						skipped question	77

14. How often do you recycle the following material?

	Daily or more often (5)	Weekly (4)	Fortnightly (3)	Monthly (2)	Yearly (1)	Never (0)	Response Count
Paper and card	38.9% (291)	30.6% (229)	10.0% (75)	8.0% (60)	2.8% (21)	9.7% (73)	749
Food and drink cans	20.7% (155)	32.6% (244)	11.5% (86)	13.8% (103)	3.5% (26)	18.0% (135)	749
Plastic bottles	17.9% (134)	34.3% (257)	16.3% (122)	11.9% (89)	4.3% (32)	15.4% (115)	749
Glass bottles and jars	11.2% (84)	24.7% (185)	15.9% (119)	23.1% (173)	5.7% (43)	19.4% (145)	749
						answered question	749
						skipped question	77
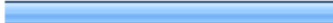
15. Where do you live?

		Response Percent	Response Count
Student halls of residence		60.6%	454
Private housing		34.4%	258
Home		4.9%	37
		answered question	749
		skipped question	77

16. What, if anything, stops you recycling more than you do at the moment? (Please tick ALL that apply).

		Response Percent	Response Count
Nothing-I already recycle everything I can		29.0%	217
Lack of recycling facilities locally		55.7%	417
Having to wash items before putting them in the recycling bins		18.2%	136
I'm not in the habit of recycling		15.2%	114
Seldom produce recyclable materials		4.1%	31
I can't be bothered, it is too much hassle		8.0%	60
I haven't got the time		9.1%	68
I'm short of storage space		22.7%	170
I don't know what to recycle		14.2%	106
I don't know how to recycle		7.2%	54
Recycling is unpleasant to do		3.2%	24
Not interested		2.1%	16
No one around me recycles		13.9%	104
Don't know		1.5%	11
Other (please specify)		13.1%	98
	answered question		749
	skipped question		77

17. Are you aware of the recycling facilities on campus?

		Response Percent	Response Count
Yes		62.6%	469
No		37.4%	280
	answered question		749
	skipped question		77

18. How often do you use the recycling facilities on campus?

	Response Percent	Response Count
Every day (4)	9.6%	45
At least once every week (3)	28.5%	133
At least once every month (2)	33.4%	156
Once every six month (1)	10.3%	48
Never (0)	18.2%	85
answered question		467
skipped question		359

20. What are your THREE main sources of information about waste and waste issues in the UK? (Please tick THREE boxes below).

	Response Percent	Response Count
On television	55.8%	417
On the radio	12.0%	90
In a magazine	12.7%	95
In a newspaper	38.4%	287
On the Internet	57.4%	429
In a letter, flyer or announcement you got in the mail	17.3%	129
Taught at school	17.9%	134
Taught at university	13.4%	100
Taught by parents	21.8%	163
Talking to friends	14.2%	106
Governmental campaigns	23.7%	177
Field trips	2.3%	17
Participate in environmental groups	5.5%	41
Other (please specify)	3.2%	24
answered question		747
skipped question		79

165
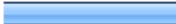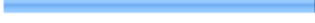
21. Are you a regular recycler (recycle at least once every week)?

		Response Percent	Response Count
Yes		70.3%	525
No		29.7%	222
	answered question		747
	skipped question		79
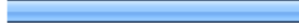
22. If you are a regular recycler (recycle at least once every week), what are your THREE primary motivations for recycling? (Please tick THREE boxes below).

		Response Percent	Response Count
Environmental Benefits		67.8%	353
Pro-environmental values held by the friends		4.6%	24
Pro-environmental values held by the family		14.6%	76
Concern about the environment		70.4%	367
Childhood experiences in nature		9.2%	48
Want to make an impact		19.0%	99
Social Responsibility		58.3%	304
Recycling habit		29.4%	153
Role models e.g. school teachers		1.3%	7
Education from school		4.0%	21
Education from university		5.4%	28
Documentaries / films about the environment on TV		7.5%	39
Don't know		1.3%	7
Other (please specify)		3.6%	19
	answered question		521
	skipped question		305

23. What do you think is the best way to encourage university students to carry out more waste recycling? (Please tick all that apply).

