The Importance of Determining Factors Affecting Household Recycling Participation and Efficiency Levels.

by

Darren Perrin

Submitted in accordance with the requirements for the degree of Doctor of Philosophy

University of Leeds

Department of Civil Engineering

June, 2002

The candidate confirms that the work submitted is his own and that appropriate credit has been given where references has been made to the work of others.

ACKNOWLEDGEMENTS

I would like to thank John Barton for his supervision, advice, guidance and support throughout the research period and preparing the thesis. Also, I would like to thank Professor Ed Stentiford for his support, encouragement and review of the thesis.

My appreciation goes to Jill Campbell (formerly at Leeds City Council), Linda Lawson (Bradford City Council) and all the involved waste management operational staff at both local authorities for their assistance. Particularly, for allowing the monitoring of their kerbside schemes, waste analyses to be completed on their premises and providing resources where required which enabled essential data to be collected for the research. Also, I would like to thank the students / friends who were involved in the waste sorting, scheme monitoring and collecting questionnaires during the course of the project.

The research could not have been completed without the financial support of EPSRC and the Faraday group who provided grant support for the project, thank you. Also I would like to thank Biffa for providing landfill tax monies to support the creation and operation of the Millennium Scheme and once again Bradford Council for allowing the scheme to operate at such short notice.

Finally, I would like to give an extra special thanks to my parents and brother for their continual support throughout the research, without which, the end would never have been reached.

ABSTRACT

New mandatory recycling targets within the UK present a serious challenge to local authorities. 9 out of 10 people claim to recycle within the UK, yet the recycling rate remains at c.10%, well short of the necessary levels required. Fully understanding how to convert households attitudes and opinions into efficient participatory behaviour, within what still remains a voluntary activity, is essential if targets are to be met at an 'affordable' economic and environmental cost.

Best practice for local authorities in relation to developing kerbside recycling schemes is currently developed on a basis of previous experience within other authorities, i.e. 'it was successful there, so it should be successful here', rather than understanding the reasons for a given success or failure. Although previous research has highlighted a series of drivers / barriers to recycling and a schemes success / failure, monitoring these relationships collectively during the same spatial and temporal conditions is rarely undertaken. Understanding the issues involved with 'Best Guidance' for local authorities, not only requires the drivers and barriers to household's recycling behaviour to be understood, recognition of the relative importance and interaction between these issues. More importantly, local authorities need to recognise those that are within the authority control.

This research has monitored in detail three separate kerbside recycling schemes that vary in their demands on both the householder to participate, and the cost to the scheme provider to implement and maintain. Household's attitudes and claimed / actual recycling behaviour were monitored both before and after their introduction in an attempt to identify the relative affect and interaction of factors determining recycling participation and participation efficiency. Collected data is supported by secondary data sets from other nationally reported research projects. The research has identified a series of relationships and behavioural patterns supported by both quantitative and qualitative data sources in relation to each of the kerbside recycling schemes monitored, and those most commonly used within the UK. Determining factors have been classified into four categories (1. the material, 2. scheme maintenance, 3. scheme design and 4. the individual). A model has been created that has ranked these factors in relation to their effect on determining participation and recovery levels, supported by a thorough understanding of the issues involved. A further self-calibrated model has been developed predicting diversion levels at a scheme or district level.

Some main findings of the project are as follows,

- The inconvenience that the 'material itself' presents to the householder to recycle it, is the most important factor effecting recycling levels. An imaginary scale in response to 5

hypothetical questions identifies the most likely recovery efficiency of a particular material as a result of conditions within the home independent of the other three categories.

- Material recovery levels fall into 3 distinct categories, determined initially in order of the materials product type, recognised as media, beverage, then food, followed by the materials type, e.g. glass, metal, then plastic, regardless of the other three categories.
- Expected recovery ratios on kerbside recycling schemes normalised against newspapers have been suggested e.g. c.0.9 (glass bottles), c.0.7 (drink cans), c. 0.6 (plastic bottles), c.0.4 (food cans) etc.
- Clear, effective communication and scheme maintenance, i.e. feedback, maintains high participation and increases materials recovery, especially for the packaging fractions.
- The scheme design affects both participation levels and participation efficiency for specific materials. A convenient system is required to achieve high levels of either.
- Positive attitudes are not necessarily a pre-determinant of recycling behaviour and are not influenced by a schemes design. Specific attitudes are similar for recyclers and non-recyclers.
- Differences between claimed and monitored behaviour in relation to participation, set-out and materials recovery were observed.

CONTENTS

List of Tables

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

List of Figures

Chapter 1

Chapter 2

Chapter 3

Chapter 4

1.0 INTRODUCTION

1.1 General

Over the past decade there has been increasing international interest and concern from both governmental bodies and the general public alike, in the protection of our environment for current and future generations. Waste management and recycling is just one of these issues. Recycling, unlike many environmental problems e.g. global warning, deforestation etc is an activity where the public can participate directly in its solution (Lober, 1996).

Waste is defined as "any substance or object, which the holder discards or intends or is required to discard" (DETR 2000b). Around 400 million tonnes of waste in England and Wales are produced each year where 106 million tonnes is produced by industry, commerce and households. The remaining c.300 million tonnes is made up of construction and demolition wastes, agricultural wastes, mining wastes, sewage sludge and dredged spoils. This thesis will focus on Municipal Solid Waste (MSW) which accounts for 28 of the 106 million tonnes (DETR, 2000a).

The recent introduction of the Government's 'Waste Strategy 2000' (DETR, 2000a) will undoubtedly change the emphasis that the local authority sector places on recycling. With new specific household waste mandatory recycling targets set, it is essential to fully understand not only why households recycle but also how to improve the efficiency of those already recycling, especially considering the voluntary nature of recycling. *"It is an important characteristic of source separation, that most benefits are shared with the society at large while the behavioural costs can be shared only within the family"* (Thogersen, 1994).

This chapter will outline the scale of the waste management problem within the context of MSW, identifying current levels of generation, composition and the various disposal options available. It will then outline the rapid development of waste legislation within Europe and subsequently England, highlighting the practical implications/challenges of England and Wales 'Waste Strategy'. Separate strategies have since been developed for Wales, Northern Ireland and Scotland. A strategy referring reporting on just England is due in August 2002.

1.2 Municipal Solid Waste – Definition

MSW within England and Wales refers to waste collected by or on behalf of the local authority (DETR, 2000a), which includes household waste from collection rounds, street and litter collections, civic amenity (C.A) sites, bring/drop off schemes etc. There are variations in the definition of MSW that limit the effectiveness of comparing scheme performances and authority recycling rates at a global level, although overall lessons and best practice can be observed and learnt from. Municipal waste statistics for England and Wales are reported by DEFRA (2000a and b, 2001) as shown in table 1.1.

Table 1.1 Municipal Waste Arisings in 1998/99 and 1999/00 in England and Wales

	1998/99 Million Tonnes	kg/hh/wk	%	1999/00 Million Tonnes	kg/hh/wk	%
Regular household collection	17.09	15.2	61.2	17.63	15.6	60.1
Other household sources	1.05	0.9	3.8	1.10	1.0	3.8
Civic amenity sites	4.57	4.1	16.4	4.83	4.3	16.5
Household recycling	2.20	2.0	7.9	2.69	2.4	9.2
Total household	**24.91**	**22.2**	**89.3**	**26.25**	**23.2**	**89.5**
Non-household sources	2.60	2.3	9.3	2.56	2.3	8.7
Non-household recycling	0.40	0.4	1.4	0.53	0.5	1.8
Total municipal waste	**27.91**	**24.9**	**100**	**29.33**	**25.9**	**100**

Source DERFA, 2001

1.2.1 Generation and Composition

There were 28 million tonnes of MSW in 1998/99, up from 27.2 million tonnes in 1997/98 (DEFRA, 2000a and b), representing approximately a 3% annual growth. In 1999/00 this further increased to 29.3 million tonnes, equating to an annual growth of 5% (DEFRA, 2001). Regular household collection accounts for the largest proportion of MSW arisings; at the same time household collections are gradually moving towards wheeled bins (Table 1.2). DEFRA (2000b) report that all main sources have increased over the past 3 years with the exception of CA sites, potentially a result of waste being diverted from CA sites to larger capacity wheeled bins and the increasing number of households served by wheeled bins for residue collections. However, anecdotal evidence from some local authorities suggests that increases in waste generation as a result of a wheeled bins introduction is not a temporary shift in behaviour (Audit Commission, 1997).

Table 1.2 **Method of Refuse Collection Round Waste Containment in England and Wales: 1996/97, 1997/98, 1998/99 and 1999/00.**

	Percentage of Households			
	1996/97	**1997/98**	**1998/99**	**1999/00**
Wheeled Bin	41%	43%	45%	48%
Plastic Sack	31%	31%	29%	29%
No Method Provided	21%	20%	19%	19%
Other	6%	7%	7%	4%
Total	100%	100%	100%	100%

Source: DEFRA, 2001

1.2.2 Disposal Options

The majority of MSW is disposed of to landfill (81%) and only 11% is currently recycled/composted (Table 1.3). No significant changes have occurred within the past four years (DEFRA, 2000a and b, 2001), despite targets to increase the amount of waste being recycled/composted being in place (D.o.E, 1995).

Table 1.3 **Municipal Waste Management in 1998/99 and 1999/00 in England and Wales**

	1998/99 Million Tonnes	**kg/hh/wk**	**%**	**1999/00 Million Tonnes**	**kg/hh/wk**	**%**
Landfill	23.01	20.5	82.4	23.71	21.0	80.8
Incineration without EfW	0.02	0.0	0.1	0.01	0.0	-
Incineration with EfW	2.15	1.9	7.7	2.28	2.0	7.8
RDF Manufacture	0.13	0.1	0.5	0.11	0.1	0.4
Recycled/Composted	2.60	2.3	9.3	3.22	2.8	11.0
Other	0.01	0.0	-	0.00	0.0	-
Total	**27.91**	**24.9**	**100**	**29.33**	**25.9**	**100**
(Of which MME)	0.06		0.2		0.06	0.2
Total Recovery			**17.7**			**19.3**

[Note: kg/hh/wk = kg/household/week]

Source: DEFRA, 2001

The Landfill Directive[1] requires a significant reduction in the proportion of waste landfilled; up to 35% of that produced in 1995 by 2020. This presents an enormous task not only for industry to significantly reduce the amount of waste produced but also for the waste management

[1] Official Journal of the European Community L182/1 16.7.99: the Landfill Directive (99/31/EC)

industry to divert this material through recycling, composting and Energy from Waste (EfW) or to develop new and existing technologies i.e. anaerobic digestion, pyrolysis, gasification to a commercial scale. Recent national surveys suggest that a large percentage of the public are unaware of where their waste is disposed of and the real cost of waste management (Waste Watch, 1998, 1999a; Burnley and Parfitt, 2000). Only a third of households claim to think about what happens to their domestic waste after putting it out for collection (Waste Watch, 1999a). This suggests we live in a throwaway society in which as long as our dustbins our emptied every week, we tend not to worry about what happens next.

In comparison to other environmental issues, household waste disposal is of little concern to the public (Oskamp et al, 1991; Oxford Brookes, 1999; DETR, 2001a). However, recycling has universal acceptance; 72% of the population claim to recycle at least once a month and 35% claim to recycle weekly (Oxford Brookes, 1999). 9 out of 10 people claim to recycle at least one material and see landfill as the least preferred disposal option (Waste Watch, 1998, 1999a). Despite public acceptance, only 9.2% of waste is recycled or composted (table 1.1).

There will always be a need for landfill, even if only to deal with residues from other disposal processes. EfW is expected to play a large part in meeting government recovery targets highlighted in the governments draft strategy 'A Way with Waste' (DETR,1999a). Although EfW is a controversial disposal option, considered unacceptable by many environmental organisations and individuals within the waste industry, it would appear that the government foresees the difference between recycling and recovery targets to be met by EfW, although reserved in its approach (House of Commons 2001). EfW would appear to be an affective ive approach to managing the parts of MSW, which is uneconomic, and technically challenging to the recycling industry. Achieving high waste diversions using alternative methods to incineration has been suggested (Greenpeace, 2001). The benefits and dis-benefits of EfW are beyond the scope of this thesis.

The relatively cheap nature of landfill within the UK in comparison to other countries highlights why traditionally landfill has been an attractive disposal option (Aumonier and Troni, 2001). There is a need to realise that current waste management practices utilize the cheapest available option, and as legislative pressures increase to develop more favourable recovery options, the challenge is to develop integrated strategies to suit local conditions (Bickerstaff, 1994, Caulter, 2001).

1.3 Development of Waste Legislation within the UK and the European Influence

The development of waste treatment and disposal has been subject to a long history of legislative control. However, until recently there has been no single Parliamentary Act dealing with the broad aspects of waste management (Williams 1998). Internationally, the development of Agenda 21 (which arose from the UN 1992 conference on environment and development; the Earth Summit) addressed the issue of waste management, ranking it among the environmental issues of greatest concern to the global community. Subsequently, a framework of objectives for dealing with waste was developed with objectives to 1) minimise wastes, 2) maximise environmentally sound re-use/recycling and 3) promote environmentally sound waste disposal (Watts, 2000).

One of the most influential pieces of UK legislation affecting UK waste management and environmental sustainability was the Environmental Protection Act (EPA) 1990. "The EPA enacted a wide range of powers designed to strengthen control over waste from cradle to grave" (Bell, 1997). Divided into two parts, the act deals with 1) prescribed processes e.g. incineration and 2) disposal of waste on land e.g. landfill and defines 'controlled waste' which is the main category of waste covered by the act (Williams 1998). Although initially inundated with problems, it successfully brought existing measures together to ensure that "the UK met their European and Directive requirements, re-emphasising the 'polluter pays' principle, the 'proximity/self-sufficiency' principle and ensuring regulator and operator functions in waste management were clearly separated" (Barton, 1997). The Environmental Protection Act 1990 was responsible and made provision for the progressive introduction of a variety of concepts such as BATNEEC (Best Available Technology Not Exceeding Excessive Costs), IPC (Integrated Pollution Control) and recycling credits, but most importantly, section 34 of the act, 'the duty of care'. This is significant in that it places a responsibility on all actors[2] involved with waste to take all necessary measures to ensure its safe keeping, transportation and disposal of waste in a responsible manner. However, households are exempt from duty of care.

The EPA 1990 presented local authorities with the task of preparing recycling plans and to take action to recover 50% of recyclables by the year 2000. Establishing the Environment Agency (following the Environment Act in 1995) brought together all the environmental regulatory functions of the National Rivers Authority (NRA), Her Majesty's Inspectorate of Pollution

[2] Any person who imports, produces, carries, keeps, treats or disposes of controlled waste or, as a broker, has control of such waste (Duxbury and Morton, 1995)

(HMIP) and the Waste Regulatory Authorities (WRA), demonstrating the government's commitment towards environmental sustainability and waste management. The Environment Act, (1995) also "amended existing legislation to rationalise the requirements to plan effectively ively for waste, including the preparation of national waste strategies (DETR, 2000a and b).

Sustainable waste management practices were also being recognised in continental Europe with the publication of the revised directive on waste in 1991[3] requiring member states to set in place plans to encourage the prevention and valorisation of waste in which the issue of recycling has taken precedence. This commitment was taken forward with the introduction of the Packaging Directive[4] in 1994 and more recently the Landfill Directive (99/31/EC). The Packaging Directive set in place recovery and recycling targets for member states. Targets to be met by 2001 are,

- To recover between 50% and 65% of packaging waste;
- To recycle between 25% and 45% of packaging waste;
- To recycle at least 15% of each material.

Member states are free to introduce their own National legislation and strategies although failure to meet the targets would result in financial penalties. There was concern that the UK would fail to meet the deadline, especially for the recycling of each material and particularly for the plastics. Subsequently, the UK is currently facing financial penalties for not reaching specified targets. However, proposals to amend the Packaging Directive (ARGUS, 2001) in which higher recovery and recycling targets are suggested, highlights the need for the relevant sectors to set in place appropriate high recovery systems for packaging waste in order to meet material specific higher targets for 2006.

Although legislative measures concerning packaging were not introduced until 1997 (DoE, 1997), meetings and discussions between various industrial and governmental bodies via the Producer Responsibility Industry Group (PRG) were undertaken in the early 90's. In response to the 94/62/EC Directive, the PRG produced a detailed report 'Real Value from Packaging Waste, A Way Forward' (PRG, 1994) identifying recycling targets alongside integration and the foundations required to effectively manage packaging waste. Industry was given the opportunity to take action and targets that were introduced were voluntary and subsequently not met and

[3] Council Directive 91/156/EEC of March 1991 modifying Directive 75/442/EEC of 15 July 1975 on waste.

[4] European Parliament and Council Directive 94/62/EC of 20Decmeber 1994 on Packaging and packaging waste. Packaging Directive O.J.E.C. L365 (31.13.94) p.10.

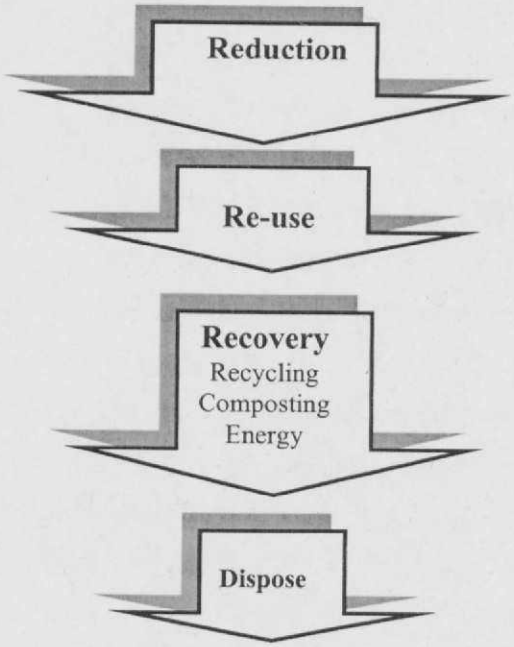
therefore resulting in the introduction of the Packaging Regulations (DoE, 1997) and statutory targets. The industry response to aspects of the legislation was hostile and a governmental review of the regulations and its operating mechanisms was undertaken c.12 months after (DETR, 1998a). Details of the regulations will be addressed later in this chapter.

The production of recycling plans (section 49 of EPA 1990) and identifying targets was a result of the government agreeing to produce a Waste Strategy. On 12 December 1995, the government published a white paper 'Making Waste Work,' (DoE, 1995) in which a series of targets were identified in an attempt to outline how (amongst other matters) the objectives of the EC Packaging Directive would be met. Two primary targets were identified:-

- To reduce landfill from 70% to 60% of controlled waste by 2005, and
- To increase recycling and recovery so that they dealt with 40% of municipal waste by 2005.

A series of subsidiary targets were also set of which the most commonly referred to was the voluntary target to 'Recycle and compost 25% of household waste by 2000'. The white paper also introduced the waste hierarchy (Figure 1.1), that aimed to identify a step by step approach of preferred disposal options in conjunction with the Best Practical Environmental Option (BPEO).

Figure 1.1 The Waste Hierarchy, (Source DoE, 1995)



It was soon realised that local authority voluntary recycling targets would not be met with a National recycling rate of only 8% in 1997/98 (DETR, 1998b). In light of the European Landfill Directive proposed targets and in anticipation that the UK would fail to meet minimum packaging directive targets, a draft for England and Wales was developed 'A Way with Waste' (DETR, 1999a) following a consultation document 'Less Waste, More Value' (DETR, 1998b) in the proceeding year. The government alone would be responsible if European targets were not met. Radical changes were proposed. Although some authorities were set to meet their targets (Maryon and Roes, 1997) the majority failed to respond and examples of city-wide recycling of 12% by 2002 were being proposed in some draft recycling plans (LCC, 1999). Unsurprisingly the failings of local authorities to meet voluntary targets resulted in a more rigorous approach being taken in the final version of 'Waste Strategy 2000' (DETR, 2000a and b) introducing a series of other stringent targets addressed later in this chapter. In addition to stringent recycling targets, the secretary of state now has powers under section 15 of the Local Government Act 1999 to intervene and potentially remove functions and responsibilities from an authority.

Households are the only sector in the waste chain not currently legislated, yet they have a crucial role to play if mandatory targets are to be met and material is to be recovered from the domestic waste stream other than through a 'dirty Materials Recycling Facility (MRF)'[5]. Previously illustrated voluntary opportunity followed by legislative action may well be a future possibility for households despite its political sensitivity, although enforcement would be far more complex. Variable charging for residual household collections to encourage recycling/composting may be a more acceptable route although over 60% of the public would not be in favour of this action (Burnley and Parfitt, 2000). Alternatively, there is a need to fully understand, not only why households recycle and how to improve participant's efficiency, but to recognise and act on those needs and motivators in terms of the collection systems provided.

1.4 The Practical Implementations and Challenges of Waste Strategy, 2000

The England and Wales Waste Strategy 2000, outlined the governments vision and objectives in delivering sustainable waste management in England and Wales, setting a series of stringent National targets in order to comply with European Directives. Although these targets are seen by industry and local authorities as challenging, perhaps unachievable, many people believe that

[5] Dirty MRF refers to recovering recyclable materials from refuse without pre-sorting by the householder

the strategy is disappointing and not comparable with the demands placed on other member states. The strategy has been criticised on four main points (House of Commons, 2001). Firstly, it fails to provide any strategy or vision and does not provide sufficient indication of the resources and tools available to implement the strategies and targets. Secondly, the targets although meaningful and if achieved, will mark some progress in waste management, fall short of the ambitious recycling and recovery targets being set elsewhere in Europe. Thirdly, its vision is short and not long term, in which there is too much emphasis on MSW to the exclusion of other larger more problematic waste streams i.e. commercial and industrial waste. Finally, the strategy was believed to be long overdue and failed to adequately address the issues of waste minimisation and the concerns expressed on EfW.