	Response Percent	Response Count
Being taught through good practice from an early age at school	70.3%	522
Making sustainable modules compulsory to all university students	13.9%	103
Through practical demonstrations to new students in University Halls of Residences	37.6%	279
Through effective advertising campaigns on television	32.2%	239
Through effective advertising campaigns on radio	14.9%	111
Through effective student union events	33.5%	249
'Pay as you throw' – being charged for all waste that goes to landfill	37.3%	277
Rewarding good practice through financial incentives	39.8%	296
Council provide better facilities within each household to help separate waste	59.4%	441
Introducing role models	9.2%	68
Incentives / Rewards	41.0%	305
Don't know	1.2%	9
Other (please specify)	7.3%	54
answered question		743
skipped question		83
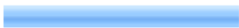
24. Are you...?

	Response Percent	Response Count
Male	44.1%	326
Female	55.9%	413
answered question		739
skipped question		87

167

25. What year of your degree are you in?

		Response Percent	Response Count
First year undergraduate		44.4%	328
Second to Fourth year undergraduate		28.7%	212
Postgraduate		26.9%	199
		answered question	739
		skipped question	87

26. Into which age category do you fall?

		Response Percent	Response Count
Under 20 years		35.0%	259
20 – 24 years		44.8%	331
25 – 29 years		13.7%	101
30 – 34 years		2.7%	20
35 – 39 years		2.3%	17
40 and over years		1.5%	11
		answered question	739
		skipped question	87

27. Are you a student of...?

		Response Percent	Response Count
Arts		12.7%	94
Social science		16.0%	118
Law		2.7%	20
Science and engineering		57.4%	424
Medicine		9.6%	71
Education		1.6%	12
		answered question	739
		skipped question	87

28. Are you a/an...?

		Response Percent	Response Count
UK student		69.3%	512
EU student		9.5%	70
Overseas (non-EU) student		21.2%	157
		answered question	739
		skipped question	87

Appendix N Student satisfaction and Planned behaviour survey at Control Hall without recycling facilities

Dear Student,

From September 2007, the university will trial a new multi-material recycling service across a number of halls. We would like to find out what you think. Your feedback will play a crucial role in the development and improvement of the recycling scheme at your hall. To help us, we would be very grateful if you could spare a little of your time to answer the following questions.

All completed questionnaires received by 15th May 2008 will have the chance to be entered into a free prize draw. Two lucky winners will receive £100 CASH - see end of survey for details!

All your answers are made in the <u>strictest confidence</u> and will only be used for research and planning purposes. Many thanks for taking the time and trouble to complete this questionnaire. Please contact Julia Zhang at <u>nz6012@soton.ac.uk</u> if you have any questions about this matter.

Please return the completed questionnaire to one of the following drop-off points:

Hall	Drop-off point
Bencraft Court	Hall office post box
Gateley Hall & Romero Hall	Hall reception at Gateley Hall
St. Margaret House	Hall office post box on the ground floor

Q1 Did you recycle during the last 4 weeks in Southampton?

Yes…………………………1(Please go to Q2)
No………………………… 2 (Please go to Q3)

Q2 Which of the following facilities did you use? (Please circle ALL that apply.)

Recycling banks (e.g. bottles banks, paper banks) at supermarkets……………………..1
Civic amenity sites………………………..2
Charity shops……………………………3
Charity donation bags……………………4
Other (Please specify)……………………5

Q3 If your answer is 'No', could you tell us why? (please circle TWO answer only)

I can't be bothered, it is too much hassle......1
I haven't got the time................................. .2
I don't know how to recycle……………....3
I don't know where to recycle……………..4
I don't know what to recycle………………5
Recycling isn't convenient………………..6
Not interested……………………………7
Recycling is unpleasant to do………………8
Other (please specify)…………………… 9

Q4 If the university provided recycling facilities at you hall, how likely would you be to participate?

Not at all likely…………………………………1
Not very likely…………………………………2
Not sure………………………………………...3
Very likely……………………………………...4
Extremely likely………………………….......5

Q5 Where did you live in 2006/07? (Please circle one answer only.)

Home…………………...…………………………1
Student halls of residence……………………2
Private housing………………………………3

Q6 Did you have access to either kerbside recycling schemes or other types of recycling scheme in 2006/07? (Please circle one answer only.)

Yes……………………………………………….1
No………………………………………………..2

Q7 Compared to 2006/07, which of the following best describes your CURRENT recycling activity. (Please circle one answer only.)

I recycle more now……………………………1
I recycle about the same amount………………2
I recycle less now…………………………...3
I did not recycle, but I do now…………………4

Personal attitudes to waste management and environmental issues

Q17 Which of these statements best describes how you feel? (please circle one number for each row)							
	Strongly disagree						**Strongly agree**
I intend to participate in the recycling scheme at my hall within the next fortnight.	1	2	3	4	5	6	7
I will try to participate in the recycling scheme at my hall within the next fortnight.	1	2	3	4	5	6	7
Recycling is important to me personally.	1	2	3	4	5	6	7
Recycling is too much bother.	1	2	3	4	5	6	7
To me, recycling is rewarding.	1	2	3	4	5	6	7
Recycling is a waste of time.	1	2	3	4	5	6	7
People who are important to me would approve of me recycling.	1	2	3	4	5	6	7
People whose opinion I value would think I should recycle.	1	2	3	4	5	6	7
There are plenty of opportunities for me to engage in recycling.	1	2	3	4	5	6	7
If I want to, it would be easy for me to engage in recycling during the next fortnight.	1	2	3	4	5	6	7
I would feel guilty if I did not recycle my waste.	1	2	3	4	5	6	7
It is everybody's duty to recycle in the UK.	1	2	3	4	5	6	7
To engage in recycling is an important part of who I am.	1	2	3	4	5	6	7
I am not the type of person oriented to engage in recycling	1	2	3	4	5	6	7
We can still find solutions to our environmental problems.	1	2	3	4	5	6	7
The environmental problems are exaggerated.	1	2	3	4	5	6	7
People worry too much about environmental problems.	1	2	3	4	5	6	7
Environmental problems should be left to the experts.	1	2	3	4	5	6	7

A little bit about you

Q9 Where do you live?

Bencraft Court……………………………… 1
Gateley Hall……………………………… 2
Romero Hall………………………….... .3
St. Margarets House…………………… .. 4

Q10 What year of your degree are you in?

First year undergraduate …………………..1
Second to Fourth year undergraduate……...2
Postgraduate………………………………..3

Q11 What gender are you?

Male………………………1
Female…………………..2

Q12 Are you a student of ..?

Arts …………………………………………..1
Social Science ………………….....................2
Law…………………………………………...4
Science and engineering ……………………..3
Medicine………………………………… 5

Q13 Are you a/an …?

UK student…………………………………..1
EU student…………………………………..2
Overseas (non-EU) student ………………….3

Q14 Where do you get your information about environmental issues from? (please circle one answer)

Friends/family…………………………..1
Newspapers/magazines………………....2
School/College/University……………...3
Internet…………………………………4
Leaflets/flyers………………………….5
Radio/TV……………… ……………6
The Environment Agency………………7
Local authorities………………………..8
Books…………………………………...9
Pressure groups………………………..10
Other

Q15 Please use the space below for any further comments on the recycling scheme. Please be as specific as possible:

……………………………………………
……………………………………………

Thank you for taking the time to complete this survey.

If you would like to take part in the free prize draw to win £100, please provide the following information.

Your name…………………………
Your contact e-mail……………....

Appendix O Student satisfaction and Planned behaviour survey at Halls with recycling facilities

Dear Student,

Since September 2007, the university has been trialling a new multi-material recycling service across a number of halls. We would like to find out what you think of this service - including whether you have used it and whether you have found it easy to use. To help us, we would be very grateful if you could spare a little of your time to answer the following questions.

All completed questionnaires received by 15th May 2008 will have the chance to be entered into a free prize draw. Two lucky winners will receive £100 CASH - see end of survey for details!

All your answers are made in the strictest confidence and will only be used for research and planning purposes. Many thanks for taking the time and trouble to complete this questionnaire. Please contact Julia Zhang at nz6012@soton.ac.uk if you have any questions about this matter.