1.4.1 Targets, required costs and infrastructure

Targets set for the UK in the Landfill Directive are,

- By 2010 to reduce biodegradable municipal waste landfilled to 75% of that produced in 1995;
- By 2013 to reduce biodegradable municipal waste landfilled to 50% of that produced in 1995;
- By 2020 to reduce biodegradable municipal waste landfilled to 35% of that produced in 1995;

These targets are based on absolute levels of waste in 1995 rather than the relative proportions of waste sent to landfill. With a 3% to 5% annual growth in MSW arisings, this has been referred to by some as "having to run to stand still" (Coggins, 2001). A series of targets have been set within the Waste Strategy in order to comply with the Landfill Directive. These are as follows:-

- To recover[6] value from 40% of municipal waste by 2005,
- To recover value from 45% of municipal waste by 2010,
- To recover value from 67% of municipal waste by 2015.

An essential part of meeting MSW recovery targets is by increasing the level of households recycling and composting. Therefore, the following targets are set:-

- To recycle or compost at least 25% of household waste by 2005,

[6] Recover means to obtain value from waste through one of the following means, recycling, composting, other forms of material recovery (i.e. AD) and Energy recovery (combustion with direct or indirect use of the energy produced, manufacture of refuse derived fuel, gasification, pyrolysis, or other technologies) (DETR, 2000a)

- To recycle or compost at least 30% of household waste by 2010,
- To recycle or compost at least 33% of household waste by 2015.

To ensure all local authorities contribute to achieving these targets, statutory performance standards for 2004 and 2006 have been set for Waste Disposal, Collection and Unitary Authorities. Currently only the standards for 2003 have been implemented, although the practical implications on most waste authorities is that there will be a need to double recycling rates by 2003/4 and for many treble by 2005/6 in relation to 1998/9 levels. The targets, intended to reflect differing local circumstances are as follows:-

- Waste authority areas with 1998/99 recycling and composting rates of under 5% to achieve at least 10%
- Waste authority areas that recycled or composted between 5% and 15% in 1998/99 to double their recycling rate
- The remaining waste authority areas to recycle or compost at least one third of household waste.

It is believed these targets will deliver an overall recycling rate of 17% by 2003 and close the gap between authorities with currently low rates and the best performers. Although current performance is accounted for in terms of interim proposed targets, long term target objectives for all authorities are the same and do not account for differences between urban/rural communities, the proportion of urban/sub-urban households and/or the age or socio-demographic profiles of authorities. Such factors have all been shown to influence the level of recycling behaviour (Speirs and Tucker, 2001, Parfit et. al. 2001). In the short term, varying targets reflect the authorities previous commitment and effort towards recycling in response to aspirational targets set out in 1995. Those who made an effort and commitment to recycling are almost being penalised for doing so. For those with poor existing recycling rates, attracting the non-recycler to recycle and 'bring' recyclers to recycle more, by providing a kerbside scheme has been demonstrated (Vining and Ebreo, 1992). This is perhaps, an easier task than improving the efficiency of kerbside recycling participants that is less understood (Scott, 1999, Read, 1999). It is therefore imperative to understand how to effectively improve a recyclers efficiency (particularly at the kerbside), a task which will not only be faced by the best performers, but soon by all local authorities.

Pocock (2001) estimated that a cost of around £1.5 billion would be incurred in order to meet targets. The universal introduction of kerbside recycling, targeting all recyclable fractions and

not just a single material, e.g. paper has been suggested. If 80% of households were covered by such schemes and 80% participate, with 80% efficiency, then potentially 50% of available recyclable household waste could be diverted for recovery. Yet, kerbside recycling alone, given current performance with 80% coverage, is predicted to only achieve a recycling rate of c.25%, this is below the targets, reinforcing the need for an integrated waste management solution. Currently 40% of households are served by kerbside collections collecting at least one material. These schemes are unevenly spread across England and Wales where the highest levels of provision are found in rural and prosperous areas of southern, south-west and central England (Parfitt et al, 2001). Changing and expanding facility provision from bring to kerbside presents local authorities with a huge task given that the majority of recyclables (mainly paper and card) are currently collected from bring sites. Although 'bring' is a lower cost option at c.£33/hh compared to £64/hh for kerbside, (Audit Commission, 1997) it must be recognised that increasingly, high impact solutions, (Figure 1.2) regardless of cost will be required to meet targets.

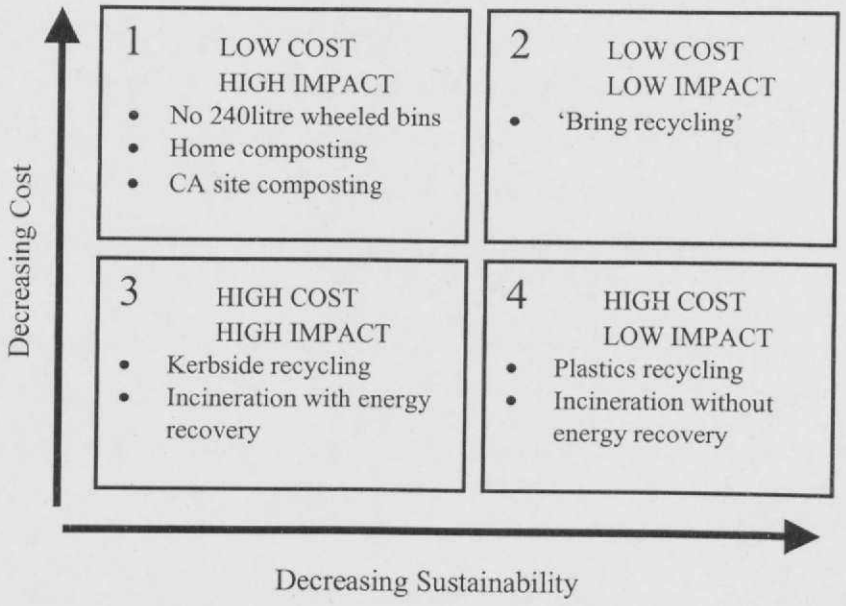
A universal achievement of 80% participation with 80% efficiency which has been recognised as a pre-requisite for meeting National and European targets, is currently not reached in areas where kerbside recycling is provided and scheme performance intensively monitored (M-E-L, 1999). Understanding how to achieve these levels is required when introducing the necessary expansion of kerbside provision and collecting the more complex recyclable fractions. This research aims to provide a framework to identify and assess a selection of the main drivers concerning recycling performance so that more informed decisions regarding scheme provision can be made.

The more an authority recycles under a system of high kerbside recovery, the greater the costs (Lowe, 2000). Limited funding available within local authorities in relation to the enormous predicted costs to meet mandatory recycling targets and the decisions required under the best value regime, may suggest that local authorities are increasingly becoming service facilitators rather than service providers[7]. However, clear guidance in relation to scheme provision and management in response to household's attitudes and behaviour is still required, whether schemes are operated by local authorities, jointly or exclusively by the private sector. However, there should be no underestimation of the challenge facing local authorities aiming to meet statutory targets whilst minimising costs at the same time as keeping council tax at an

[7] Statement from Bradfords City Council waste manager Richard Longcake (2001) during an informal seminar

acceptable level. The difficulties are considerable, especially given the current reported recycling levels and cost structures across authorities (Audit Commission, 2001).

Figure 1.2 Cost Sustainability Matrix (Source: Audit Commission 1997)



1.4.2 Drivers of the Waste Strategy

The 'Waste Strategy 2000' refers to a series of drivers to bring about sustainable waste management within the UK, which could be categorised as statutory, discretionary and voluntary. This section will aim to define a selection of the most relevant drivers to this thesis identifying their aims and highlighting any opportunities and implications they potentially cause.

1.4.2.1 Statutory and Enforceable

These drivers are mandatory and unavoidable. Failure to comply, can result in industries and local authorities facing legal action / prosecution and / or a financial penalty.

Producer responsibility –

The Producer Responsibility (Packaging Waste) Obligations were the UK's legislative response to the Packaging Waste Directive (94/62/EC). The UK's response was different from all other member states as it is market led introducing the concept of 'shared responsibility', placing sector specific recovery obligations on businesses throughout the packaging chain (Table 1.4).

Table 1.4 Percentage Activity Obligations

Activity	Obligation
Raw material manufacturing	6%
Converting	9%
Packaging / Filling	37%
Selling	48%

Source: DETR, 2000c

Business exceeding specified threshold tests must comply or face prosecution from the Environment Agency who is responsible for the monitoring and enforcement of the regulations. The threshold criteria and the recovery/recycling obligation have changed from those previously identified in 1997, (D.o.E, 1997; DETR, 1998a). The current targets that face industry are shown in Table 1.5. Additionally it stated that a minimum of 26% of all material recovered must be recycled (D.o.E, 1997), but this level has been achieved. A summary assessment of the reviewed packaging targets and associated implications can be found in (Barton and Freer, 2001).

Businesses now obligated are those with a turnover over £2million / handling more than 50 tonnes of packaging (DETR, 2000c) with the adjustment of the threshold requirements effective from 2000 over 3,000 more industries become obligated under the packaging regulations, yet the poor performance of industry to meet initial interim targets has resulted in a continual increase of material targets.

Obligated businesses are required to register with the Environment Agency or the Scottish Environment Protection Agency, but may discharge the waste (packaging) collection responsibilities by registering with one of the compliance schemes. Proof of recovery and recycling is by obtaining packaging recovery notes (PRN's) issued by reprocessers.

Table 1.5 Business Recovery and Recycling Target.

	Business Recovery Target	Business material-specific recycling target
2002	59%	19%

Source, Wastes Management, 2002

The intention is for the revenues from the PRN's to be re-invested into new waste collection, sorting and reprocessing capacity. However, as PRN's are tradable and determined by market forces, price fluctuations were high and there was little evidence of significant investment in the period, which led to the system being criticised and subsequently reviewed. The packaging regulations introduced the concept of 'shared responsibility' whereby the percentage recovery obligation to recover packaging is shared between industries producing and handling packaging based on their packaging 'activity'. The packaging regulations have been quoted as "a good example of how NOT to introduce effective producer responsibility requirements," highlighting that the lack of hard hitting producer responsibility measures means that society at large will continue to pay the full price of waste disposal (House of Commons, 2001). The regulations had more success in increasing amounts of packaging being recycled over the past two years and longer term benefits include forcing companies to monitor their packaging flows (House of Commons, 2001) and they are potentially an effective tool in encouraging industry/local authority partnerships. This latter aspect is only likely to occur under the new targets (for 2006), as the new levels appear to have been delivered mainly from commercial/industrial sources. For the most recent consultation on this issue, reference should be made to DTI (2002), where it has been suggested that to meet proposed future targets, some materials will need to be recovered exclusively from the household sector.

Local authorities can have a role in the implementation of the Packaging Regulations. The collection of material on behalf of an obligated business or compliance scheme and subsequent processing can count towards their obligation (DETR, 2001a). In theory this makes it attractive for both parties concerned to work in partnership, considering over half of all packaging waste ends up in the domestic waste stream (DETR, 2000b).

Landfill Tax –

In October 1996 the government introduced the Landfill Tax aimed to reduce the amount of waste going to landfill and to encourage those disposing of waste to consider alternative options. The current rate is £12/tonne for active waste and £2 per tonne for inactive wastes. An escalator of an additional £1 per year subject to review in 2004 was introduced in 1999 (DETR, 2000a). Although effective in principle, even with the tax, landfill remains the cheapest disposal option. Mindful of this fact and high landfill costs in Europe, increasing the tax to at least £25 per tonne over the next 5 years have been suggested (House of Commons, 2001).

Landfill Directive and Landfill Permits -

One of the primary objectives outline in the 'Waste Strategy 2000' (DETR, 2000a and b) is to reduce to amount of waste going to landfill, which European mandatory targets set out in the Landfill Directive (99/31/EC) aim to ensure. Price (2001) suggested three issues that make these targets extremely difficult to meet. The annual growth in waste arising, lack of market availability and stability, and finally inadequate funding and infrastructure for alternative options have been cited. Landfill permits, tradable between local authorities, has been suggested as a means of enabling Local Authorities to landfill additional waste. Those Local Authorities which have reduced its reliance on landfill can sell excess permits. Local authorities have to ensure that households are in a position to make use of these alternative schemes by equipping them with knowledge and understanding, ensuring that there is adequate opportunity to participate (Price, 2001). Although the trading of permits is not compulsory, the number of permits would be limited and vary between authorities. However legal action will take place if landfill amounts exceed permit levels. (DETR, 2000a). The larger authorities (subject to public apathy) can potentially opt for EFW as their main disposal option to achieve recovery levels as a result of the limited landfill. However, the majority of authorities will have to develop and maintain successful recycling and composting programmes, which can only be achieved if sufficient guidance is available.

Municipal Solid Waste Management Strategies (MWM) -

These strategies, required under 'Waste Strategy 2000', aim to provide the framework for a fully integrated waste management system based on active partnerships between local authorities. Guidance on how to produce them has been outlined in DETR (2001b). A MWM is required for each Waste Disposal Authority and should clearly set out the authorities objectives and standards of services, including polices and plans of how to achieve these along with a framework for monitoring and evaluation. These plans should then be communicated to government, key stake holders, partners and the wider community. Most importantly the MWM should incorporate the mandatory recycling plans prepared by Waste Collection Authorities (DETR, 2001a).

The development of these strategies will ensure that local authorities develop a planning framework compliant with mandatory targets and identify the mechanisms and tools required to lever change. However, strategy development in relation to household recycling can only be achieved if a 'bottom up' approach is adopted whilst developing an understanding of the drivers and barriers of behaviour so that a successful strategy can be formulated.

Best Value –

All local authorities responsible for waste management are subject to the duty of best value; this is where authorities are expected to deliver services to clear standards and ensure continual improvement in the way in which they operate. They are expected to; Challenge, Compare, Consult and Compete. These are of particular importance to this thesis, as now, local authorities not only have to provide a recycling service in an economical and efficient way in comparison to other authorities, but satisfy residents with this service. All recycling schemes will now be subject to review, by amongst others the householder i.e. the customer. Two out of the nine waste management best value indicators are focused/based specifically on the householder; 1) the percentage of people expressing satisfaction with recycling facilities served by a kerbside recycling scheme and 2) the proportion of households served by a kerbside scheme or close proximity to a bring site. There is a need to understand households' service provision needs in order to improve recovery levels and effectively introduce and maintain kerbside recycling schemes that perform acceptably in comparison with other similar authorities. Failure to meet performance indictor targets may result in central government intervention.

1.4.2.2 Discretionary

Although these drivers are legally available, compliance/utilisation is not mandatory.

Landfill Tax credit scheme –

The landfill tax credit scheme is funded by money collected from landfill tax credit. Operators donate to an approved environmental body, which may carry out activities, defined in the regulations. One area is 'research and education activities to promote re-use and recycling', and on "1st January 2001, amended the list to make explicit that funding for recycling related research was eligible under the scheme" (DETR, 2000a). The amendments suggest a strong need for research in recycling and market development. A recycling scheme experiment, as a major part of this thesis, was part funded by Biffa's landfill tax credit.

Waste Minimisation Act –

Originally proposed as the Waste Prevention Act, this act introduced in 1998 allowed a local authority to "do or arrange for the doing of anything which in its opinion is necessary or expedient for the purpose of minimising the quantities of controlled waste, or controlled waste of any description, generated in its area." (DETR, 2001a). Although the act does not place any obligation on authorities to introduce measures or give them power to enforce action from

businesses or households, it does allow local authorities to introduce initiatives to reduce the amount of waste as opposed to recycling it.

1.4.2.3 ***Voluntary***

These drivers are available to local authorities and industry but there are no mandatory requirements or statutory powers associated with them.

Beacon Councils and Partnerships –

Beacon status under the Beacon Council Scheme (developed to promote excellence in service provided by local authorities) is awarded to authorities that demonstrate a strong strategic approach and deliver their waste management services effectively, promising to share that good practice. All of these have a good record on diverting waste (DETR, 2000a). Hampshire and partner councils comprise a large proportion of the Beacon councils in which household attitudes, opinions and performance of schemes offered have been intensively monitored parallel to this research under 'Project Integra'. Findings of this research have been integrated into this thesis and will be addressed later in the research methodology. It is important to note that all councils who have Beacon status have to improve recycling levels to meet mandatory targets and therefore a need to understand how to make the best perform better is required.

It has been recognised that there is a need for partnership between different local authorities, community groups, the waste management industry etc. (DETR 2001a). Yet there is also a requirement for the co-operation and partnerships between local authorities, the packaging industry and associated compliance schemes. The DETR (1999a) estimated that for packaging 95% of aluminium, 84% of glass, 78% of steel and 65% of plastics was thrown away by households and recovery from this waste stream was becoming increasingly important in order to meet EU packaging targets. However, it is industry that has specific material recycling targets whilst Local Authorities only have overall material weight targets (DETR,2000a). This may lead to conflict in the approaches used and systems implemented to secure these materials. Partnerships are required to avoid the packaging industry developing a dual collection system as seen with DSD (Dual System Deutschland) in Germany (and other member states) in addition to provisions and maintenance of extensive kerbside schemes by Local Authorities. Industry has the financial resources, local authorities the experience and the waste collection infrastructure. Co-operation and partnership between industry and/within local authorities is not only a practical and sustainable way forward, but is perhaps essential in meeting mandatory requirements.

NWAI, WRAP and Public Procurement –

The National Waste Awareness Initiative (NWAI) is currently being developed in partnerships with local authorities, industry, community groups and others. Examples of action include the national 'are you doing your bit' campaign. Its aim is to increase public awareness of environmental issues such as waste and recycling through clear effective communication. However, responsibility to inform and educate the public about how residents should participate on a particular scheme should still reside with local authorities and service providers. To ensure effective systems are in place, (recognising the needs of an aware and motivated public) requires an understanding of the relationship between attitudes, behaviour and service provision.

The waste strategy recognises that in order to achieve the required increase in tonnage's of recyclables, there is a need to overcome market barriers; in response the Waste Resources and Action Programme (WRAP) has been established. WRAP will be responsible for commercial, municipal and industrial wastes, including hazardous wastes. This will focus on "developing markets and end uses for secondary materials and promoting an integrated approach to materials resource use" (DETR, 2000a). Around £40 million has been allocated to WRAP for the next 3 years, to provide a step change rather than a steady growth in recycling markets. WRAP aims to focus on 4 specific materials, paper, glass, plastic and wood; in addition to market development, WRAP aims to benchmark best practice and offer training to the local authority collection workforce (French-Brooks, 2001).

The government also believes that public procurement can play a role by increasing the demand for recycled goods, raising the awareness of their high quality and ensuring secure markets for those wishing to invest in new processing capacity. However, the changes required to increase recovery, may pose new challenges to industry, which may have to find new markets as a consequence of changes in feedstock. These secondary markets have traditionally determined recycling service provision.

1.4.3 Summary

Although belatedly in the view of most observers, the necessary drivers appear to be in place to implement successful waste strategies at a local level and sustainable waste management within the UK; yet these policy aims are not entirely consistent. There are conflicts between the objectives of Best Practical Environmental Option, Best Value, Life Cycle Analysis and the statutory recovery and recycling targets now in place. There is perhaps a need to put more emphasis on the voluntary drivers identified, as effectively these are the key to success,

particularly in terms of cost effective development of collection infrastructure and developing markets.

The lack of direct fiscal drivers or legal obligations on householders is an area, which may well need to be reviewed if initial diversion efficiencies fail to improve alongside service provision and markets. In current circumstances, ensuring household behaviour is effective within a voluntary regime is a key issue for scheme providers and has been selected as the central research issue in this thesis.

1.5 Aims of Research

The main aim of this research is,

'To develop a qualitative decision support model to assist recycling officers/scheme managers and designers to improve and maximise new and existing household kerbside recycling schemes participation and participation efficiency in the recovery of MSW'.

In order to achieve this aim, 4 objectives must be fulfilled. To: -

1. Investigate and attempt to understand the relationship between household attitudes and their recycling behaviour in relation to bring and kerbside scheme provision,
2. Identify, understand and attempt to quantify the variation between self-reported and observed recycling behaviour,
3. Assess the relative importance of a selection of factors influencing household recycling in terms of 1) participation and, 2) participation efficiency/effectiveness,
4. Determine the presence and the affect of 'Inconvenience' at each stage of and within a selection of factors influencing the household recycling process.