Please return the completed questionnaire to one of the following drop-off points:

Hall	Drop-off point
Bencraft Court	Hall office post box
Gateley Hall & Romero Hall	Hall reception at Gateley Hall
St. Margarets House	Hall office post box on the ground floor

Q1 Have you participated in the recycling scheme at your hall? (Please circle one number only.)

Yes……………………………1 (Please answer Q2-9)
No……………………………..2 (Please go to Q10)

Q2 Where did you get most of your knowledge on the recycling scheme at your hall? (Please circle one number only)

'Welcome Pack' (i.e. an introductory brochure provided by the halls at the beginning of the academic year)………………………………………………	1
'Welcome Talk'(during fresher's week)………………………………………	2
Recycling Poster (on your kitchen's noticeboard)………………………………	3
Hall staff…………………………………………………………………	4
University Bulletin………………………………………………………	5
I don't know anything about the recycling scheme at my hall………………………	6
Other (Please specify)…………………………………………………	7

Q3 How often do you use the <u>INTERNAL</u> recycling bins/bags at your hall (i.e. placing your recyclables in the recycling bins in your bedroom or your kitchen)? (Please circle one number for each type of material only.)

	Daily or more often	Weekly	Fortnightly	Monthly	Every 2 months	Less often Every 2 months
Paper and card	1	2	3	4	5	6
Cans	1	2	3	4	5	6
Plastic bottles	1	2	3	4	5	6
Glass bottles and jars	1	2	3	4	5	6

Q4 How often do you use the <u>EXTERNAL</u> recycling bins/bags at your hall (i.e. placing your recyclables in, or emptying your recycling bins/bags at the recycling points outside your building)? (Please circle one number for each type of material only.)

	Daily or more often	Weekly	Fortnightly	Monthly	Every 2 months	Less than every 2 months
Paper and card	1	2	3	4	5	6
Cans & Plastic bottles	1	2	3	4	5	6
Glass bottles and jars	1	2	3	4	5	6

Continue personal use of the scheme

Q5 Do you feel you recycle as many recyclable items as you can? (Please circle one numbers only.)

Yes……………………………..1
No…………………………...2

Q6 What would encourage you to use the recycling facilities more often? (Please circle one number only.)

Knowing what to recycle…………… 1
Knowing how to recycle…………… 2
Knowing where to recycle………… 3
More information on the impacts of 4
rubbish
Rewards e.g. free prize draw for
participating……………………… 5
Not having to wash items before
putting them in the recycling bins… 6
Nothing………………………… 7
Other (Please specify)……………… 8

Q7 Where did you live in 2006/07? (Please circle one answer only.)

Home…………..……………………1
Student halls of residence…………………2
Private housing……………………………3

Q8 Did you have access to either kerbside recycling schemes or other types of recycling schemes in 2006/07? (Please circle one number only.)

Yes…………………………………………
.1
No……………………………………….
.2

Q9 Compared to 2006/07, which of the following best describes your CURRENT recycling activity. (Please circle one number only.)

I recycle more now…………………………1
I recycle about the same amount……………2
I recycle less now…………………………3
I did not recycle, but I do now………………4

Q10 If you have not used the recycling scheme, could you tell us why? (please circle TWO numbers only)
I can't be bothered, it is too much hassle.....1
I was not aware of the scheme…………….2
I haven't got the time.................................. 3
I don't know how to recycle………….....4
I don't know where to recycle……………..5
I don't know what recycle…………………6
Recycling scheme is inconvenient…………7
Not interested………………………………8
Recycling is unpleasant to do…………… 9
Other (please specify)…………………… 10

Personal satisfaction with the scheme

Q11 Please specify your level of satisfaction/ dissatisfaction with the following elements of the recycling scheme at your hall. (Please circle one number for each row only.)

	Not at all satisfactory						Extremely satisfactory
Location of the internal recycling bins/bags	1	2	3	4	5	6	7
Location of the external recycling bins	1	2	3	4	5	6	7
Size of the internal recycling bins/bags	1	2	3	4	5	6	7
Overall convenience of the scheme	1	2	3	4	5	6	7
Signage on the external recycling bins	1	2	3	4	5	6	7

Q 12 Do you have any concerns about any of the recycling facilities at your hall? (Please circle one number only.)