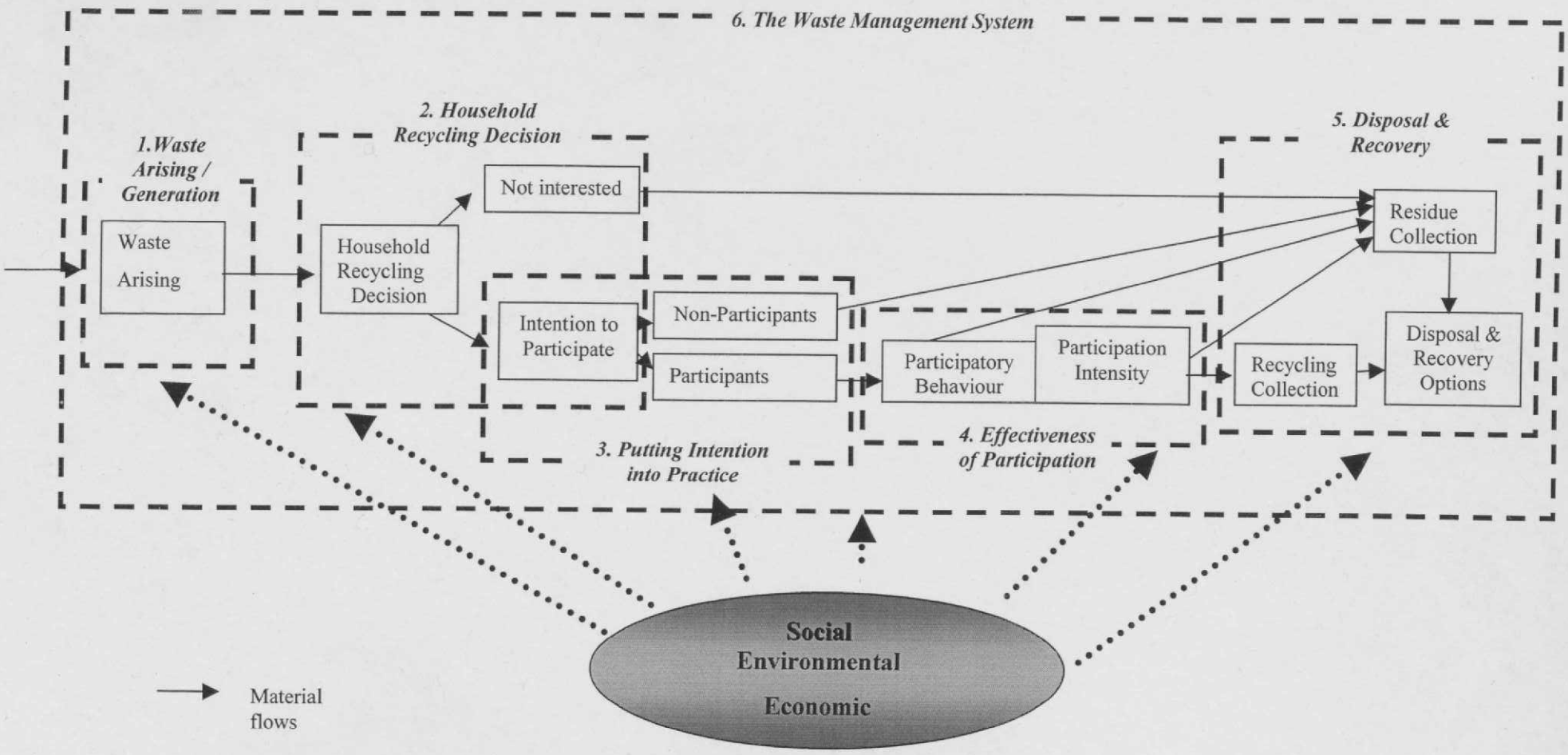
2.0 LITERATURE REVIEW

2.1 Introduction

An assessment of the literature has indicated several research areas. Figure 2.1 illustrates these in the form of a conceptual flow model, (based on material flows and household decision stages from the materials arising to its disposal) the previous and potential areas of research in relation to kerbside recycling. Each of these six areas can be assessed in a social, environmental or economic context. Undoubtedly, research at the waste management system level will provide an overall view on performance. However this process perhaps fails to cover in the detail necessary to understand the mechanisms involved with changing behaviour and material flows at each stage of the process. Similarly, research at a more detailed level must also recognise the influences of, and effects upon, the other processes within the model. It is beyond the scope of this study to review in detail previous research in all of the areas highlighted within the model, but instead it will give an insight into those most relevant to the research. Given this, the literature findings will be reported within this framework.

Perhaps the most intensively researched area is 'Household Recycling Decision(s)' (area 2, figure 2.1), concerned with understanding and predicting ways to influence behaviour, in order to shift material flows into the recycling collection. Less research is reported within areas 3 and 4: 'putting intention into practice' and 'effectiveness of participation'. With mandatory targets requiring a high recovery of household waste, it is necessary to move the focus of research towards these areas in an attempt to retain this material for the recycling collection. 9 out of 10 people claim to recycle (Waste Watch, 1999a). c.40% of households claim to be served by Kerbside recycling systems (Burnley and Parfitt, 2001). However a current national household recycling rate of only 9.2% (DEFRA, 2001) reinforces the need for research in this area. This research project will mainly address areas 2 - 4 although recognising areas 1 and 5.

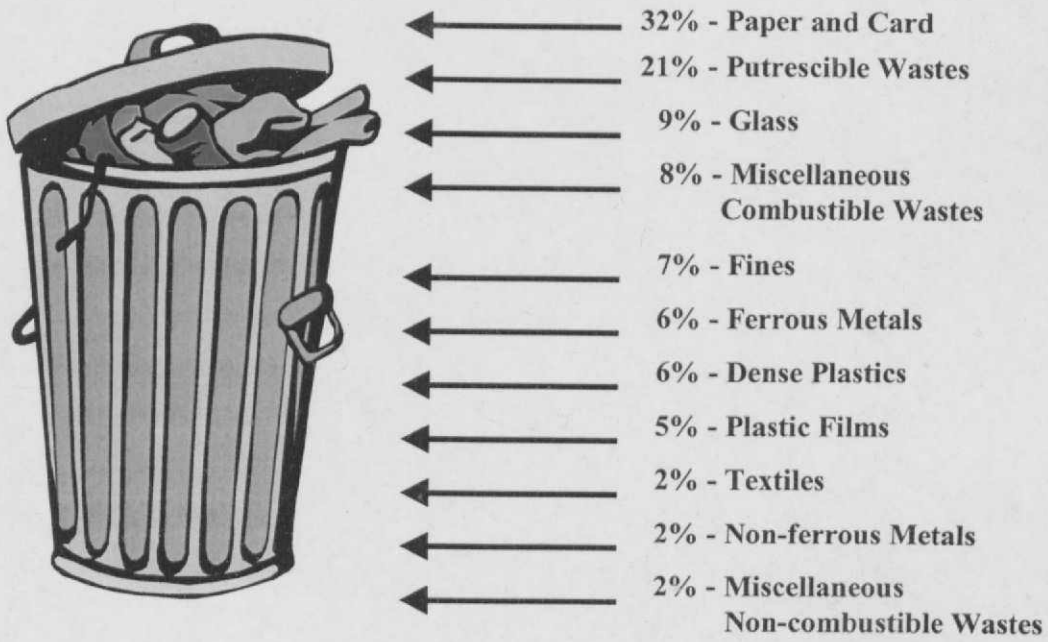
Figure 2.1 Potential Areas of Investigation in a Kerbside Recycling Collection Scheme



2.2 Household Waste Composition

The following is an overview of household waste composition. A more detailed analysis and full international literature review is available in D.o.E. (1994), Parfitt et al (1997), UEA (2000), DETR (2000a and b) and Barton and Freer (2001). "Household waste is inherently variable in its composition and highly variable in most parameters used to quantify its characteristics" (UEA, 2000). Before an assessment can be made of the effectiveness of any collection scheme in recovering materials from the domestic waste stream, the composition of that waste must be identified. Figure 2.2 illustrates the composition of a typical UK household dustbin. These proportions can vary significantly across the UK as a result of a series of factors e.g. socio-demographics, residual collection container used etc.

Figure 2.2 Typical UK Household Waste Composition



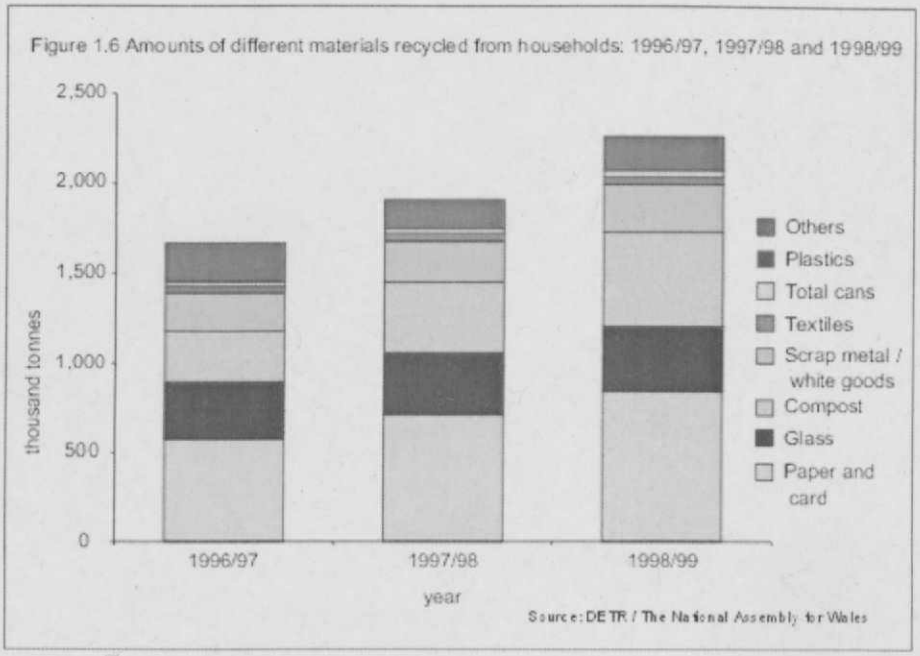
Source: DETR 2000b

On comparison of compositional data at a more detailed level, the variability between UK authorities can sometimes be substantial (DoE,1994; M-E-L, 1999; Ecotec, 2000; Waste Research Limited, 2001). However sometimes some studies use such detailed category analysis (over 50 categories in some cases), which can result in very small individual category quantities unless sample sizes are very large. This can make comparisons and establishing accurate recovery levels at such a detailed level difficult.

It has been suggested that c.50% of municipal waste is potentially recyclable or recoverable and a further 30% potentially compostable (DEFRA 2000b). Some environmental groups have claimed that, with this in mind, there is no need for incineration, as the remaining 20% of currently non-recyclable waste e.g. sanitary towels, household batteries etc. should with time, either be re-designed or have developed a new potential market (Greenpeace, 2001; Roberts and Glynn, 2001). Although this is perhaps optimistic given the time already taken to redesign and develop markets for the easier recyclable fractions, this debate is beyond the scope of this thesis, which is more concerned with what can be achieved with the waste we have.

Although the amount of material recycled by households has steadily increased, over the past three years (figure 2.3), most of the growth can be accounted for by centralised composting schemes, which have grown by a third each year and to paper and card recovery.

Figure 2.3 Amounts of different materials recycled from households



Source: DEFRA 2000b

Compositional analysis undertaken by kerbside monitoring projects has continually highlighted a significant variation in the recovery levels between material types (M-E-L, 1999; Aylesford Newsprint, 2000; Ecotec, 2000; Mansell, 2001; Waste Research Limited, 2001). Theoretically, 'ce par', kerbside recycling schemes should attain similar recoveries for different targeted materials, suggesting there are additional factors influencing an individual recycling such materials. Typically, kerbside schemes are most successful at recovering the paper fraction,

glass (where collected) then bottle plastics and metal drink cans, with reports of metal food cans attain the lowest recoveries. Textiles, where collected, usually achieve medium recoveries.

Table 2.1 Estimated material recycling rates for the packaging content of the UK households waste stream

Packaging Category	Estimated 'Dustbin Waste' Recycling Rate
Glass Packaging	32%
Paper and Card Packaging	6%
Metal Packaging	3%
Plastic Packaging	Less than 1%

Source: UEA, 2000

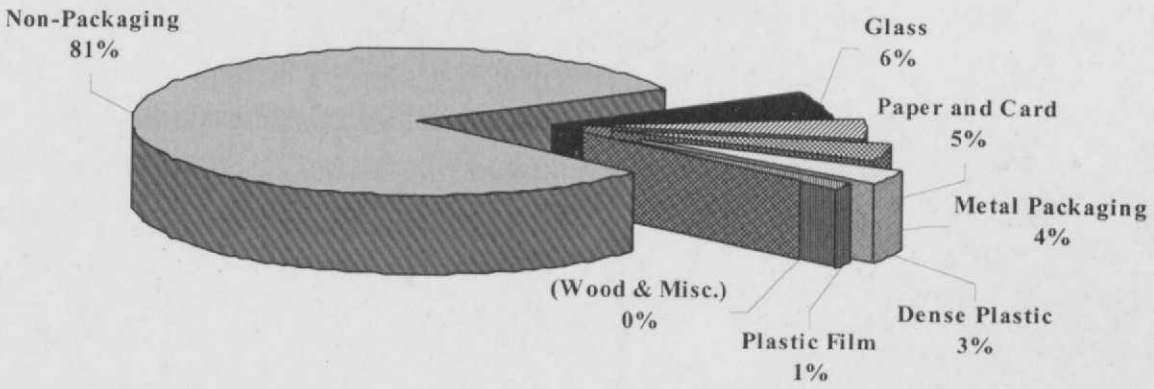
It is estimated that c.4.5 million tonnes of packaging waste exists in the UK household waste stream which is often the most difficult fraction to recover (table 2.1). If the packaging directive targets were applied to households alone, only glass would have met the 2001 16% minimum recycling target[1] (UEA, 2000). Fortunately, for industry, current targets appear to be achievable through focusing on commercial and industrial sources for the other materials. The amount of packaging waste as a proportion of the collection round household waste is relatively small (figure 2.4). This may explain (in relation to the necessary increase in collection and processing costs) why local authorities have previously opted for non-packaging kerbside collection systems (e.g. paper only) and the packaging industry have failed to finance local authority managed kerbside collections schemes.

There appears to have been an increase in the number of centralised composting schemes within England and Wales. The quantity of paper, putrescibles and glass as a proportion of the waste stream and the relative success and familiarity of glass bottle banks, would suggest local authorities could try to meet mandatory targets through a combination of centralised composting collected at the kerbside, (with paper only collection) and extending bottle bank density for Local Authorities may be, but not if new 70% glass recycling targets are introduced on industry. This would be conceivable, certainly for short-term targets and in relation to reducing the

[1] While minimum Directive specific targets have been set at 15%, minimum UK targets for 2001 were set at 16% to account for the fact that the Packaging Regulations were not applicable to all industries. This target has increased in the interim to reflect the poor progress of industry towards material and EU targets.

biodegradable fraction in accordance with the Landfill Directive. However, for this to be a success (where maximum diversions of the targeted fractions are needed), a thorough understanding of the drivers and barriers to household recycling behaviour and maximum participation efficiency is still required.

Figure 2.4 Proportion of Packaging in Collection Round Household Waste as a % of Total Weight of Waste, 1996 & 1997 Analysis of Waste



Source UEA, 2000

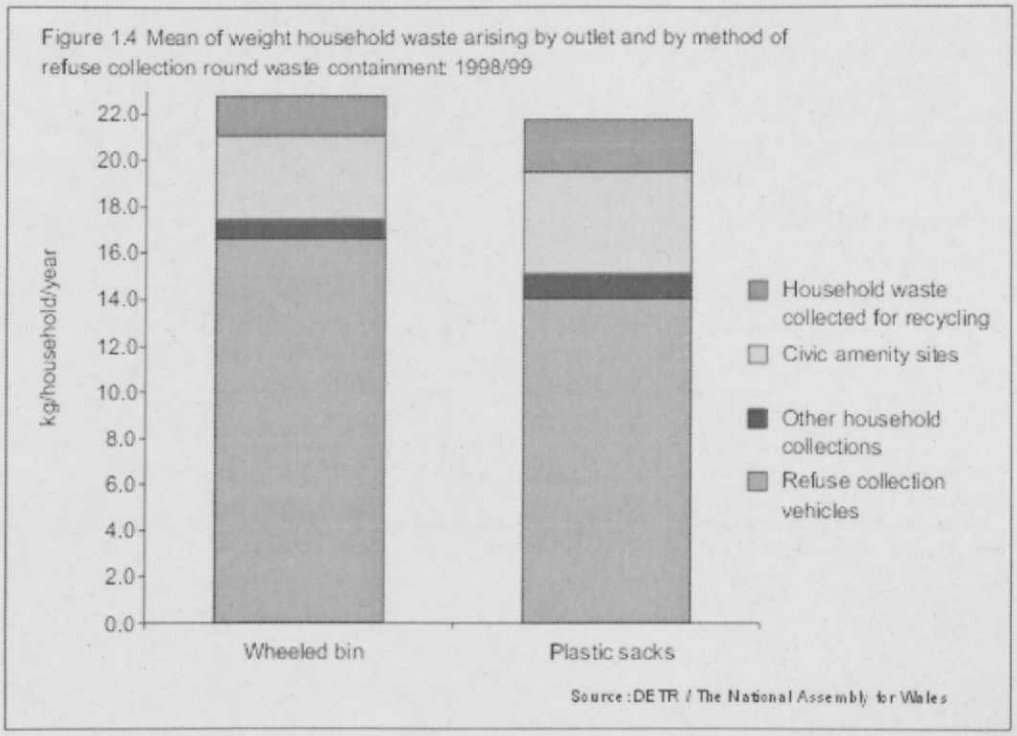
2.3 Factors Affecting Household Waste Arising, Composition and Generation

A series of variables influencing household waste composition have been suggested (DoE, 1994; UEA, 2000). A full analysis is beyond the scope of this thesis, although a brief summary of three main factors, refuse container, households size and socio-demographics will be presented.

2.3.1 Refuse Containers

Local authorities have increasingly provided 240 litre wheeled bins for households, ultimately to increase the efficiency of household refuse collections. This sends a conflicting message to households, promoting waste minimisation and recycling opportunities at the same time as making disposal easier and increasing their capacity (Price, 2001). It is estimated that around 45% of households now have wheeled bins in England and Wales (Parfitt et al 2001) and there has been much discussion about their effect on increasing waste arising. Figure 2.5 illustrates the difference in arising by source and by refuse collection/containment.

Figure 2.5 Mean Weight of Household Waste Arisings by Source and by Method of Refuse Collection and Containment 1998/99



Source: DEFRA, 2001b

Comparing two similar areas, households served by a wheeled bin were found to generate c.50% more waste than those served by a traditional sack collection (D.o.E, 1994). Parfitt et. al. (1997) suggested that households served by a sack collection generated an average 11.8kg/hh/wk compared with wheeled bin households at 16.9 kg/hh/wk. Following waste analyses such increases appear to reflect a permanent change in waste disposal behaviour (Audit Commission, 1997), e.g. using the bin for materials previously disposed of at CA sites, burnt in bonfires, composted at home etc.

However, several local authorities have reported no stabilisation or decrease in the volumes of waste collected following the introduction of wheeled bins, but instead report continual increases in CA arisings (Audit Commission, 1997). Although it is hard to believe that the mere presence of a container 'makes a household create more waste', it would be expected to have been transferred from somewhere and this highlights the problem of the continual increase in waste arising identified by DEFRA (2001b).

2.3.2 Household Size

Household's size has been positively correlated to waste generation (UEA, 2000), although the mean quantity of packaging waste was similar for wheeled-bin and non-wheeled bin

households. This was not the case in relation to non-packaging waste where differences were noted in relation to household size, composition and container provision.

2.3.3 Socio-demographics

Evidence suggests that the weight and composition of household waste varies between different ACORN[2] groups and varies considerably less between regions. More affluent groups generate about 50% more waste per week than the less affluent groups. UEA (2000) suggested that households in the manual socio-economic group produced both the largest amount of total waste and highest median amount of waste, around 20.2kg/hh/wk. Respondents who were retired produce the smallest median amount of total waste (average 14.9kg/hh/wk), reflecting the smaller household size and the tendency for lower levels of consumer spending, as well as possibly the interest of this group in recycling and composting. Waste composition in relation to affluence would suggest that these households produced higher amounts of paper and card (c.6kg/hh/wk), twice as much plastics and higher amounts of glass (DoE, 1994). UEA (2000) found that households' purchasing, recycling and composting behaviour is correlated to the generation and composition of their waste and their residual container used. Effectively, household characteristics, attitudes and behaviour affect what people buy, so similarly it must affect what they throw away.

The review illustrated the difficulties of disentangling the causative factors of a household's different waste composition and generation. What is clear is that these factors are often inter-connected. However, waste containment, household size, and affluence would all appear to be the key factors influencing the amount and composition of household waste.

2.4. Scheme Design and Optimising Performance

The 376 local authorities in England and Wales are categorised in relation to their household's waste collection and disposal responsibilities. These categories are, Waste Collection Authorities (WCA's), Waste Disposal Authorities (WDA's) and Unitary Authorities (UA's), which are responsible for both the collection and disposal. All have best value performance indicators (especially recycling rates) that need to be met.

Previously, aspirational targets of 25% by 2000 (D.o.E, 1995), which resided with smaller WCA's have been met only by a select few. However, this structure puts WDA's into a difficult position; although they can request source separation, they can not dictate the quantities

[2] ACORN – (CACI, 1997) is a classification of households according to their socio-demographic factors (see method)

of waste being delivered to them on behalf of WCA's but they remain responsible for the siting of waste disposal facilities which face continual public opposition. With the emphasis on local authorities to deliver sustainable waste management and the reliance on households to enact this policy, an alternative to the difficult two tier system has been suggested (Price, 2001). By merging the two functions, effectively generating a 'waste management utility' (treating waste as a utility service like water, gas etc), would overcome the potential conflicts inherent in the existing system. Furthermore, the utility covered would bill households directly, which would allow households to recognise the cost of waste in relation to the amount they generate. This would potentially lead to an increase in public participation in the new recycling and composting alternatives. However, this would also require primary legislation and no change is anticipated in the near future.

Local Authorities can approach the design of recycling programmes from two perspectives: 1) design the programme to achieve a specified waste diversion target or 2) optimise the design by considering trade-offs between higher diversion rates and higher costs (Noehammer and Byer, 1997). Previously, local authorities opted for the second option implementing paper only schemes and designing schemes to accommodate existing infrastructure and markets. Following the introduction of mandatory targets, high specific waste diversion targets have been set and schemes should be designed with the former perspective in mind.

A variety of schemes exist within the UK which differ in terms of the socio-demographics of households served, the materials they collect, operational characteristics and the level of communication with households served by the scheme. Unsurprisingly, scheme diversion levels and recoveries of specific recyclable material between schemes vary. Recycling rates of WCA's and WDA's within England and Wales ranged between 1% and 31% in 1998/99 (DETR, 2001b). Similarly, the level of participation in recycling schemes can vary considerably although reasons are still unclear (Read, 1999).

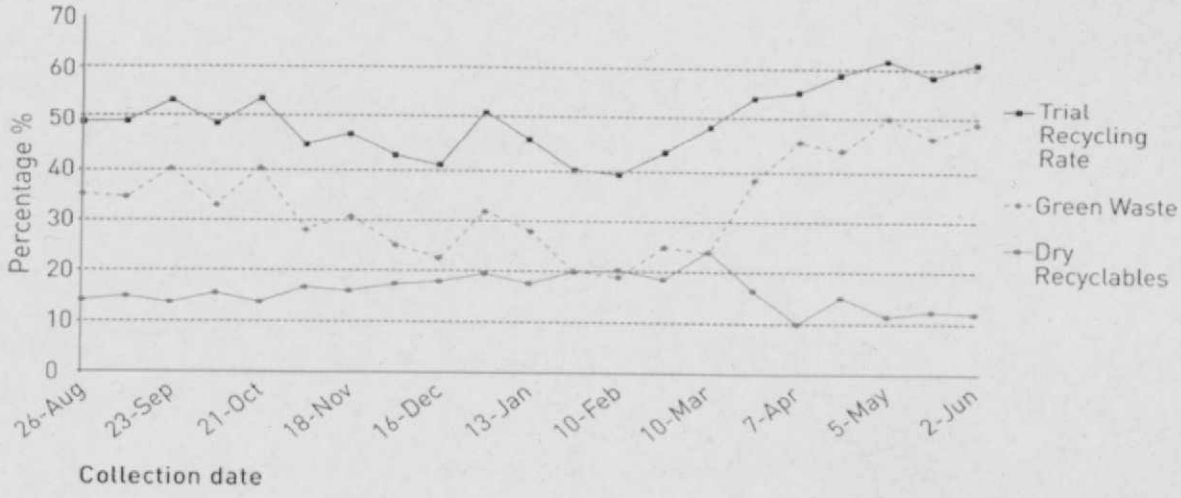
There are numerous examples of best practice in England and Wales (Aylesford Newsprint, 2000; Roberts and Glynn, 2001, House of Commons, 2001). Best practice has also been demonstrated at an International level (Aumonier and Troni, 2001). An integrated strategy where the collection of both dry recyclables and compost at the kerbside appears to be affectiveive in achieving high diversion rates (Waste Watch, 1999b; Woodard et al, 2001). However, equally impressive results from schemes collecting only dry recyclables are reported (Roberts and Glynn, 2001). Due to the range of designs offered within the UK, it is difficult to clearly identify the reasons for a scheme's success or failure.

2.4.1 Operational characteristics

Although kerbside schemes collecting both fractions demonstrate impressive overall recoveries, the recovery of dry recyclables (particularly the packaging fraction) may be compromised. The CROWN scheme (Woodard et al, 2001) demonstrated pilot recoveries of c.55%, however only 1.5kg/hh/wk were dry recyclables (glass and plastic not collected) compared to 5.7 kg/hh/wk collected for composting. Similarly, Daventry reported overall high diversion rates (figure 2.6), although the recovery of dry recyclables (which included glass) was still relatively low, despite intensive promotion. However, it does perhaps demonstrate that UK mandatory targets can be achieved if such a dual approach is implemented.

An important characteristic to both these schemes is that the refuse collection frequency was changed to a fortnightly collection. This may be an affective way of forcing people to recycle and compost by limiting their residual capacity although no monitoring of CA site arisings were reported.

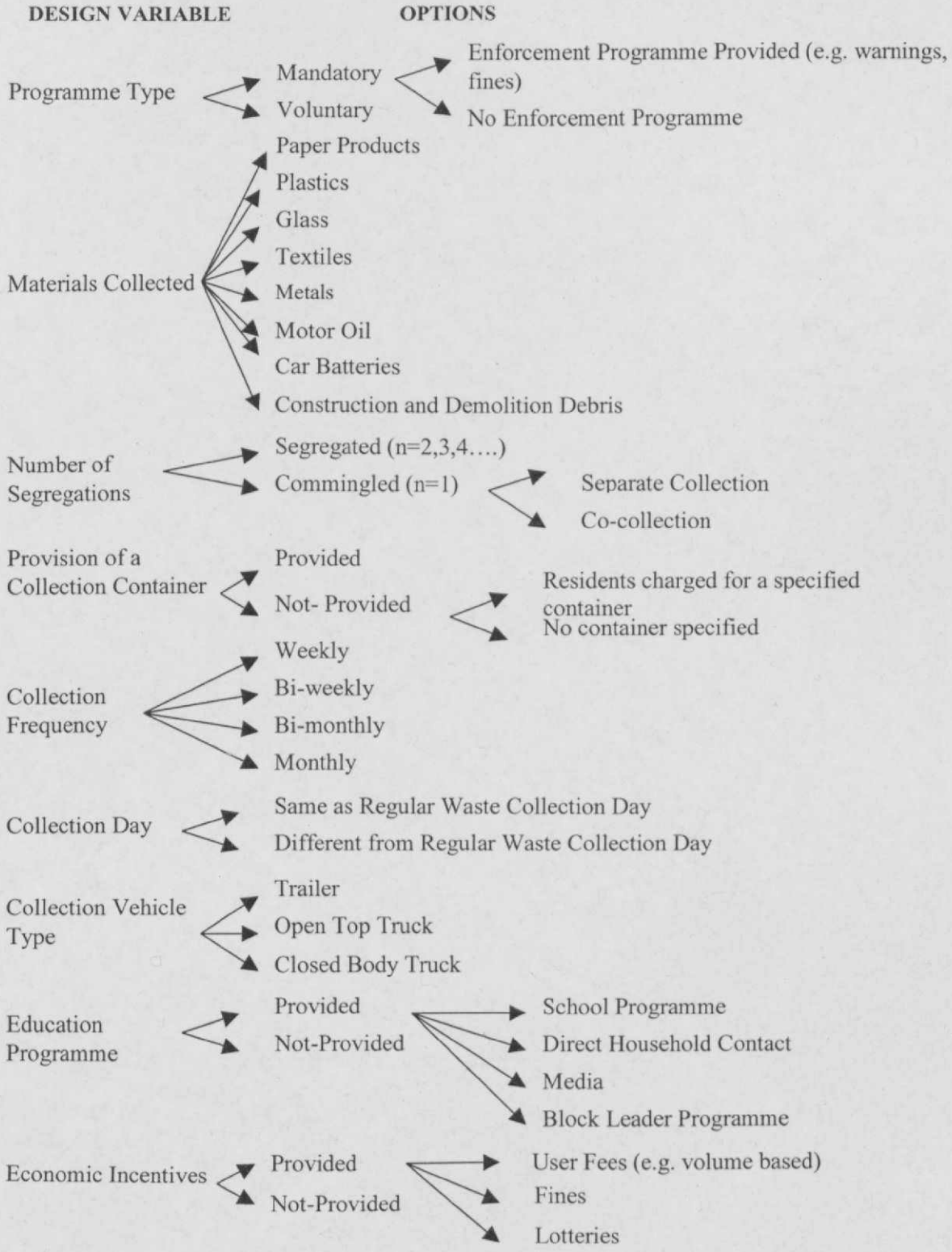
Figure 2.6 Recycling Rates Throughout the Daventry District Councils Green Waste Trial. Source: Waste Watch (1999a)



The design of a recycling scheme has to consider a series of variables (figure 2.7). These have been shown to influence participation, set out rate, contamination and overall recovery levels. Although participation in recycling schemes remains a voluntary activity within the UK, previous research has shown that where applicable, mandatory recycling programmes achieve higher material recovery rates and participation levels than voluntary programmes (Folz, 1991; Folz and Hazlett, 1991; Everett and Peirce, 1993; Noehammer and Byer, 1997). However, Noehammer and

Byer (1997) also indicated that voluntary recycling programmes, if well designed, can achieve comparable participation rates.

Figure 2.7 Kerbside recycling programme design variables



Source: Noehammer and Byer, 1997

In the US such mandatory recycling programmes exist, achieving mean participation rates of 74%. This compares against 49% in voluntary kerbside schemes and suggests that such mandatory systems achieve significantly higher household participation (Folz, 1991). Participation levels are the secret of a programmes success. Read, (1997) showed an obvious statistical trend, in that higher participation levels lead to increased recovery and recycling levels, suggesting that high levels of participation are required if mandatory targets are to be met. Lansana (1992) found that recyclers preferred mandatory programmes, perhaps to ensure that everyone in the community recycles.

The affect of high participation is limited if the recovery of targeted materials from each participant, i.e. their efficiency of participation referred to as the 'recognition ratio' by DETR (1999a) is low. Everett and Pierce (1993) found that in relation to recovery levels c.50% more newspaper, c.100% more glass and c.12% more aluminium were collected with mandatory programmes. A relationship between material recoveries and whether punishments exist, and enforced, was also evident. Reasons for such differences were thought to be related to law-abiding behaviour patterns and the public's perception of the programmes more serious nature. Overall, higher participation and recovery levels may be associated with mandatory programmes and the affect of a change in the schemes designs e.g. provision of a free collection container or collection frequency, is limited on a mandatory schemes performance.

In the UK, household recycling is voluntary and so providing a well designed and managed scheme is essential. Provision of a free container is universally regarded as of paramount importance in achieving acceptable participation and recovery levels (Ball and Tavitian, 1992; Everett and Peirce, 1993; Noehammer and Byer, 1997, Wang et al, 1997). Central to an individual recycling is that they have the ability and opportunity to behave and thus recycle (Thogersen, 1994; Taylor and Todd, 1995; Franco and Huerta, 1997). Providing a free container is fundamental to facilitating this behaviour, acting not only as a visual reminder to recycle and an affectiveive prompt (especially with rigid containers) but also making the process more convenient to the household by providing storage for their recyclables (Jacobs et al, 1984). Removal of a container from a scheme can have disastrous affectss; (Ball and Tavitian, 1992) found that the participation rate halved when an attempt was made to manage without them. The loss of a container can provide equally disastrous affectss as removing or not initially providing one. Many public surveys have highlighted the absence of a recycling container as a primary reason for a household's failure to participate (Tucker 1999; King, 2000; Mansell, 2001). Although perhaps not a pre-requisite of mandatory programmes, a container is essential if voluntary programmes are to achieve high participation and recovery of materials (Everett and Peirce, 1993; Noehammer and Byer, 1997, Thomas 2001).

Within the UK, local authorities providing free containers can operate their kerbside scheme on an 'opt-in' or 'opt-out' basis. As the term suggests, the latter refers to households within the scheme area being provided with a container (bag or rigid), but they are free to choose as to whether or not they participate. If they do not, the container may be set out empty for collection for alternative activities or disposed of. Alternatively, 'opt-in' schemes require the residents to positively request a container to be a participant on the scheme, which in itself is an inconvenience to the householder before the scheme is in operation.

Thomas (2001) found that 30% of participating households did so 'because it was there, the scheme existed, they were given the boxes, or they thought they had to,' highlighting the importance of the container as a motivator to recycle irrespective of attitude, demographics, normative influences etc. This would therefore suggest that an 'opt out' scheme would achieve higher participation levels as a result of the facility just 'being there'. However, there is a risk that households use a scheme 'just because it is there' even if they don't fully understand what is requested of them and why they are doing it. An uncertain recycler can lead to either a high level of contamination or low recoveries. Reminders of how to use the scheme by providing printed bags or labels to stick on the bins has been shown to positively correlate with higher levels of understanding (Thomas 2001), which could positively translate into higher levels of participation and materials recovery.

Collection containers can represent a significant proportion of the start up costs of a kerbside recycling scheme. Kerbside recycling schemes usually provide a bag (re-usable or non-reusable), box or wheeled bin (usually 120-240 litre) or a combination of these. The difference in costs per container can vary substantially and can be a serious consideration in relation to maximising scheme budgets. Although Thomas (2001) suggested that there was no real difference in a household's recognition of what materials are targeted by a scheme in relation to the container provided, comparisons with the overall quantity and type of material collected in relation to the container used needs further research. Hawkins (1991) suggested that different containers with the same volume do not differ greatly in the amount of recyclables captured per recycler once households become recyclers. Results from 'Project Integra' (MEL, 1999, Thomas, 2000) suggested, although not conclusive, that the authorities with the three highest diversion and participation rates all used a wheeled bin, whilst the three lowest used sacks or no container. On a national scale (table 2.2), data would suggest that a rigid container, either bin or box appears to achieve higher recovery rates. The main design issue regarding the container may relate to its volume, visibility and durability rather than its material and design. Each container has its own advantages and dis-advantages. However, more specific research is required to be conclusive.

Considering the importance of the collection container on participation levels, the nature of a re-usable bag (often only replaced when a bag with materials is set out), presents a series of drawbacks. Once the bag is mislaid, (either blown away, lost, not returned etc.) it is very easy for the household to drop out of the system (Ball and Tavitian, 1992). Wang et al. (1997) showed that hard durable containers sustain higher participation rates over time. If the container is easily damaged or lost then it no longer provides the mechanism needed for households to participate and therefore participation rates will decrease with time.

Table 2.2 National Results of Recovery Levels in Relation to a Scheme's Design. (Adapted from Audit Commission, 1997)

Collection Container	Collection Frequency	Co-collection	Materials Collected	Average Recovery (kg/hh/wk)	S.D
Box(n=7)				1.52	0.67
Wheeled Bin (n=4)				1.40	0.28
Bundled (n=2)				1.20	0.07
Carrier Bags(n=2)				1.15	0.95
Sack (n=6)				1.07	0.64
	Weekly (n=9)			1.36	0.73
	Monthly (n=3)			1.32	0.43
	Fortnightly (n=9)			1.24	0.49
		No (n=18)		1.39	0.56
		Yes (n=3)		0.79	0.41
			>5 (n=1)	1.94	
			4 (n=3)	1.68	0.99
			3 (n=10)	1.20	0.62
			1 (n=2)	1.20	0.07
			5 (n=4)	1.20	0.26
			2 (n=1)	1.17	
		Overall		1.30	0.16

One of the most conflicting scheme design features is the collection frequency and collection day in relation to the normal refuse collection, often determined by cost. Depending on the collection frequency, the convenience of a kerbside scheme may be offset by the effort required

to save, sort and store the materials for collection (Vining and Ebreo 1992). Substantial increases in participation and recoveries have been observed in communities with high collection frequencies (Glenn 1988; Wang et al, 1997). The most common collection frequencies at kerbside for recyclables within the UK are weekly, fortnightly and monthly. Noehammer and Byer (1997) also found higher participation rates from weekly than fortnightly or monthly programmes, although recognising that these increases may be a combined result of other design and intervention factors and not necessarily solely the collection frequency. Everett and Pierce (1993) demonstrated that collection frequency had no affect on participation and recovery rates, although recognised that these results were contradictory to other published literature. They also showed that recoveries could potentially vary with the type of materials collected in relation to the frequency of collection; however, the results were not statistically significant and it was concluded no relationship existed.

There is an incentive for local authorities to reduce costs by reducing the collection frequency (Tucker et al, 2001a). Unlike the convenience of an increase in collection frequency, a decrease requires a longer period of storage and potentially acts as a larger barrier to the householder to participate. Werner et. al. (1995) recognised how a change in the collection frequency without notifying all residents, resulted in a drop in recycling levels. This was thought to be a result of residents being confused about what and when recyclables would be collected. However, Tucker et. al. (2000 and 2001a) found a small minimal reduction in participation and overall, material tonnages collected as a result of a well informed changes in a paper scheme's collection frequency, from a fortnightly to four weekly collection. During the change in collection frequency, households filling their collection bag under the original fortnightly collection were issued with an additional collection sack counter attacking the maximum storage capacity threshold and preventing the additional material being discarded elsewhere noticed by Wang et. al. (1997). They found that overall 6 monthly tonnages had only decreased by c.8%, of which a significant percentage (c.80%) of the shortfall had been transferred to the local bring site paper bank facilities. Further analysis of weight/composition data and age span of contributions (Tucker et al 2000) illustrated that more households were setting out multiple bags and that c.72% of the population were saving their material and recycling regularly at four weekly intervals. During this period the proportion of magazines and catalogues affectivelyively doubled although this could not be explained.

Participation levels, as a result of the change in collection frequency, had decreased from 48.1 to 39.9% (Tucker et 2000 and 2001a). A proportion of this decrease was thought to be a result of the failings of the recommended DETR participation ratio (currently households setting out their container once during a four week period) to recognise all participating households (DETR,

1999c). It was suggested that the DETR participation ratio underestimates true participation by c.4-11%. A bi-weekly participation ratio is believed to be more accurate in measuring the true number of scheme participants especially on a fortnightly collection (Tucker et al 1997b). Ratios of participation to set out rate are thought to be c.1.4 (Tucker et al. 2001a).

Tucker's research was based on a paper kerbside collection scheme and no problematic storage issues could be expected, as would be the case for example with food cans. In order for recycling households to drop out of the scheme a negative change in their attitudes towards recycling or additional (perceived) barriers would be required (Tucker et. al. 2000), both of which were unlikely to occur on a single clean material scheme. The affect of attitudes will be addressed later in the chapter.

The popular hypotheses is that recyclables collected on the same day as residual waste achieve higher participation levels as it is easier to remember on what day recycables are collected as opposed to what week. The implications of this on the collection authority can be immense, considering the variation in collection tonnages between residual and recyclables and the different size of rounds in relation to the collection vehicle used. Noehammer and Byer (1997) suggested that there was little evidence to support higher participation levels on schemes with same day collection and that recycling and residual collection rounds should be compatible in a cost-affectiveive manner rather than forcing a same day collection. The authors did recognise that factors such as a mandatory regime, provision of a free collection container etc. could be influencing this result. Jacobs et. al. (1984) through the use of controlled groups showed that weekly participation was c.5% higher for same day collections across sessions, representing proportionally a 60% greater participation level. Again it was recognised that unidentifiable variables may have contributed to the outcome. Everett and Pierce (1993) suggested that same day collection was only more convenient if recyclables were collected weekly the same as MSW, but not if collections were fortnightly or monthly as participants must still remember what week to recycle, even if the day remained the same. The important factor is perhaps ensuring through effective communication that households fully understand the recycling scheme and exactly how to use it.

Households do not always set out their recyclables at every collection opportunity. However, recycling schemes are often assessed on their set-out rate, assuming an increase in set-out rate translates into high materials recovery. Often the success of a recycling programme is calculated from estimated participation levels rather than calculated data (Everett and Pierce, 1992). Lambeth District Council, London, is currently operating a pilot kerbside recycling scheme where residents are paid £10 if they set out their recycling container during a given period.

Although this could increase the number of households who set out their containers, the amount of material recovered may remain the same as households may set out their container but more often with less material.

Set-out rates can not necessarily be compared between schemes, as the recovery of materials can be affected by a magnitude of reasons, even if the set-out rate is the same. Wang et. al. (1997) illustrated that under the same set out rate, the larger the storage capacity relative to recyclables generation, the greater the quantity of recyclables that will be collected. Therefore comparing two areas with the same scheme and set out rates, the one with the larger container volume will achieve a higher diversion level.

Table 2.3 illustrates a potential combination of scheme designs achieving different area recoveries. The data suggests that higher recoveries are achieved by schemes collecting more materials. Noehammer and Byer (1997) suggested that little research has been done to identify the relationship between the number of segregation's and participation. They concluded that voluntary programmes appeared to achieve higher participation rates if fewer segregation's were required, i.e. more convenient to the householder.

Table 2.3 Average Recoveries from Different Scheme Designs (n=21) (Adapted from Audit Commission, 1997)

Container	Collection Frequency	Average Recovery (kg/hh/wk)
Box	Weekly	1.6
Wheeled Bin	Monthly	1.5
Box	Fortnightly	1.3
Bundled	Weekly	1.3
Wheeled Bin	Fortnightly	1.3
Bundled	Fortnightly	1.2
Sack	Fortnightly	1.2
Carrier Bags	Weekly	1.2
Sack	Monthly	1.0
Sack	Weekly	0.6

Within the UK there are a variety of designs in relation to the materials collected and number of segregations required by the householder. A common kerbside scheme design as seen in Hampshire, operates a co-mingled collection of newspapers, magazines, cardboard, drink and food cans, and plastic bottles (M-E-L, 1999). Glass is usually excluded from co-mingled

kerbside collections unless sorted at the kerbside; other materials excluded, e.g. plastic bottles depend on market availability or issues of contamination with materials of good existing markets. Often the materials targeted are determined by the requirements of the MRF at a county level. If collections are not co-mingled, households are usually not requested to segregate their recyclables into more than two containers (usually box, but sometimes bag), separating the food and beverage containers from the drier materials, e.g. newspaper, magazines, textiles etc.

More recently local authorities are introducing kerbside compost collections, requesting that garden and compostible kitchen waste are collected via a wheeled bin or bio-degradable sacks to complement their existing dry recyclables collection. For some schemes this results in households having 4 rigid containers; two wheeled bins, one for compost and another for residual waste, alongside 2 plastic boxes for different dry recyclables (Waste Watch 1999b). To minimise containers and maximise collection efficiency, one authority uses the same wheeled bin for their dry recyclables and compost collected on alternate weeks. This creates storage problems for participating households, which can be overcome by requesting a third wheeled bin (c.25% of households have chosen to do this) or the individual choosing to use the bin for either recycling or composting (Thomas, 2000). A public attitudinal survey undertaken during the same period reported that residents served by this scheme were more confused and more likely not to sort their waste in comparison to other households served by different schemes within the District (Miller Associates, 1999).

Historically, recycling has originated through the use of bring sites at a central location. From an administrative perspective this reduces the cost of the programme, yet from the householders perspective, it is more inconvenient adding personal costs such as extra time and effort with transporting the recyclables to these sites (Schultz et al 1995). Therefore, the individual has a series of barriers to overcome in addition to the original decision to recycle before they can actually recycle. Inadequate provision of kerbside recycling schemes in the large majority of local authorities within the UK currently represents the biggest limiting factor on recycling rates. But even where such facilities are available, as shown there are often large differences in household participation and recovery rates (Audit Commission, 1997). Despite these variations, research has suggested that the introduction of a kerbside scheme positively effects attitudes, the amount of people recycling and the proportion of materials recycled (Vining and Ebreo, 1992). An analysis of US municipalities showed that the participation at bring sites was lower than kerbside schemes producing a recycling rate of 25% compared to 49% (Folz, 1991). Attitudinal research has shown that the introduction of a kerbside scheme would motivate non-recyclers to recycle (Coggins , 1994). Similarly, 48% of kerbside participants claimed they would recycle

less if their kerbside scheme was replaced by neighbourhood bring sites (Scott, 1999). Therefore, as suggested by Vining et. al. (1992), the situational context (i.e. the convenience of a programme) is critical for recycling participation.