Yes…………………………1
(If Yes, your concerns are……………………………………………………………………)
No…………………………..2

Q13 Did you find the information provided about the scheme…? (Please circle one number only.)
About right……………………1
Too little……………………..2
Too much……………………3

Q14 Did you find the following publicity material helpful and informative? (Please circle one number for each row only).

	Not at all satisfactory						Extremely satisfactory
'Welcome Pack' (introductory brochure provided at the beginning of the academic year)	1	2	3	4	5	6	7
Recycling poster and simple guide to recycling (on your kitchen's noticeboard)	1	2	3	4	5	6	7

Continue personal satisfaction with the scheme

Q15 Are you clear about which material you can and can't recycle?

Yes…………………………1
No…………………………..2
Not Sure……………………3

Q16 Overall, how satisfied are you with the recycling scheme at your hall? (Please circle one answer.)

Not at all satisfactory						Extremely satisfactory
1	2	3	4	5	6	7

Personal attitudes to waste management and environmental issues

Q17 Which of these statements best describes how you feel? (Please circle one number for each row)							
	Strongly disagree						**Strongly agree**
I intend to participate in the recycling scheme at my hall within the next fortnight.	1	2	3	4	5	6	7
I will try to participate in the recycling scheme at my hall within the next fortnight.	1	2	3	4	5	6	7
Recycling is important to me personally.	1	2	3	4	5	6	7
Recycling is too much bother.	1	2	3	4	5	6	7
To me, recycling is rewarding.	1	2	3	4	5	6	7
Recycling is a waste of time.	1	2	3	4	5	6	7
People who are important to me would approve of me recycling.	1	2	3	4	5	6	7
People whose opinion I value would think I should recycle.	1	2	3	4	5	6	7
There are plenty of opportunities for me to engage in recycling.	1	2	3	4	5	6	7
If I want to, it would be easy for me to engage in recycling during the next fortnight.	1	2	3	4	5	6	7
I would feel guilty if I did not recycle my waste.	1	2	3	4	5	6	7
It is everybody's duty to recycle in the UK.	1	2	3	4	5	6	7
To engage in recycling is an important part of who I am.	1	2	3	4	5	6	7
I am not the type of person oriented to engage in recycling	1	2	3	4	5	6	7
We can still find solutions to our environmental problems.	1	2	3	4	5	6	7
The environmental problems are exaggerated.	1	2	3	4	5	6	7
People worry too much about environmental problems.	1	2	3	4	5	6	7
Environmental problems should be left to the experts.	1	2	3	4	5	6	7

A little bit about you

Q18 Where do you live?

Bencraft Court……………………………… 1
Gateley Hall……………………………… 2
Romero Hall………………………….... .3
St. Margarets House……………….…..4

Q19 What year of your degree are you in?

First year undergraduate …………………..1
Second to Fourth year undergraduate……....2
Postgraduate…………………………….3

Q20 What gender are you?

Male………………………1
Female…………………….2

Q21 Are you a student of ..?

Arts …………………………………………..1
Social Science ………………........................2
Law…………………………………………..4
Science and engineering ……………………..3
Medicine……………………………………5

Q22 Are you a/an …?

UK student…………………………………1
EU student……………………………..2
Overseas (non-EU) student ………………3

Q23 Where do you get your information about environmental issues from? (please circle one answer only)

Friends/family……………………………..1
Newspapers/magazines…………………....2
School/College/University………………...3
Internet…………………………………….4
Leaflets/flyers……………………………..5
Radio/TV…………………………………..6
The Environment Agency………………….7
Local authorities…………………………..8
Books………………………………………9
Pressure groups……………………………10
Other

Q24 Please use the space below for any further comments on the recycling scheme. Please be as specific as possible:

……………………………………………

…………………………………………….

Thank you for taking the time to complete this survey.

If you would like to take part in the free prize draw to win £100, please provide the following information.

Your name………………………
Your contact e-mail……………....

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