Materials not collected at kerbside is collected through bring sites located at supermarket car parks, C.A sites, public places etc. In 1995/6 645,000 tonnes of material was recycled through bring sites equivalent to a household waste diversion rate of 2.7% (Aylesford Newsprint, 2000). Within Britain the density of bring site provision is currently around 1:1,200 households. In comparison to other European member states glass bottle bank density in England and Wales was 1:1,170 households compared to 1:800 households in Germany and 1:400 households in Belgium. The Audit Commission has suggested that 'good practice' would be to aim for a ratio of 1:750 households. However, with this expansion, the diversion of waste through bring sites would only achieve a rate of c.7% of total household waste (Aylesford Newsprint, 2000).

The distribution of bring site densities within England and Wales exhibit no regional pattern, although across all regions urban districts are found to have significantly lower site densities than rural areas (Parfitt et al, 2001). Increasing site density is believed to be essential in increasing the amount of material recovered through bring sites, although this should reflect the urban/rural environment. For example in rural areas a site density of 1:500 households would require the householder to travel 1-3kms making them dependent on the use of a car whilst the same density in urban areas would require a travelling distance of 350 to 500 metres. In urban/metropolitan areas the Audit Commissions recommended density of 1:750 households would be within walking distance of c.500 metres, satisfying the governments best value indicators and 'close to home' recycling provision (Aylesford Newsprint, 2000).

Increasing the number of bring facilities can boost the level of recycling. However, net costs per household increase as bring site density increases (Audit Commission 1997). Table 2.4 shows the difference in costs between kerbside and bring sites. Although bring sites have an important role to play in meeting national recycling targets (especially for the glass fraction), the necessary increases in recoveries required to meet statutory targets clearly indicates the need to move from relying predominantly on bring sites towards kerbside.

Table 2.4 Comparing the costs and recovery of bring and kerbside recycling

	Bring Recycling	Kerbside Recycling
Cost	**Average**	**Average**
Gross Cost per household	£ 1.59	£ 8.61
Net cost per household	£ 0.61	£ 6.01
Gross cost per tonne	£ 47.00	£ 143.00
Net cost per tonne	£ 17.00	£ 107.00
Recovery		
Kg per household	33	64

(Source: Audit Commission, 1997)

2.4.2 Education and Information Provision

Undoubtedly, one factor generally agreed upon within the literature is the need for public education, to effectively inform the public about recycling and participating correctly in a given recycling scheme (Howenstine, 1993; Read, 1999, Jones et al 2001, Coggins, 2001). Quite simply, Martinez and Schicchitano (1998) found higher levels of recycling in communities where media efforts were carried out compared to those that did not. The importance of environmental education and awareness has been recognised by the government with their recent introduction of mass media campaigns, i.e. 'Are you doing your bit' delivered through various media types and the creation of the NWAI responsible for the education and communication of environmental issues. There are, however, examples of authorities still providing insufficient education and communication strategies reflected in their recycling performance and scheme providers not providing adequate information on how to participate within a scheme (Evison and Read, 2001). Without such public awareness programmes it is believed recycling schemes will fail as a result of non-participation or over contamination (Audit Commission, 1997).

The good intentions of an uncertain public can lead to contamination as highlighted by Scott (1999) where one respondent stated "If I'm not sure, I think, oh heck, put it in anyway and see if they will take it. If in doubt put it in." (p.285). Alternatively, uncertainty could lead to low recoveries with recyclables being disposed of in the normal refuse containers. Both of these actions adversely affect a scheme's performance, which more than justifies any costs incurred in communicating with the public. Read's assessment (1999) of the costs of an intensive public awareness programme showed that as a result of the increased savings in disposal costs and recycling credit payments from increased recoveries of recyclables, the publicity campaign not only effectively paid for itself, but brought about positive environmental changes in behaviour.

There are numerous examples in the literature of different types of public education and communication campaigns (Kneass, 1997; Read, 1997). Some elaborate methods have been

tested, e.g. referral cards, tupperware parties, videos, road shows etc. However, sometimes despite extensive promotion, residents still claim to have never heard about a recycling collection scheme in their area (Read, 1997). Kneass, (1997) highlighted how successful intense communication strategies can be when an increase of 90% in steel-can recovery was observed following various promotions. Perhaps one of the main issues is that information and communication with the public is not just delivered as a one off campaign but continued long after a scheme is introduced. There is also a need to re-emphasise to the public why recycling at a household level is important no matter how small their contribution (Simmons and Widmar, 1990; Evison and Read, 2001).

Chan (1998) highlighted the importance of mass media in establishing the required social pressure to activate norms and subsequently behaviour. McKenney and Hruska, (1996) found that as a result of a mass media approach, recovery rates of almost all material types increased although recognising, that in comparison to door to door contact, a mass media approach is not as effective. Read (1999) has shown how effective personal contact can be at increasing recycling levels and raising the perception of residents despite problems of 'salesman syndrome' when knocking on doors. Reams and Ray (1993) highlighted the importance of personal communication, reporting significantly higher observed participation rates in their direct contact group, gaining pledges to recycle, compared to their other two indirect groups, a) posting pledges and, b) information only groups. Although direct contact appears effective, this approach should be carried out in conjunction with other traditional types of communication.

The effectiveness of different types of communication can vary. Nyamwange (1996) reported that residents ranked television programmes, public campaigns, newspapers and radio advertisements as the top four sources of public information about recycling. Information was the top reason for instigating more recycling and bringing about changes in behaviour. Vining and Ebreo (1990) suggested that the type of medium used to communicate the recycling message may be dependent on the educational level of the recipient. Highly educated individuals are more likely to receive information through newspapers whilst less educated individuals are more likely to have received their information from the television. Similar differences were found in relation to income, where higher income households were more likely to have heard about recycling from newspapers compared to middle and lower income households who more likely to have heard about recycling from school programmes.

If the quality and quantity of information is poor then it will have little effect on changing the public's attitudes and behaviour (Evison and Read, 2001). McKenney and Hruska (1996) found

that households wanted continual reminders with minimal words and lots of illustrations in their communication materials with the assurance that their material was being recycled.

Residents are often unaware of their recycling performance, how well they are doing and the effect of their recycling activity. A lack of information on local scheme performance could diminish people's motivation to continue participating in a recycling programme (Katzev and Mishima, 1992). Providing residents can resolve this with feedback on recycling schemes that has been shown to be effective (Goldenbar and Connel, 1993; Katez and Mishima, 1992; Deleon and Frequa, 1995; Schultz, 1998) and non-effective (De Young et al 1995; Tucker 2001d) in increasing recycling levels. Feedback can take two forms. Specific feedback provides individuals with information about their own behaviour and how that behaviour may relate to other behaviour; general feedback however, provides information on the community's behaviour as a whole (De Young et al, 1995). Seligman et al (1981) suggested that in order for feedback to be successful, two criteria must be met. Firstly, people must be able to identify a relationship between the feedback and their behaviour, i.e. ' you are currently recycling 70% of newspaper' and secondly, people must be interested in changing their behaviour i.e. they want to recycle more. Schultz et al (1995) reinforced this stating studies, which have shown more successful effects of feedback, are where the recipients are more interested in change.

Research into the direct effect of feedback on recycling levels has shown increases in the number of people claiming to recycle (Goldenbar and Connell, 1993) and the amount of material recycled, with an increase of 77% in the amount of paper collected (Katzev and Mishima, 1992). Other studies monitoring the affect of feedback on recycling in comparison to other intervention methods have also shown positive results (De Leon and Fuqua 1995, Schultz, 1998). De Leon and Fuqua (1995) showed that a combined strategy of feedback and commitment was the only intervention that significantly changed the weight of paper collected. Although feedback on its own showed similar increases in the weight of paper collected in comparison to baseline levels, the difference was not statistically significant. An increase in the amount of paper recovered was found to be a result of households recycling more paper than an increase in the number of households recycling. Previous research on the effect of feedback is limited in their applicability, undertaken within student dorms (testing a bias population) and provides limited post feedback monitoring.

Unlike other previous reports, Schultz, (1998) monitored the affect of different intervention methods on a residential housing estate served by a multi-material recycling scheme. More importantly, he assessed two forms of feedback, group and individual. Results showed that the individual and group feedback conditions increased both the level and frequency of participation

as well as the amount of material recycled. No significant changes were noticed for the 'information' and 'plea' conditions and none of the feedback conditions reduced the amount of contamination found in the bins.

Schultz (1998) suggested that a reason for group feedback participation levels continuing to increase post-intervention period whilst the individual feedback condition declined, may have been an effect of personal 'norms' being activated. As recycling is a socially desirable behaviour reporting an individual recycling behaviour would make the individual feel guilty and put their recycling bin at the curb even if it was not full. Therefore, when they feel that they are no longer being watched they revert back to their original behaviour. However, group feedback would take longer to activate 'norms' as they are not activating an existing personal 'norm' but creating a new one. This not only activated but defined the 'norm', the behavioural standard for the community as households become aware of their neighbours and communities recycling behaviour (Schultz, 1998).

The affect of feedback on improving behaviour has been seen in other disciplines. Katzev and Mishima (1992) described how previous authors have found how individuals are motivated to act and that their performance improved when they were provided with performance feedback, thus highlighting success in areas such as curtailing the speed of drivers and conserving energy etc. The delivery of such feedback could take several forms. For example, providing drivers with information on their speed on electronic notices beside the road to curtail speed.

De Young et al (1995) found that neither general nor specific feedback improved recycling behaviour and was only successful in reducing contamination. The research was undertaken in multi-family dwellings where the size of the complex was found to be a more important predictor of recycling behaviour. It was recognised by the authors that although recycling strategies for multi-family dwellings were an adoption of single-family dwellings, the situational and demographic characteristics were inherently different. Tucker (2001b) also found that feedback/goal-setting and pledges had no statistical significant affect on set-out and participation levels, where, only marginal increases of c.2-3% in participation levels were noticed. The effectiveness of any surge in participation following the interventions disappeared within a 6-month period.

Although on balance positive, the effect of various forms of feedback is unclear. Most researchers, reporting specific or unknown factors, make it difficult to extract real effect. The value of informing the public on a continual basis is more clear, with the need for reminders on a six-month basis in order to maintain set-out and participation levels. Communicating with the

public and making them aware of their contributions, highlighting the difference they can make appears to be effective. This suggests that social marketing should be carried out which build on these motivations, yet this is an activity that does not appear to be widespread within the UK (McDonald and Ball ,1998; Scott, 1999). Unfortunately, a lot of promotional events are still based on the philosophy that 'it worked somewhere else' or 'it seems like a good idea' with no real understanding of what effectively communicates well to households or more importantly what kind of information can motivate them to recycle more (Tucker 2001c).

2.5 Household Recycling Decision: Attitudes, Opinions and Participation in Recycling

Attempting to understand why households recycle is one the most intensively researched areas surrounding recycling. Causal relationships between a multitude of psychological, socio-demographic and other factors in relation to households engaging in recycling have been identified in an attempt to predict behaviour. Although relationships are sometimes contradictory, there would appear to be a consensus that a households decision to recycle is not a result of a single factor, but a variety of influences at different levels. Prioritising them in order of influence is not so clear and further research within this area is required. A review of literature more than c.10 –15 years ago has been limited, due to a significant cultural change during this period where individual environmental concern and improved service provision has significantly increased (Shultz et al.1995).

Vining and Ebreo (1992) recognised the different requirements for households to recycle at bring and kerbside schemes, and the effort required to save, prepare and store recyclable materials. Therefore it is probable that the factors that facilitate kerbside recycling differ from other forms of recycling. Differences in households motives and barriers to recycling may therefore be influenced by scheme provision as well as a real shift in attitude, motive etc. This requires continual monitoring, as scheme provision, education, awareness etc. develops.

2.5.1 Motivators to Recycling

Table 2.5 lists reasons why people claim to recycle from three current national attitudinal research projects; concern for the environment would appear to be a central motivator for recycling behaviour. Previous literature, distinguishing recyclers from non-recyclers in an attempt to predict recycling behaviour, can be divided primarily into two main categories, psychological and demographic.

Table 2.5 Reasons for Recycling

Aylesford Newsprint 1998		Oxford Brookes 1999		Burnley & Parfitt 2000	
Reason Stated	**%**	**Reason Stated**	**%**	**Reason Stated**	**%**
Helping the environment	54	Environmental reasons	64	Environmental benefits	63
Its what every responsible citizen should do	32	It just made sense	24	Makes sense	26
Its just habit	26	Just do it	11	Just do it	17
Its so easy it would be stupid not to	16	Other	11	Other	10
My children make us	5	Got into the habit	10	Don't know	8
None of these	3	General Publicity/Advertising	3	Habit	5
Not stated	8	Don't know	3	Publicity	3
				Convenient	2
				Saves money	2
				Reduces landfill	1

2.5.1.1 Psychological Influences

Schultz and Oskamp (1994) recognised that although research findings prior to 1980 had identified relatively strong relationships between environmental concern and recycling behaviour, studies post 1990 had not. There have been claims that the relationship between environmental concerns and recycling behaviour has decreased over time, as prior to the 1980's, recycling required an immense amount of effort to participate in poorly advertised bring facilities (Schultz et al, 1995). They concluded that there were however, relationships with specific environmental concerns, i.e. specific to recycling. Therefore, although households may recycle due to their concern for the environment, it is not the result of a general environmental concern, e.g. global warming.

Environmental concern has recently been cited throughout the literature as a main reason for households recycling (Aylesford 1998; Oxford Brooks, 1999; Burnely and Parfitt, 2000) alongside other altruistic reasons, e.g. 'it means I can do my bit, make my contribution' (Miller Associates, 1999). Although recyclers may claim environmental reasons as their main motive, this does not necessarily mean that non-recyclers do not have the same environmental concern

(McCarty and Shrum, 1994). Other authors have shown how altruism and frugality have been main motivators in recycling (De Young, 1986;Vining et al 1992). Previous literature has debated in some detail the attitude-behaviour relationship where there appears to be some discrepancy in whether any relationship exists and its ability to predict recycling behaviour. McCarty and Shrum (1994) highlighted that, with behaviours such as recycling, there are trade offs between long-term societal gains and short-term personal needs. Therefore, a person may feel that recycling is good for the society and have positive environmental attitudes, but may also feel it is inconvenient and therefore not recycle.

Vining and Ebreo (1992) found that recyclers were more inclined than non-recyclers to believe that people should live in harmony with nature. That "one should recycle because it is the correct thing to do was mainly endorsed by recyclers, but still, moderate with non-recyclers. Simmons and Widmar, (1990) found that on two scales, those holding strong conservation ethics and a sense of responsible action were more likely to recycle than those with weaker scores.

It can not be assumed that environmentally concerned citizens or individuals holding positive attitudes will be likely to recycle (Oskamp et al 1991). Environment related attitudes and beliefs may not necessarily be predictors of recycling behaviour (Goldenbar and Connell, 1993). However, some earlier authors have identified positive relationships between recycling and environmental attitudes (Vining and Ebreo, 1992; Lansana, 1993). Vining and Ebreo, (1992) demonstrated how recyclers differed from non-recyclers, not only in the extent to which they exhibited global pro-environmental attitudes, but also the extent to which they endorsed specific pro-recycling attitudes. They did however acknowledge that the difference between recyclers and non-recyclers at least in term of attitude, are a matter of magnitude of agreement and not a contrast in fundamental values (Vining and Ebreo 1992). This view is supported by Tucker (1999a) who found that although participants in a kerbside recycling scheme had slightly stronger attitudes towards recycling, all attitudes were very positive for both participants and non-participants towards pro-recycling and general environmental attitudes, concluding that other factors other than attitudes may have been inhibiting recycling activity.

Although general global pro-environmental attitudes may not distinguish recyclers from non-recyclers, attitudes specific to recycling would. This suggests that any campaigns to promote recycling needed to concentrate specifically on awareness and favourability to recycling rather than general environmental consciousness Oskamp et al (1991).

Alternatively, the ability of environmental concern to predict recycling behaviour might be a function of the amount of effort required to recycle. Environmental concern could predict recycling behaviour when the amount of effort required to recycle was high (e.g. bring sites). When the required effort was low, only a moderate or low environmental concern was needed for recycling to take place (Schultz and Oskamp, 1996).

Vining and Ebreo (1992) found that respondent's general environmental attitude (both recyclers and non-recyclers) changed over time and generally improved over their three year monitoring period. Experience of an existing programme, community infrastructure or policies has been shown to affect people's attitudes towards a programme (Vining et al 1992). Positive experiences are thought to be central to improving recycling performance or attitudes (Werner and Makela, 1998). The feelings of responsibility for generating solid waste were found to be more closely connected to respondents experiences than with their broad beliefs concerning 'living in harmony with nature' (Vining and Ebreo 1992).

More recently, research has began to show that there is no significant attitudinal difference between recyclers and non-recyclers (Tucker, 1999), although it has been suggested that general attitudes can directly predict behaviour in certain situations (Schultz and Oskamp, 1996). De Young (1989) highlighted similarities between the two groups over a decade ago regarding attitudes, satisfaction from frugal actions, the degree to which people view recycling as a trivial activity etc. Schultz et al (1995) believes that more people are recycling today for reasons more than altruistic concern for the environment. The relationship between general environmental concern and recycling, (if previously present as a predictor of recycling behaviour) appears to have disappeared. Despite environmental concern being cited by households as of their main reasons for recycling, environmental concern may not necessarily be a predictor of recycling behaviour but more reflective of individuals wishing to be seen as environmentally conscious and aware.

An alternative suggestion for the similarities in environmental concern between recyclers and non-recyclers is that non-recyclers who were more interested in environmental problems were more likely to complete a recycling survey, despite their failure to recycle (Vining and Ebreo 1990).

It is thought that general environmental attitudes may be a better predictor of the amount of material recycled rather than the level and frequency of participation in a recycling programme (Schultz and Oskamp 1996). Any change in behaviour takes time to translate into changes in attitudes and is a function of continual positive experiences (Werner et al, 1995) so that

individuals can change a relatively boring task into something more interesting to do (Werner and Makela 1998).

Social pressure has often been referred to within the literature as a stimulus to recruit more participants in recycling schemes (Oskamp et al, 1991; Everett and Pierce 1992), however few direct assessments of any relationship have been undertaken (Tucker 1999b). Norms can take several forms. Social norms are beliefs about the behaviour of another whilst personal norms reflect feelings of obligation to act in a particular manner in certain situations i.e. recycling. Descriptive norms are beliefs about what other people are doing whilst injunctive norms are about what other people think should do be done (Schultz, 1998). The effect of social pressure may therefore take two forms, direct and indirect. Direct will result from family and friends and indirect, a result of guilt when observing others participate.

The effect of social pressure on individuals recycling behaviour would appear to be suggestive rather than a measurable variable. Chan (1998) suggested that the relative importance of social norms is lower in its ability to predict behavioural intention than environmental attitudes, suggesting that any publicity campaign should be on changing attitudes towards the use of waste recycling services. Oskamp et al (1991) found that respondents' recognition of recycling by friends and neighbours was predictive of their own recycling behaviour. De Young (1989) suggested that social pressure might have been a reason for a group of respondents participating in a kerbside scheme even though they did not think highly of the activity but merely because it becomes embarrassing not to recycle. However, it is thought that the existence of normative influences can not be definitively proven but instead provides a theory which can help to explain observed behaviours, although such behaviours may also be a result of alternative models (Tucker, 1999b).

An individual feeling, integrated and part of their community, is thought to be a significant determining factor in the successful use of social pressure to induce recycling. Therefore, its effect may differ between communities and property types (Schultz, 1995). Indirect social pressure may be affected by the visibility of the recycling activity. This will be a result of the schemes design, i.e. bring or kerbside. Recycling behaviour at bring sites is not open to public scrutiny in the same way as a highly visible kerbside scheme with their recycling containers laid out along the street ready for collection. Some authors have suggested this is why social pressure is not reported to be as an important factor by recycler or non-recyclers (Vining and Ebreo 1990).

Alternatively, respondents may not wish to declare family and peer pressure. They view it negatively and therefore may have under-reported it as not to be seen as being swayed by other opinions or actions (Vining and Ebreo 1990). Recyclers have been shown to perceive a greater social pressure and feel more obligated to recycle than non-recyclers (Vining and Ebreo, 1992).

If social pressure is occurring on kerbside schemes, the effect may not necessarily be increasing the overall level of participation, but the frequency at which those already recycling participate (Tucker 1999b). The highly visible kerbside recycling containers may serve as a reminder to participate (Vining and Ebreo 1992) although the associated social pressure may not be enough to overcome the other perceived barriers to induce non-recyclers to recycle. As no significant increases in material recovered can be identified as set out rates increases, it may be concluded that the individuals perception of the social norm is to set out at least some of their recyclables. This may override their perceptions of minimum threshold weight of collected materials before setting out (Tucker, 2001) in order to comply with that social norm. Therefore, although no relationships were identified between, for example cul-de-sacs and through streets, large differences in participation in individual streets may be a result of their own local normative experiences, established very early on in a recycling schemes operation (Tucker et al 1999b).

A common, sometimes overlooked factor of scheme providers, about those who recycle or who are concerned with recycling, is the assumption that people know what recycling is, why they should be doing it and more importantly that everybody knows how to recycle (De Young, 1989). Households may support the idea of recycling but not know how to as they feel ill informed and many more may participate if only provided with the information and knowledge of how to begin (Howenstine, 1993). Assumptions may be simple things like terminology e.g. landfill or hole in the ground, incineration or burning, waste or rubbish (Herritage, 2001).

Lack of knowledge of how to use the location of a facility is as much an inconvenience as not having the facility. If households become overwhelmed, then a simple task becomes a major hassle. De Young (1989) found that the issue is not why one should recycle but how to recycle. It has been suggested that having specific knowledge about a recycling programme is one of the most important predictors of recycling behaviour (Thomas, 2001). Simmons and Widmar (1990) found that those who were confident of their knowledge participated more in recycling than those who were not. They also suggested that a lack of knowledge can act as a barrier to recycling even for individuals endorsing responsible action and having a high conservation ethic, variables they had previously identified independently as predictors of recycling behaviour.

Recyclers have been found to be better informed than non-recyclers in their knowledge and awareness of the recyclability of materials, local programmes and sources of information (Vining and Ebreo 1990; Lansana, 1992). Lansana (1992) reported that 47% of recyclers were aware of a recycling scheme being introduced compared to 73% of non-recyclers who were not. However, this lack of knowledge about recycling may not be entirely the result of a failure in the provider to educate and communicate to residents and make them aware. Vining and Ebreo (1990) suggested that non-recyclers selectively ignored information that they perceive as irrelevant to their behaviour compared to a recycler who will make an effort to remember information.

Even on kerbside schemes, lack of knowledge can act as a barrier to participation, either not knowing what or how to recycle or even being unaware of the programmes existence (Nyamwange, 1996, Read 1999). Read (1999) claimed that 73% of non-recycling households cited lack of awareness of the programme as the main barrier to participation. Even when non-recyclers are aware of a recycling scheme operating in the area, failure to know the details of how to correctly use it will result in a failure of these households to participate (Jones et al, 2001). Addressing these perceived barriers through increasing logistical knowledge associated with recycling may result in a change in motives and thus a change in behaviour (Ebreo and Vining 2000). Effectively, as Schultz et al (1995) state, 'the more a person knows about which materials are recyclable, or where recyclables are collected, the more likely they are to recycle'.

Although minimal effort and convenience are rarely cited as reasons for recycling (table 2.5), factors relating to inconvenience and effort are often cited as the main reason for not recycling. When non-recyclers are asked what would encourage them to recycle, changes to make the system more convenient are often noted. *"When source separation is introduced, the consumer is requested to deliver unpaid work to the society. In return, the society should provide a source separation system that minimises the demands on the consumer."* (Thogersen,1994, p.160).

The motives of an individual have been related to recycling behaviour, however these motives can be vastly different depending on the accessibility to convenient facilities within their community. Providing these facilities would not only make the act of recycling more convenient, acting as reminders to recycle, but would encourage non-recyclers to participate. If these experiences are positive allowing previously non-recyclers to realise how convenient and the minimal effort recycling requires, they may continue to recycle/participate in a scheme (Ebreo and Vining 2000).

Inconvenience, whether a perception or an opinion following a previous experience, may ultimately determine whether an individual chooses to recycle. Beliefs are not always related to behaviours. Regardless of how important an individual believes recycling to be, the more inconvenient an individual perceives recycling to be, the less likely they are to recycle (McCarty and Shrum , 1994).

Therefore, one of the most common ways suggested of increasing recycling levels is to reduce the amount of effort required to recycle (Vining and Ebreo,1990). The effect of introducing such effort reducing programmes has generally shown increases in recycling levels (Schultz and Oskamp 1996). Such strategies include changing the collection system from bring to kerbside, which have been shown to change behaviours, i.e. converting non-recyclers into recyclers and to increase the volume and type of materials recycled (Vining and Ebreo 1992). Introducing a more convenient/kerbside collection system has often been cited by non-recyclers as a main reason that would encourage them to recycle (Coggins, 1994).

It has previously been suggested that there are two types of recycler (De Young 1989). Those who previously recycled at bring sites may not be as sensitive to the issue of convenience, may have very positive attitudes etc. Various authors have shown that non-recyclers perceive recycling to be more inconvenient than recyclers (Vining and Ebreo 1990; Lansana, 1992). This suggests that the inconvenience claimed by non-recyclers may be based on perception rather than on experience although this may differ with scheme provision.

Another reason for households recycling, besides attitudes, effort, social pressure etc, is their recognition that that they can do their bit for society (Thogerson, 1994)). De Young (1989) believed that people need a sense of being 'needed' and recycle in an attempt to make a difference, which can be a necessity of an individual's psychological well being. Carrying out recycling, for some, may not be in the hope of a tangible reward but from the personal satisfaction from carrying out the activity. With such reasons to persist in a boring activity, they may overcome the other perceived barriers and transform the recycling task into ways which make it more interesting to do, e.g. crush cans with kids (De Young 1986; Werner and Makela, 1998).

2.5.1.2 Socio-demographic Influences

As with psychological variables, previous research has highlighted links between socio-demographic variables, e.g. age, income, education etc. and recycling behaviour. Predicting recycling behaviour based on socio-demographic indicators is a concept, more so than predictions based on attitudes, although recognising that finding a suitable selection of socio-

demographic descriptors may be problematic (Tucker et al, 1997a). Lansana, (1993), suggested that households demographic characteristics can provide a solid base on which to formulate recycling strategies. However, now that high mandatory targets are in place, with a suggested 80% household coverage of kerbside recycling for targets to be met using such knowledge to target the "best areas" may have less practical applicability. Ebreo and Vining (2000) claimed that socio-demographic factors are only important when developing a solid waste management infrastructure and less important in the latter stages.

Schultz et al (1995)' whilst reviewing previous literature found that people with the highest level of environmental concern were young, female, better educated, higher earners, urban dwellers and ideologically liberated. A recycler's profile is less clear although the general tendency suggests that older, more affluent, more educated people are more likely to recycle. The most common reported demographic variables are age, gender, income and education.

Vining and Ebreo (1990) found that the only demographic differences between recyclers and non-recyclers were in age and income and were not distinguishable in terms of educational level, gender, households size or occupation. The mean age of recyclers was 42, for non-recyclers, 35. Lansana also found that recyclers tended to be older, generally between 40 and 64. She also recognised that education was a discriminating characteristic between the two groups. Hamburg et al (1997) found kerbside recyclers to be concentrated within the 30-49 age group with few under 30 or over 70 years of age. Some authors suggest that retired residents are also more likely to participate in a recycling scheme (Ball and Tavitian 1992; Mansell, 2001). Waste Watch (1999a) identified that recyclers in the older age group claimed to recycle more materials.

Relationships with socio-demographic variables are thought to be strongest where drop off/bring systems are in operation. Folz and Hazlett (1991) noticed that the higher participation and diversion occurred in communities with larger proportions of females, older residents and citizens with higher educational attainment. Ball and Tavitian (1992) claim that responsibility for collection tended to be a female one.

Some authors have found demographic indicators, including age and education, do not distinguish between recyclers and non-recyclers (Oskamp et al, 1991) where it has been suggested that in comparison with psychological variables, demographic variables play only a small part in the prediction of recycling behaviour (Vining and Ebreo 1992).

Income has been positively related to levels of participation in a kerbside scheme (Jacobs et al 1984). They observed that a higher proportion of higher income households participated in their kerbside recycling scheme (66%) than those on middle incomes (51%) and similarly with those on lower incomes (29% and 10% respectively). Upper middle income homes were also found to recycle more frequently. Tucker (1997b) suggested that some infrequent recyclers tend to accumulate large quantities of material between participation and were generally found to be from more affluent single household housing types. However, this relationship may be a result of the additional storage space in affluent single households and may be entangled with the income variable.

Relationships between housing type (in terms of type and rateable value), social / occupational class and recycling behaviour have also been identified (Hamburg et al, 1997; Mansell, 2001). Social class (or socio-economic status) comparing ABC1 and C2DE households has shown differences in recycling behaviour (King 2000), participation in a kerbside scheme (Ball and Tavitian 1992) and recycling frequency (Oxford Brookes, 1999), concluding that recycling schemes would be best targeted at ABC1 households. Although claimed participation/recycling levels appear to be related to socio-economic class, Miller Associates (1999) found that a higher proportion of residents in the C2DE group claimed to recycle all of their available material. Ball and Tavitian (1992) also found a relationship between occupation and participation in the scheme, where only a small proportion of manual workers participated in the scheme. When they did participate, they were less likely to put their bag out.

Previous research would suggest that recyclers tend to be home owners living in a single – family dwelling more than those who rent or live in flats, maisonettes, mobile homes etc. (Oskampet al 1991; Lansana, 1992, Hamburg et al, 1997; King 2000). Lansana (1992) found this to be significant, with 88% of recyclers compared to 27% of non-recyclers owning their own home. King (2000) found a significantly higher percentage of non-recyclers living in council rented and housing association property. Tucker et al (1997a) believe that housing type is, if any a weak predictor of recycling behaviour, it is recognised that there may be differences between single and multi-household dwellings.

In addition to housing type, the rateable value of a property has been related to recycling participation and the level of material claimed to be recycled (Ball and Taviatan, 1992; Mansell, 2001). Mansell (2001) showed that as the council band increased from A to H so to did the participation rate. Similarly, the same relationship was evident with the type of materials recycled. The strongest relationship was with paper and glass and to an extent, plastic bottles. The increase in cans was slight and more consistent across tax bands. Band A properties were

more likely to suggest lids for the recycling boxes and were concerned about them getting dirty than higher tax bands that suggests storage space as a major issue.

Recent research surveys have indicated recycler and non-recycler profiles as part of attitudinal or scheme monitoring surveys rather than specifically trying to identify statistical demographic variations as a predictor of recycling behaviour. They show similar demographic differences between recyclers and non-recyclers (Waste Watch, 1999a; Oxford Brookes, 1999; King 2000; Burnely and Parafitt, 2000; Mansell, 2001). Typically they suggest that recyclers are more likely to be older, with regularity of recycling increasing by age, own their property (usually a single dwelling house), have higher incomes, female, have a higher social grade and to a lesser extent, less infants within the household.

2.5.1.3 Variable Charging

Direct charging or unit pricing etc. to the householder, have generally shown promising results in improving recycling and participation rates (Hong et al, 1993; Miranda and Aldy, 1998). Over 4,000 communities in the USA successfully participate in direct charging schemes (Skumatz et al, 1997), yet Fullerton and Kinnaman (1996) concluded that the effect of variable charging schemes on increasing household recycling levels was minimal and that other design variables can demonstrate equally impressive results. Successful and unsuccessful variable charging schemes world-wide have identified initial problems of residents placing rubbish in neighbours bins and increases in fly tipping (Harder and Knox, 1992). However, it is thought these 'teething' problems are short lived as people 'would not be bothered' to get into their car every week to dispose of waste on a long-term basis.

The UK Environmental Protection Act (1990) currently prevents any form of variable charging scheme being implemented in the UK stating that "no charge shall be made for the collection of household waste" (Duxbury and Morton, 1995). Therefore, no change can take place until there is a change in legislation (Perry, 1997). However, when the issue was raised during the development of the UK Waste Strategy 2000 it was dismissed on the basis of high administration costs and being negatively perceived as a 'waste tax' having a disproportionate effect on poorer households and those with children (Price, 2001).

Research into volume-based schemes has shown diversions of between 15-60% and are generally recognised by some local authorities as the only real motivator of change, hitting people in the pocket and making them aware of the true costs of waste collection and disposal (Macquillin, 1998). However, more direct attitudinal studies have shown that 58% of local authorities asked thought such a system was unfair and only 38% thought it could work in

practice (Oxford Brookes, 1999). Miranda and Aldy (1998) reported increases in participation and recycling in all monitored communities operating variable charging schemes, some with increases of up to 70%. However, if households are to be charged for the amount of waste they generate for disposal, it is vital that adequate facilities are in place to enable them to divert as much material as possible, i.e. intensive recycling and composting schemes (Price, 2001). In addition, minimising the size of residual containers in conjunction with recycling and composting provision has shown to positively correlate with increasing recycling levels (Miranda and Aldy, 1998). Similar parallels with variable charging can be seen in the UK transport sector where substantial increases in fuel duty to reduce car use, are met by fierce public opposition, as no adequate alternative i.e. public transport currently exists.

Miranda and Aldy, (1998) claimed that households modify their waste behaviour in two stages in response to unit pricing. Firstly, they divert their waste through recycling and composting collections until they reach what they perceive as a maximum level. Secondly, once this level is reached, they begin to source reduce to minimise further the amount of waste they are being charged for. This re-emphasises the importance of providing adequate facilities to recycle and compost to maximise the initial reactive diversion of waste.

At present, local authorities are only allowed to charge for separate collections of garden waste, under the 1994 controlled waste regulations, schedule 2. An indirect method of introducing variable charging in the UK, without a change in legislation, is to stop providing free bin sacks for sack collection rounds (although admittedly not in line with the increasing coverage of wheeled bin domestic collections). Similarly, Fullerton and Kinnaman (1996) found that pricing waste by the number of bags collected had little effect on the total weight of waste collected as households merely set out heavier bags. This perhaps highlights the careful consideration needed in scheme design and implementation if potential future charging schemes are to be introduced within the UK.

Although empirical evidence of variable charging schemes in other parts of the world would claim such schemes are successful at increasing recycling levels, attitudinal research within the UK suggests the concept is unpopular (Waste Watch, 1998,1999a; Miller Associates 1999, Burnley and Parfitt, 2000). Waste Watch (1999a) found that the percentage of people agreeing with the idea of waste collection being charged per bin or bag to encourage recycling increased to 57% from 48% in the previous year. In contrast, a more recent attitudinal survey found that around 70% of households were against the idea of moving towards such a system. The more affluent ABC1 social class group were more in favour than the C2DE group of such a move (Burnley and Parfitt, 2000). Similarly 53% of respondents felt variable charging would be

unfair. Miller Associates (1999) also found high disagreement amongst Hampshire households with 52% disagreeing with the idea. Likelihood of agreeing was again related to socio-economic class. Households' failure to accept the concept of variable charging may be a result of only a small minority understanding the true costs of waste collection and disposal identified in recent attitudinal surveys (Waste Watch, 1998,1999). Thus, tackling negative views may be an issue of education rather than a need to change a fundamental attitude to the concept.

Attitudes towards being charged separately for waste collection are unfavourable; in Hampshire 67% of households were against the idea (Miller Associates 1999). As with variable charging the likelihood of agreeing to charging was related to socio-economic class, with those in the higher AB and C1 groups agreeing more with the idea than those in the C2 and DE groups. If these negative attitudes are in response to a lack of awareness and can be addressed by education, increasing publicity would be a more politically sensitive route than a change in fiscal policy and legislation, especially given that high participation rates have been reported on voluntary recycling schemes.

2.5.2 Barriers to Recycling

All recycling schemes, bring or kerbside, require some effort on behalf of the householder with no tangible reward for their effort (Thogerson, 1994). Shultz et al (1995) suggested that one of the most direct, but often overlooked ways of increasing recycling behaviour was to remove the barriers to recycling, i.e. minimising the effort by the householder to recycle. Table 2.6 lists reasons why people claim not to recycle from a selection of recent research projects. The main reasons identified can be categorised into two main issues, inconvenience and awareness. These two barriers could be overcome with the introduction of a well publicised and effective multi-materials kerbside recycling scheme.

Attitudinal surveys have documented that the provision of a kerbside scheme is quoted as the main factor to encourage non-recyclers to recycle whilst making current 'bring' recyclers recycle more. Encouragingly, only a small percentage of people claim not to recycle because of intrinsic negative reasons such as 'can't be bothered', 'too lazy', 'don't see the point' etc. (Oxford Brookes 1999, UEA 2000, Burnley and Parfitt, 2000). This would suggest that recycling behaviour can be changed relatively easily with the introduction of a door-to-door kerbside collection scheme. However, there is much documented research that shows that in areas where households are served by a kerbside scheme, there remains a high proportion of non-recyclers. Although their reasons for not recycling may differ to those not served by a kerbside scheme, they can still be categorised into two main areas, inconvenience and awareness. Reasons include lack of a container as a result of losing it or not being provided with

one, unaware of the scheme or how to correctly use it, or issues of storage within the home etc. The proportion of households who are not bothered and don't see the point of recycling remains relatively low in comparison (King, 2000). Tucker (1999a) found that generally non-recyclers did not provide a series of reasons for not recycling, and that the main reason was often their only reason for not recycling.

Failure to recycle and put recycling intentions into practice would suggest one of two reasons. Either, the individuals are making false claims about their intended behaviour (consciously or subconsciously) or the kerbside recycling service provided is insufficient to overcome the perceived inconvenience, which may result in households choosing not to participate in the scheme. The original barriers then come back into force.

King (2000) suggested that non-recyclers fall into four groups; the excluded, the apathetic, the frustrated and the unaware. The 'excluded' refers to individuals living in for example flats and are physically excluded from a particular kerbside scheme, whilst 'apathetic' refers to those who can't be bothered and have no time regardless of the service provision. 'Frustrated' are those who have tried the scheme but have dropped out for various reasons, usually poor service provision; and finally the 'unaware', are a result of for example households moving home and generally being unaware that a scheme exists. Each group presents different barriers to be overcome, yet all but the apathetic are an issue of inadequate scheme design and maintenance. Although it must be accepted that there will always be the apathetic non-recycler, and this group is the hardest to tackle; if the scheme required a minimal additional effort to engage in recycling (through the time, effort and thought needed to recycle), the size of this group may also be reduced.

Table 2.6 Reasons for not recycling

Aylesford 1998		Oxford Brooks 1999		Burnley and Parfitt 2000		UEA 2000*	
Reason Stated	**%**	**Reason Stated**	**%**	**Reason Stated**	**%**	**Reason Stated**	**%**
Lack of facilities	39	Its too difficult	26	Too much effort	32	Too far away / not enough banks / don't know where banks are	25
We never think about it	38	Facilities too far away	24	Not considered it	24	Lack of / expense of transport	16
It is too much hassle	28	Can't carry / no car	13	Banks too far away	20	Other	13
We can't see the point	5	Never considered it	13	Not bothered about the environment	16	Not enough time	11
None of these	5	Other Reasons	13	Not sure how to do it	8	Not enough / nothing to recycle	9
We don't know how to	3	No space to store	8	Other	8	Too old	8
None stated	3	Not sure how to	8	No space to store things	6	Too lazy	5
		I'm just not bothered	8	No car	4	The council collects	5
		Don't know	5	Don't see the point	3	Not enough space	5
		Can't see the point of it	3	Too expensive	3	Use charity shops not banks	4
		I re-use things myself	3	Don't know	3		

* Refers specifically to reasons for not recycling waste at recycling centres or bring sites

2.6 Putting Intention Into Practice: Variations between claimed and observed recycling behaviour

Variations between attitudes and self-reported behaviour compared to actual observed behaviour continue to cause frustration to waste managers and create problems interpreting and understanding collected data. Although it is widely accepted that a respondent bias exists (Rathje, 1984) and that people when questioned tend to over-exaggerate their pro-environmental performance (Ball and Tavitian, 1992; Barker, 1994; Gamba and Oskamp, 1994, Tucker, 1998) few studies have directly quantified these effects in relation to households recycling participation and efficiency.

Rathje (1989) identified that a disparity between what we should do, what we want to do and what we actually do exists. McGuire (1984) also noted that a correlation between reported household participation in recycling schemes in relation to actual behaviour as measured by refuse data is often absent, concluding that what people say they recycle and actually recycle are quite different. The discrepancy between self-reported and actual behaviour has led to suggestions that verbal reports are potential indicators of an ideal reality and, although connected, are independent of instrumental reality (Corral-Verdugo, 1997).

Understanding the cause of these 'false claims' is imperative in understanding a variety of factors such as the failings of a schemes provision and effectively converting intention into actual behaviour. One factor is identifying and ensuring that households interpretation and understanding of interviewers' questions are correct so that results obtained (and subsequently acted upon) are also accurate, truly reflecting household responses and reducing the number of these 'false claims' as a result of misinterpretation. McKenney and Hruska (1996) described how households used the term recycling to describe a series of other additional behaviours as well as actual recycling, i.e. reduction, re-use, and composting. If not recognised by the interviewer, this could lead to inaccurate reports of behaviour.

Satisfaction of two stages as a prerequisite of accurate self-reports has been suggested (Warriner et al, 1984). Firstly, the respondent must be able to answer correctly. The effects of time/memory and/or simple lack of knowledge, or questions phrased in a confusing manner can all increase the likelihood of inaccuracy in self-reports. Secondly, the respondent has to be willing to answer correctly. Sensitive, threatening, demanding or 'socially desirable' questions can elicit misleading responses. Over-reporting of behaviours, which are socially desirable i.e. recycling, can occur if respondents believe that the survey instrument has the potential of evaluating them as individuals. They exaggerate their more favourable qualities, even if this

means reporting intentions and wishes rather than real behaviour. For example, Ball and Tavitian (1992) illustrated that over a third of respondents who claimed to have never missed a collection had not set out on the day of the survey.

Differences between self-reported and observed disposal and environmental behaviours have been cited in a variety of different circumstances, including waste disposal (Rathje, 1984), household recycling behaviour in relation to materials re-used/recycled (Corral-Verdugo, 1995; 1997, Tucker et al, 1998), household's participation and set-out frequency (Gamba and Oskamp, 1994; Werner and Makela, 1998) and energy consumption (Warriner et al 1984).

In relation to recycling, Gamba and Oskamp (1994) found over-estimated participation and set-out levels when comparing self-reports with observed behaviour on a co-mingled kerbside recycling programme. The phenomenon was explained as a 'social desirability effect' stressing the importance of using actual observation measures. Schultz and Oskamp (1996) suggested that when people state their environmental attitudes in the same survey as reporting their behaviours, the strength of the relationship is artificially inflated and subsequently reported recycling behaviour is an overestimation of actual recycling behaviour. The size of that bias from self-reports relating to an individuals level or frequency of participation may reflect the strength of their personal or social norms about recycling (Thøgersen, 1996).

A measure between questionnaire surveys and actual refuse data has also identified discrepancies. McGuire (1984) suggested that interview surveys and refuse analysis may be measuring separate realities. Interview surveys are designed to measure attitudes, ideas and beliefs. It is believed that when these are used to measure actual behaviour, the informants response is likely to reflect attitudes more than behaviour. This idea of a 'dual realities' model was developed Corral-Verdugo et al (1995) and subsequently by Corral-Verdugo (1997) on re-use and recycling behaviour. Comparisons of material indices indicated two separate constructs. Self-reports seem to be related to a perception of being a recycler whilst observations reveal the quality of that conservation behaviour.

An audit trail developed to specifically test individuals claims with their actual recycling behaviour (Barker et al, 1994) identified that a high percentage of individuals with a pro-recycling position failed to recycle their paper in facilities provided. Tucker et al (1998) also identified differences between observed behaviour and self-reports and highlighted these discrepancies by material type. Discrepancies of c.5-10% for paper products, 20% for glass and 50% for cans were identified.

Not all differences between self-reported and observed behaviour have identified individuals making either conscious or sub-conscious false claims. Discrepancies between self-reports and actual behaviour were coincidentally recognised by Werner and Makela (1998), when monitoring residents who set out recyclable material for collection. Social differences between self-reports and actual behaviour were found to be a reflection of the interpretation of the question(s) by the householder. Self-reported recycling behaviour was correct, although the recycling method communicated to the interviewer was false. Households' response to a question may not be the response required but a response to what the interviewer has communicated, which can often be quite different (Daniel and Ittelson, 1981). Thus, households' know they should recycle, they want to and may even think they do recycle, yet in reality they don't, or at least, not by the method communicated.

2.7 Effectiveness of Participation

Previous literature has extensively researched the motivators and barriers to households recycling. To an extent, research on the affects of the waste composition, a scheme's design/operational characteristics and households' failure to put into practice intended behaviour on the level and frequency of participation, has been well documented. However, less research focus has been on understanding how to improve the level of efficiency at which new and existing recyclers participate and the factors that influence some materials being recycled more effectively than others.

National findings report that 9 out of 10 households claimed to recycle (Waste Watch 1999). From a separate survey 80% of respondents claimed to recycle monthly or more often with only 9% claiming not to recycle (Burnley and Parfitt, 2000). In the previous year, 72% of respondents claim to recycle monthly or more often, of which 35% reported recycling on a weekly basis (Oxford Brooks, 1999). Of those who recycle, the materials recycled (as previously shown in figure 2.3) broadly reflect current service provision in the UK; paper, glass, cans, then plastics etc. With the exception of plastics and aluminium foil, over 50% of recyclers claim to be recycling these materials, for paper, magazines and glass the figure is 80-85% (Waste Watch 1999a).

If these findings are accurate, and only a 10% recycling rate was achieved in the same year (DEFRA, 2000b) including composting, we could conclude that those recycling (or at least claiming to) are not recycling with maximum efficiency. The survey data reports that the task of convincing households to recycle is nearly complete, where the motivators and barriers are now becoming clear. The factors that have changed their behaviour need to be better understood

along with what measures would encourage the remaining non-recyclers to recycle. There remains a need to understand how to ensure recyclers improve the level at which they participate, the factors prohibiting maximum recycling efficiency and reasons for the significant differences in recoveries between different materials if mandatory targets are to be met. If 80-90% of the population are recycling 10% of household waste, then merely encouraging the remaining 10-20% to recycle will not lead to the targets being met. It is now being recognised that although the level of scheme participation is critical to success, how effectively households participate is equally important (Thomas, 2001).

Scott (1999) suggested that in order to increase overall recycling intensity, we have to first have a better understanding of the reasons why a high degree of variability persists in households with equal access to a convenient kerbside recycling scheme. The research question may need to go further, addressing why a high degree of variability persists at the household for different materials equally targeted by a kerbside scheme. Previous research on recycling intensity has been divided into two areas. The first is poor efficiency as a result of households not understanding what materials / products are required and the associated effort / general inconvenience of a scheme (Thomas, 2001). Secondly, as with motivators of recycling behaviour, studies on the prediction of intensity of recycling in relation to an individual's age, knowledge, attitudes etc. have also been attempted (Scott, 1999).

Thomas (2001) claimed that a low capture rate on a scheme reporting high participation levels suggests participants have an inadequate understanding of how to participate. The results implied that low capture rates were a result of households not fully understanding exactly what they should be doing rather than not wishing to comply. Such findings have previously been found within literature (De Young, 1989; Howenstine,1993), which may suggest the issue of poor efficiency is primarily dependent on insufficient information and knowledge. Where respondents have been asked to indicate which materials they recycle (table 2.7), they are quite prepared to admit that there is a difference between materials (although these percentages are still higher than actual recoveries).

Table 2.7 Claimed recycling behaviour of recyclers from recent attitudinal surveys

	Jones et al (2001)	King (2000)	Burnley and Parfitt (2000)	Oxford Brooks (1999)	Waste Watch (1999)	
					1998 data	1997 data
Paper	91%	91%	62%	94%	86%	85%
Glass	86%	87%	49%	82%	79%	83%
Metals	56%	83% (cans)	32% (cans)	61% (cans)	55% (cans)	56% (cans)
Plastic	60%	81%	21%	41%	31%	n/a
Textiles	16%	40%	12% (clothes)	76% (clothes)	71%	66%

Research by Aylesford (1998) indicated that households estimate that they recycle around 30% of all their household waste. This raises the question as to whether poor efficiency is a function of lack of information and knowledge or individuals not recognising how little they are recycling due to other influential factors. It was found that over half of respondents were claiming to recycle more (reflecting to an extent the small increases in national recycling levels) with the biggest claims concerning newspapers and magazines, textiles and rags. Recovery of these materials, are at reasonable levels and already recovered potentially close to maximum levels. In comparison, packaging materials, e.g. food cans, plastics etc. are not, which highlights the area where research is most needed.

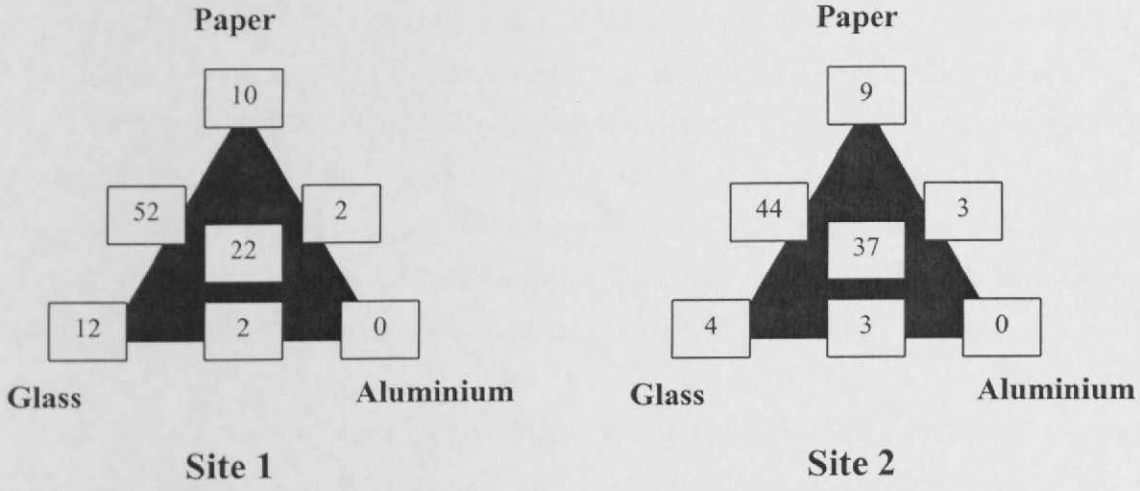
It has been suggested that household recycling efficiency is related to the amount of waste they produce (Lake et al, 1996). They indicated that although keen recyclers (i.e higher recorded set out frequencies) were setting out heavier bags for collection, as a percentage of their total waste generated, this was smaller than less keen recyclers i.e. although the weight per household of households setting out more frequently was greater, as a percentage of total waste arisings over a given period it was smaller. Following this it was suggested that instead of encouraging the converted to participate more effectively, more effort is needed towards encouraging non-recyclers to recycle. Scott (1999) suggests that if people derive a greater sense of satisfaction from recycling they will consistently recycle at a higher level, regardless of other factors. Conversely, Scott (1999) also found that the only demographic predictor of recycling intensity was age. Knowledge of how to use a programme, environmental motivation or social pressure did not predict the efficiency that people recycled.

Tucker et al (1998) suggested that recycling intensity does not necessarily increase with a progression through ones life cycle. They showed households with young adults or young children recycled less effectively than more mature residents. However, this is not necessarily a relationship with age as retired residents were found to recycle with high levels of efficiency. In

relation to housing type those who lived in terraced houses or housing schemes are most likely to not recycle all available material, although no relationship was identified between housing type and newspaper under-recovery.

An interesting point noted by Tucker (2001c) was the relationship of households behaviour between materials. Figure 2.8 shows the relationship between three materials recycled at two separate bring sites. What this indicates is that only a small percentage of households recycle a single material; nobody recycled just aluminium. Although a high proportion of households recycled all 3 materials (paper, glass, aluminium), with the most common combination is paper and glass.

Figure 2.8 Combination of materials recycled by percentage of recyclers



Taken from Tucker 2001c

The participation efficiency of households appears potentially to be related to the level of understanding as well as conditions within the home. This level of understanding was not thought to relate strongly to a schemes design. Thomas (2001) showed no relationships between scheme design characteristics, i.e. container type and the level of understanding (although no container provided led to a lower level of understanding). Placing prompts on bags and containers was shown to increase the level of households understanding of a scheme, although no indication was made to suggest this necessarily increased performance. Inadequate knowledge and information to residents to a schemes design, e.g. change in collection frequency has been shown to cause confusion amongst residents as to whether recyclables would be collected; thus low participation efficiency was reported (Werner et al 1995).

Thomas (2001) showed that there is considerable variance in how well different recyclables were recognised as targeted by kerbside schemes. Newspapers and plastic bottles were

identified most often. Magazines and cereal boxes were also well recognised in schemes which accepted mixed paper. Households were however confused regarding the acceptability of magazines on schemes not requesting mixed paper and card. There was also a lower level of understanding if cans should be recycled, particularly for pet food cans.

Tucker et al (1998) indicated that inconvenience, forgetfulness and effort are the strongest factors for households not recycling all available material. This is especially the case if washing of dirty materials is required. They also suggested that a lack of knowledge regarding certain classes of materials causes confusion and poor recoveries (particularly amongst the paper categories). However, Thomas (2001) indicated that increasing the range of targeted materials could significantly reduce the capture rate achieved as a result of confusing residents. Although feedback should have provided more knowledge about would could be recycled etc., it also brought with it more complexity as a result of effectively a longer list of materials. This caused confusion and thus lower recoveries and capture of materials. This is an issue that needs clarification and is addressed within the thesis. Precise information material types may be appropriate on a single material scheme identifying the various grades, but not on a multi-material scheme. The Millennium scheme information addressed later in the thesis tried to reflect and test this finding by increasing the range of materials collected but by maintaining a simple message to avoid this confusion and thus lower recoveries. The belief is that although increasing the range of materials can simplify the message, it is the relationship between complexity and what is demanded of the householder that is important.

Recovery rates reported on recycling schemes indicate that households are not recycling with maximum efficiency indicated by low diversion rates. Furthermore a household's participation efficiency would appear to differ in relation to the material being recycled. In general, newspaper and magazines report the most effective recoveries and food cans the lowest. This pattern is consistently reported throughout multi-material kerbside recycling schemes (Poll, 1991; Thomas, 1996; M-E-L, 1999; Mansell, 2001; Waste Research Ltd, 2001). Therefore, in addition to households participating with different effectiveness, there is also a difference in the efficiency in which a household recycles each material.

2.8 Waste Management Modelling

Modelling provides a picture of the real world that can relate to a simplification of reality and used to understand the processes and structures, which occur in the real world (Tucker, 2000b). Models have been developed at all levels from decision support models to support waste management planning (Barlishen and Baetz, 1996) to the individual decision making process

(Tucker, 2001c). Scheme performance is the result of individual decisions of householders and developing and testing models can help in our understanding of the complex relationships that determine behaviour at an individual level.

The preceding literature review has illustrated that many factors associated with attitudes, knowledge, convenience and control affect overall system performance, which is the aggregative response of individual decisions of householders. This section focuses on the individual and draws on the approaches developed in the social sciences to explain behaviour and how these approaches have been applied to recycling activity specifically. Although few researchers have attempt to "calibrate" such models (e.g. predict actual recovery rates), and those that do recognise that "calibration" is very case specific (in terms of system provision, time frame etc.) the concepts and process of modelling recycling behaviours does provide insight into the key stages leading to the action of recyclers/non-recyclers, the factors that need to be addressed and their relative importance, which ultimately will assist in the design and improving recycling provision.

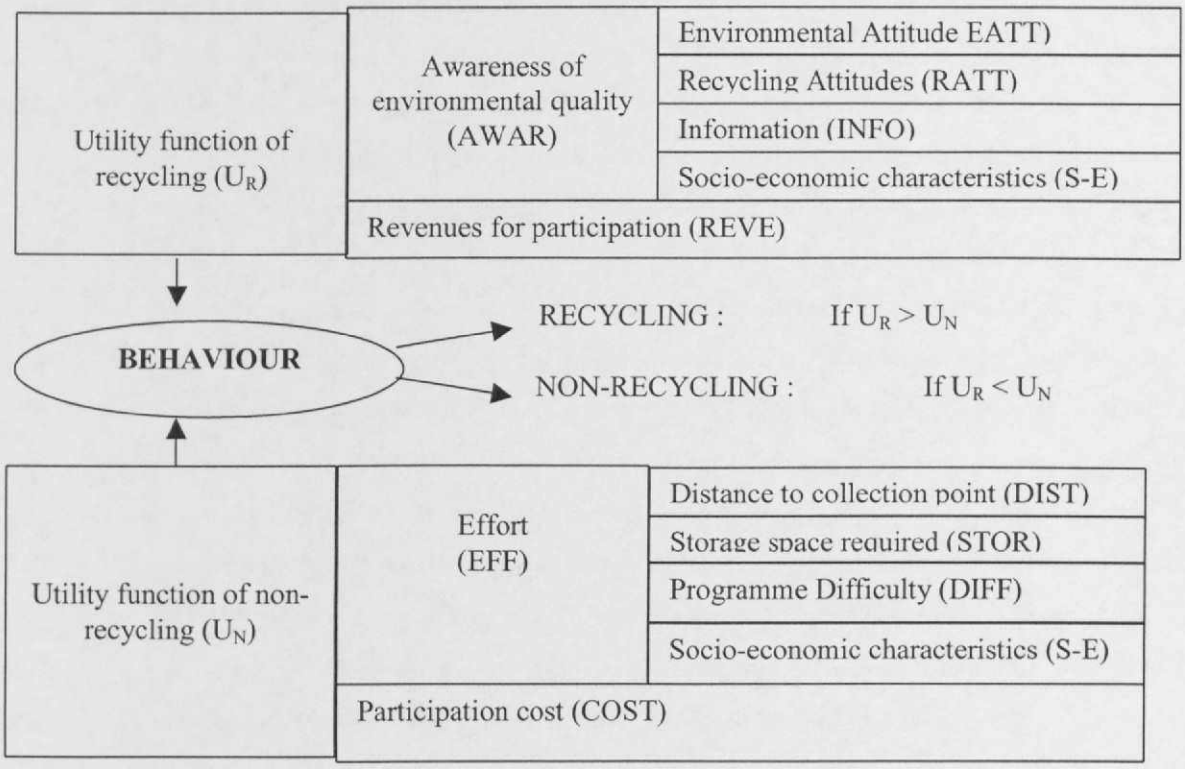
Most recycling behaviour models are an adoption of the original 'Theory of Reasoned Action' (TRA) model (Fishbein and Azjen, 1975) that was later adapted to the 'Theory of Planned Behaviour Model' (Azjen, 1985). These models take behaviour as a direct function of behavioural intention, which in turn is affected by attitude, subjective norm and perceived behavioural control (Tucker 2001c). Selections of these models will de discussed to illustrate the key parameters, similarities and differences. For full details of specific models, reference to the individual papers should be made.

2.8.1 Modelling Characteristics

The model of Franco and Huerta (1997), (figure 2.9) was based on the hypotheses that if the utility of recycling was greater than the utility of not recycling, then an individual would recycle. A series of categories identified within the literature were classified under either the recycling utility or non-utility function, depending on these previous positive / negative relationships. The model was applied to a 500 Spanish sample questionnaire survey and several conclusions were derived. An individual will participate if the personal satisfaction is greater than the effort required to do so. The main factor that reduces personal satisfaction once participating is related to the amount of effort involving participating. Finally factors that will increase satisfaction levels of an individual, will depend on the level of awareness they have of the problem. Relevant factors will firstly be attitude followed by the information level they possess.

Unlike many behavioural models, the model is not based on the TRA model. Instead the model assumes that recycling behaviour is primarily influenced by attitude and effort in addition to the associated costs with (non) participation.

Figure 2.9 A Behavioural Model of Participation in Recycling (Franco and Huerta, 1997)



Most behavioural models are based on the TRA model. A selection of which are presented in figures 2.10 to 2.12, where behaviour is a function of intention, that itself is influenced by an individuals attitudes and norms. The links identify where relationships have been found. Goldenhar and Connell (1993) unlike other models, do not recognise that external factors can affect an individual converting intention into behaviour. All these models recognise that individual's attitudes, social norms, perceived barriers or beliefs etc. influence the intention of an individual to perform recycling. However, the most critical element of this is to understand the 'personal difficulties' / ability / habits / opportunity element which prevent / allows this intention to take place. Another important issue that these models address is that the motivation of an individual to recycle is limited if they do not have the 'ability' to put that intention into practice. Much of the research focus has been on understanding individual motivations. However, if adequate facility provision, education etc. are not in place, recycling behaviour will not actually take place and will remain only an intention.

Figure 2.10 Path Analysis of Recycling Behaviour. Goldenhar and Connell (1993)

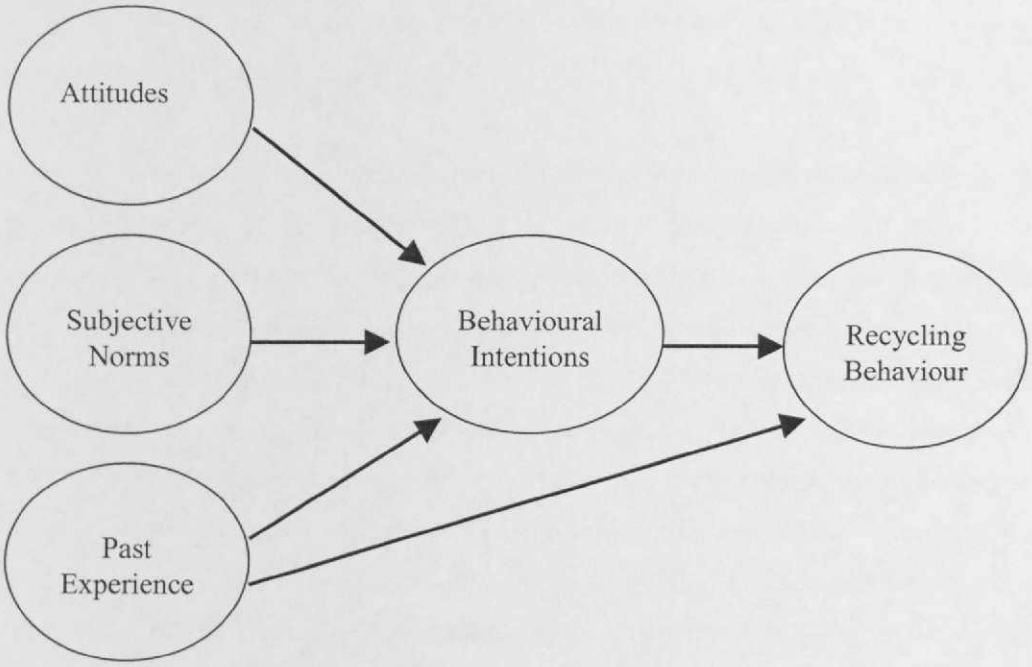


Figure 2.11 A Behavioural Science Frame of Reference (Thøgerson 1994)

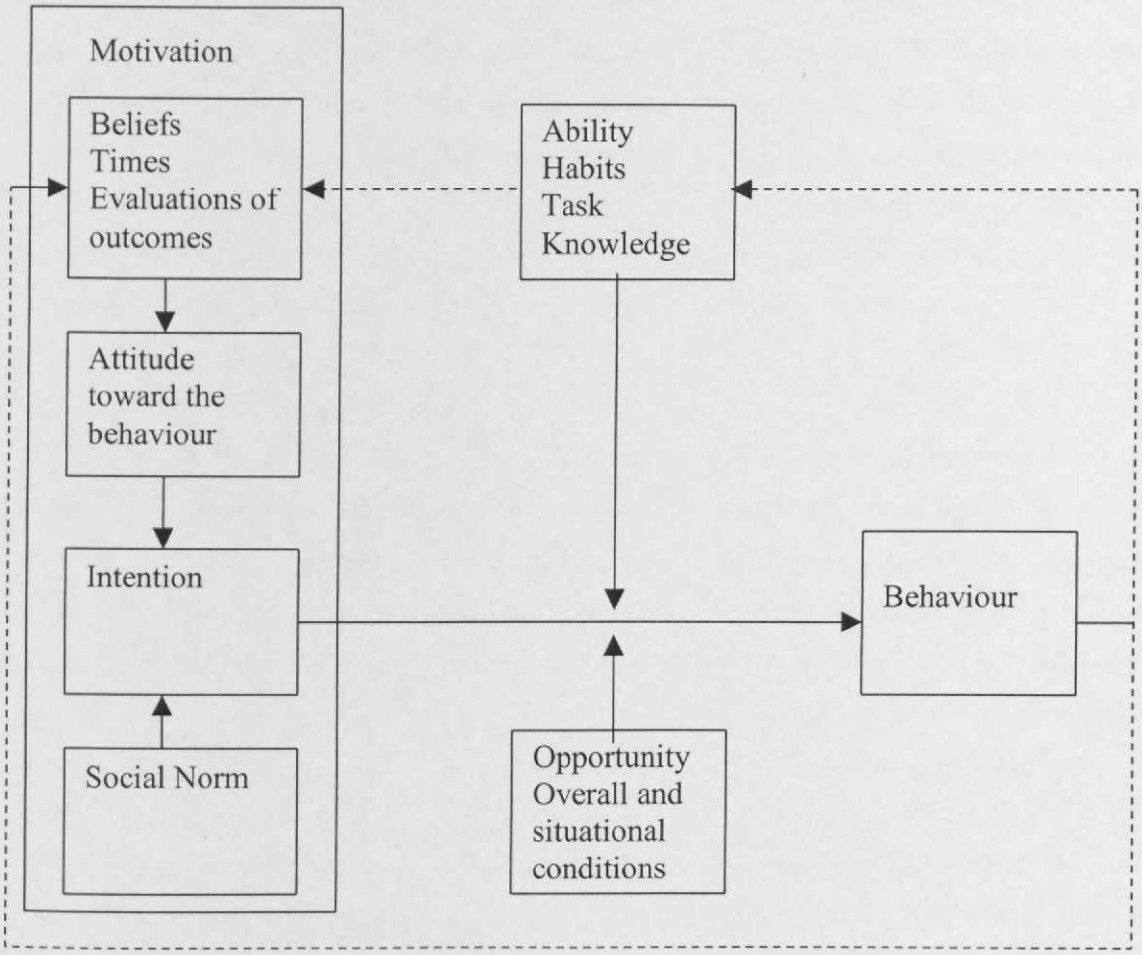
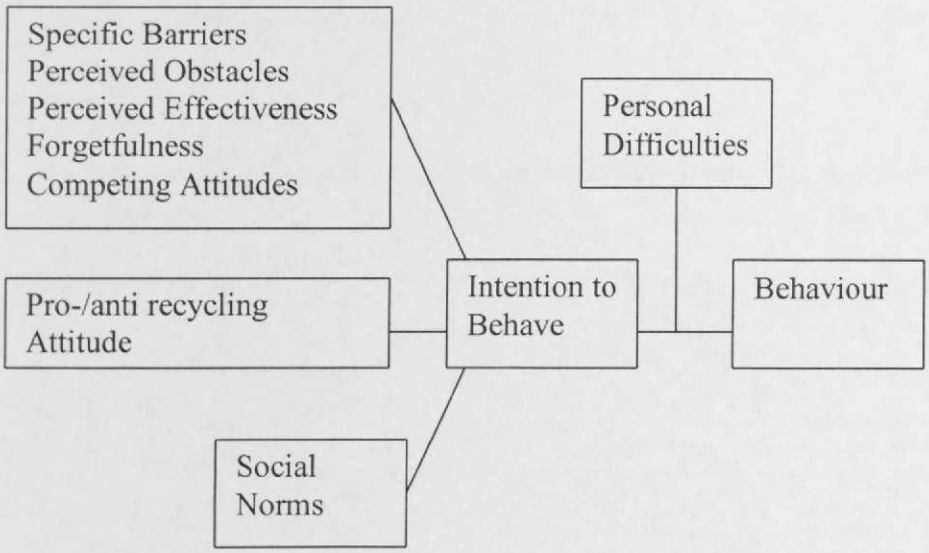


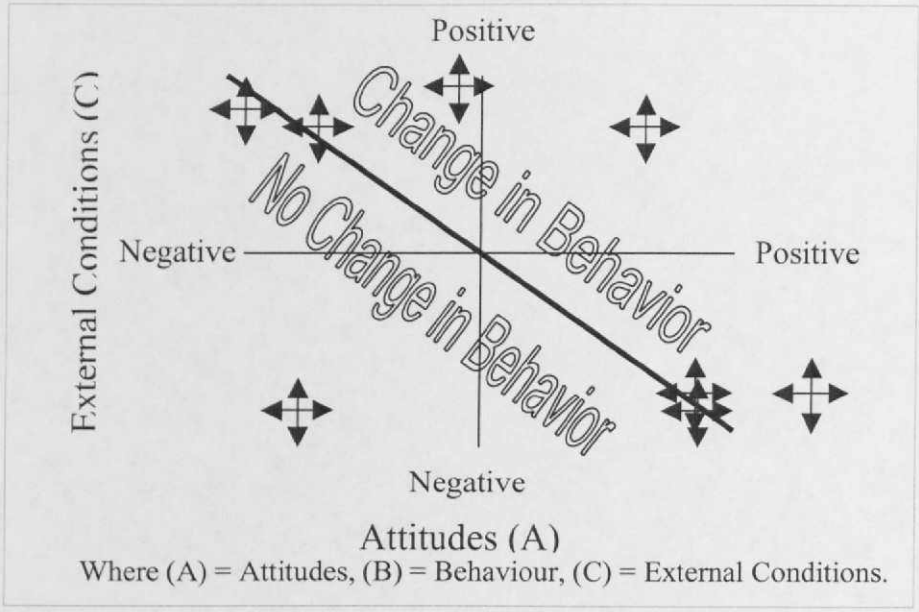
Figure 2.12 Hypothesised cause-effect model of recycling, Source:Tucker et al (1998)



Guagnano et al (1995) suggested an A-B-C model framework, which, unlike other models prior to it, recognised the importance of external conditions on an individual's attitude and thus facilitating behaviour. Much research only investigates the positive effect of A or C in isolation. Figure 2.13 postulates that in any population of individuals there are distributions of A and C for any behaviour. In relation to recycling, if the behaviour is, for example difficult or inconvenient for most members of the population (negative C), then the resulting behaviour will be rare in comparison with strong positive conditions, e.g. easy or convenient, (positive C) then behaviour will be common. This is also the case in relation to a behaviour strongly influenced by attitude (positive and negative A), i.e. dropping litter.

The critical element of the model is the affect of A and C on behaviour occurring will depend on the values relative to each other, rather than a certain value of either by itself. Particular behaviours will occur if values of A + C are above the line and be absent if A + C are below the line. Ultimately, the success of any recycling strategy will depend on the absolute value of the sum of A and C. When the absolute value is small, shifts in either A or C may cause a particular combination of A and C to move across the line. This would result in a change in behaviour. However, if the absolute value of A + C is large, then any modest change will not result in a change in behaviour. The success of any intervention strategy will be greatest when the absolute value is close to zero, i.e. lying near the diagonal line in figure 2.13. This conceptual A-B-C model was not however tested with empirical observations (Guagnano et al. 1995).

Figure 2.13 A-B-C Model. Source: Guagnano et al (1995)



From Tucker's (2001c) hypothesised cause-effect model, he was able to classify recyclers into a series of categories (table 2.8). Effectively, the level at which the barriers existed in relation to attitudes and norms would not only determine an individuals decision to put intention to behave into practice but the level at which they would practice that behaviour.

Table 2.8 Proposed Classification of Recyclers (Tucker 2001)

Category	Description	Main Determinants
I	**Regular Recycling**	**Attitudes + Norms >Barriers**
I (i)	Committed Recycler	Norms relatively low
I (ii)	Social Recycler	Norms relatively high
II	**Infrequent Recycler**	**Attitudes + Norms comparable with barriers**
III	**Non-recycler**	**Attitudes + Norms < Barriers**
III (i)	Potential Recycler	Attitudes + Norms just < Barriers
III (ii)	Committed Non-recycler	Attitudes + Norms << Barriers

With the exception of Tucker (2001c) none of the models have attempted to be calibrated, and, although they identify relationships between variables, are subjective in their applicability on a wider basis. They rely on self-reports, which (within the thesis) have been shown to provide inaccuracies and the models are not based on measured behaviour in terms of recycling participation or recovery levels. However, all these models are useful in identifying the constructs of a household's behaviour, although limited in their predicative qualities.

Tucker (2001c) has gone beyond the traditional modelling approach and assessed and modelled behaviour based on attitudinal surveys, waste analyses and scheme performance data to develop

the integrated household waste management model. This model was developed parallel to this research. However, all materials are not monitored and the focus currently remains on newspapers.

Considerable resources have and continue to be committed in order to fully understand household recycling behaviour. The lack of calibrated models so far illustrate that much of the previous research has failed to provide data of either the appropriate type or level of reliability needed for this purpose. However, despite lack of calibration, the behavioural models are reasonably consistent and do provide a useful framework to grade and focus on research and development monitoring recycling schemes in a manner that permits more generic lessons to be drawn.

There appears to be two main differences in the manner in which these model approach recycling behaviour; both are useful and shed good light on influences of behaviour. All the models are of individual behaviour, but one approach is on utility, the other is predominantly on the TRA concept and intrinsic and extrinsic behaviour. On revising these models, it is difficult to comment and provide accurate advice to operations managers. To calibrate these models is an immense resource intensive task and extrinsic factors will vary significantly depending on the scheme looked at. Bearing this in mind, no decision on what model element would be tested in the PhD was made other than noting effectively testing out the convenience issue of the utility model suggested by Franco and Huerta (1997). However, there is still a need to test the front-end issues i.e. motivational factors, which contribute extensively on the other models and play an integral part in the utility model.

All of these models can only be calibrated at a set out level on a scheme basis given the current information needs and resources demands within the thesis. To calibrate would require each individual household to be monitored and analysed separately. There is a need to identify if there are links between global recovery and attitudes and if so, classify them.

3.0 METHODOLOGY

3.1 Introduction

This chapter will firstly identify the research needs and the experimental framework in which the research was undertaken, followed by a brief description of the pilot kerbside recycling schemes investigated, the monitoring protocol adopted and specific tests undertaken.

The two previous chapters have highlighted current legislation, drivers and challenges that face UK local authorities, industry and the waste management system as a whole. A review of associated literature has highlighted previous and current research assessing the relationships of recycling behaviour in an attempt to predict recycling performance. Much of this focus has been on the household's decision to recycle, investigating differences between recyclers and non-recyclers in terms of their attitudes, demographics etc. and to a lesser extent understanding how to improve the effectiveness of participation. The need to understand how to improve participation efficiency is often quoted as a research need within recent literature (Read, 1999; Thomas 2001) and it is noted that there is little peer reviewed work within this area (Tucker, 2001b).

Although many studies have investigated recycling attitudes and behaviour from self-reported or observed behaviour, few have monitored and compared these at the same time to scheme monitoring. To date, none have investigated household's attitudes and behaviour prior to and after two different kerbside scheme designs, monitoring the effect of these scheme designs on changes in attitudes and behaviour.

Several principles are becoming clear within the literature regarding what is understood about recycling behaviour. Others are not so clear, and clarification is required. The general demographic profile of a recycler is older, more likely to be female, own their property (single family dwelling), have higher incomes and socio-economic grade, and, to a degree, have a better education and relatively less infants within the household. Although positive environmental attitudes are quoted as reasons for recycling, there is little fundamental difference in attitudes, rather the level of performance under the current service provision between recyclers and non-recyclers. Historically there may have been differences in relation to the amount of effort required to recycle in previously poor managed bring sites, although it would appear that this relationship is becoming less pronounced.

There is little consensus on an ideal voluntary scheme design. Certainly with such variations in scheme design between UK local authorities alone, it is hard to disentangle the specific reasons for a scheme's success or failure. The literature would suggest that convenient schemes are more successful i.e. providing a free container, good communication programmes, kerbside collections etc. Actions that suddenly make the scheme inconvenient, i.e. losing or failure to return the households recycling container, will result in households dropping out of a scheme. Providing kerbside schemes would appear to increase the number of households recycling, although little research documents household's change in recycling behaviour following a scheme's introduction.

Inconvenience, either perceived or a failure in service provision to meet the need of the individual appears to be a major barrier in household recycling. The lack of knowledge and awareness of non-recyclers (and in some cases recyclers) does not assist the situation. There is general agreement that education and communication, whether on a personal contact or mass media basis is an essential pre-requisite for recycling and these campaigns should continue well after the initial programmes implementation. Communication with households to boost participation and recovery levels i.e. feedback have shown mixed results although studies have predominantly been limited to student dorms, single material schemes and have failed to look at recoveries in terms of specific materials. There is certainly a research need to clarify the effect of feedback on residents recycling behaviour and on the quantity of materials recycled by the household.

Finally, source separation requires an immense effort on the part of the individual for which they receive no tangible reward. When individuals are asked about their recycling behaviour, attitudes are positive and there is a general consensus agreeing with its principles. When studies have compared self-reports against observed behaviour in an attempt to understand why recycling levels are lower than expected, differences are often found between the two. A number of reasons have been suggested for such discrepancies. Some have questioned the methodologies used in their studies, claiming they are measuring separate realities or result from a misinterpretation of the question communicated by the researcher. Others have suggested that in relation to environmental behaviour, households want to be seen to be proactive and are prepared to inflate their responses (effectively make false claims) even if their circumstances prevent them from carrying out this behaviour, or at least at the frequency communicated. No definitive explanation exists; however there is a general consensus that self-reported behaviour is usually higher than observed behaviour, although clarification of this issue is required.

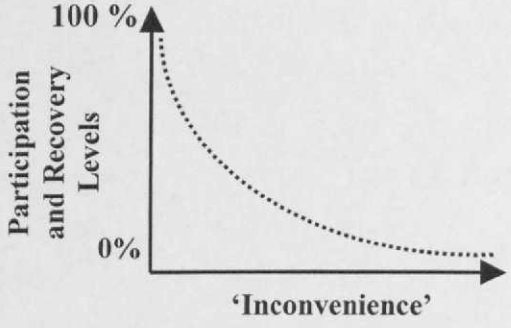
3.2 Research Design

3.2.1 Experimental Framework

The research methodology was designed within the general framework of understanding that ultimately scheme design should be household focused. Maximum recoveries will be achieved by schemes that demand minimal thought and effort by the householder. This should dictate the sorting technology required and let the market develop in a framework of assured supply regardless of whether the material will be utilised or ultimately disposed of.

Figure 3.1 is a simple illustration of this concept in relation to scheme performance. As the scheme becomes more inconvenient less people will use a scheme and participants will recycle less efficiently. 'Inconvenience', interpreted in its broadest sense represents an accumulation of factors illustrated within the literature, i.e. lack of knowledge, lack of storage space, effort etc. Therefore, the view is that as recycling becomes more 'convenient', participation and recovery levels will increase. Numerous assumptions are made in relation to this concept. For example there is unlikely to be 0 or 100% participation / recovery in addition to the fact that the relationships in recycling are complex and uncertain etc. Determining what factors are incorporated within the term 'inconvenience' and the feasibility of providing an appropriate scale(s), be they quantitative or qualitative, are areas of uncertainty. However, the general concept is central to this thesis and therefore the research design chosen. This concept will also be applied at a material level to investigate the high degree of variability between material recoveries, despite being on a kerbside scheme. The hypothesis is that each material has its own inconvenience level which can be categorised.

Figure 3.1 A Conceptual hypothesised relationship between the level of 'Inconvenience' and participation/recovery levels

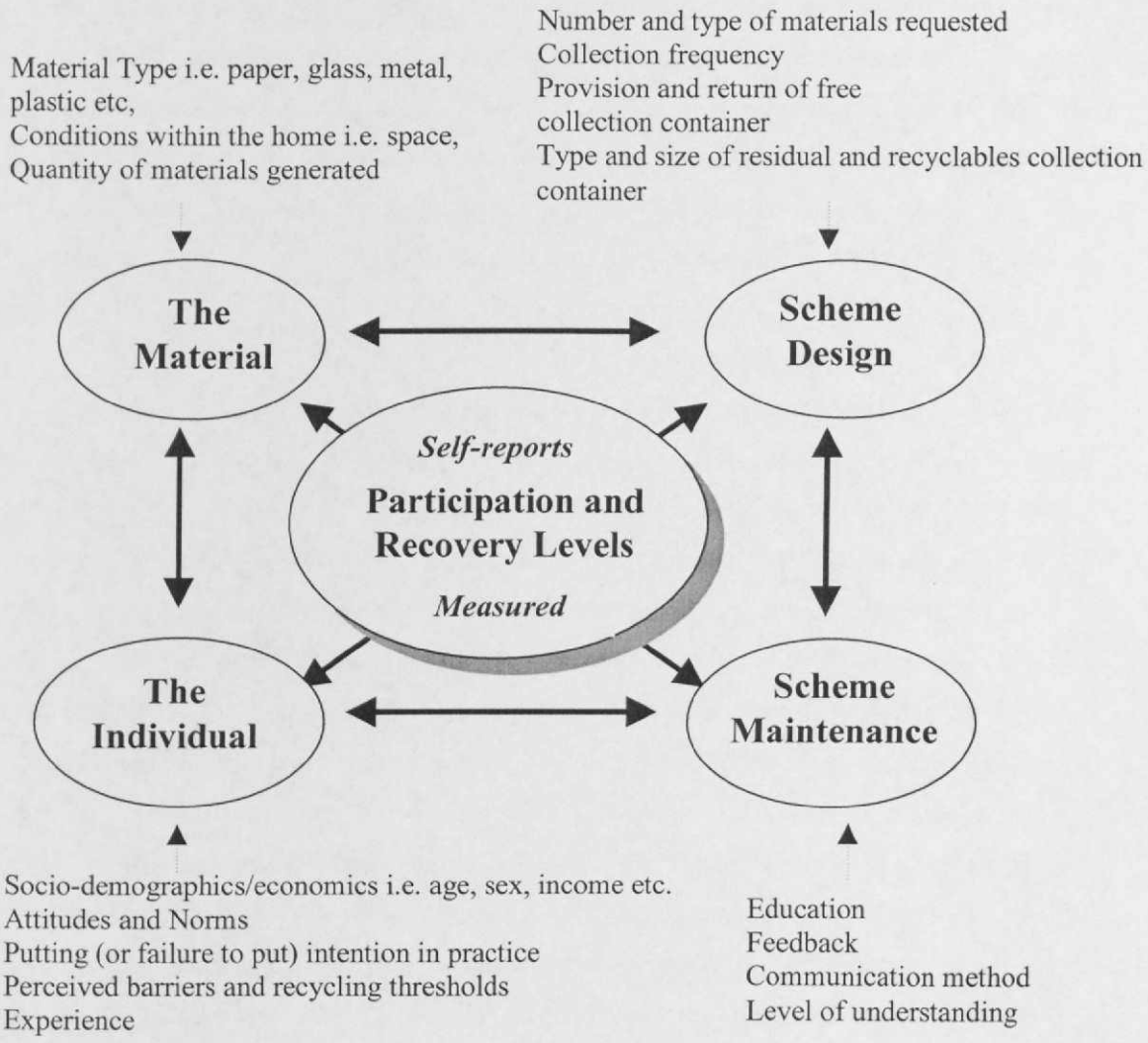


Throughout the literature, a series of factors have been identified as having a relationship with recycling behaviour and therefore effecting participation and / or recovery levels. These factors

can be allocated into four main categories; 'the individual', 'material', 'scheme design', and 'scheme maintenance'. Figure 3.2 is a hypothesised conceptual model illustrating the interaction of these categories. A series of tests were completed to assess the relative importance of these factors in determining recycling participation and efficiency levels.

The concept behind figure 3.2 is that all four variables not only influence participation and recovery levels but also interact with each other. For example, the scheme design influences the individual's perceived barriers; the individual's circumstances will determine the conditions within the home whilst the maintenance of the scheme will depend on the scheme design etc. Also, it is suggested that self-reports quantifying recycling levels at higher levels than measured participation and recovery, this is subsequently illustrated within this model.

Figure 3.2 Hypothesised cause-effect model of kerbside recycling participation and recovery levels



In order to satisfy the aims and objectives identified within this thesis, a methodology allowing these four categories to be tested was required that could be implemented within the time and resource constraints of a PhD project. To develop a universal, robust model, qualitative or mathematical, account must be taken of a whole variety of scheme designs and householder characteristics, introducing intervention strategies calibrated in different spatial and temporal conditions. The resource demands of such a project would be impractical for anything less than a national research project. Alternatively, this thesis monitored a selection of factors within each of these four variables in an attempt to provide an insight into the mechanisms involved and causal factors to currently restricted recovery levels and participation efficiency.

To improve the validity of the results and any subsequent model, results from 'Project Integra' (M-E-L, 1999, Miller associates, 1999, Thomas, 2000) have been integrated where necessary to either support or substitute data sets. Results from Daventry District Councils 'Green waste' trial (Waste Watch, 1999b) have also been recognised within the project on a more limited scale and research for the Newspaper Industry Environmental Technology Initiative' headed by Peter Tucker at the University of Paisley is referred to (Tucker, 2001c). Results from these projects only came to light during the latter period of this thesis and no attempt has been made to test out the approaches adopted by the various authors, merely to utilise the published data to develop / complement the primary research undertaken on the thesis. However, these studies do recognise the need for improved understanding of factors influencing recycling behaviour and their conclusions will be valuable in reflecting on the studies reported here.

In order to test the conceptual model, intensive monitoring of both attitudes and scheme performance was required. For this purpose, two pilot kerbside schemes were monitored within the Leeds/Bradford area, (Paper Chain and Millennium) prior to and after their introduction. This allowed the conditions to be controlled so that the tests could be undertaken under the supervision of the research project within similar temporal and spatial conditions. A third scheme (SORT) was also monitored, but less intensively as this scheme was already established and no 'before' and 'after' studies could be carried out.

3.2.2 The Paper Chain, Millennium and SORT Kerbside Recycling Schemes

The two principal schemes (Paper Chain and Millennium) differed, not only in their design, but also in the amount of effort required by the household to participate. Both schemes were introduced on a pilot basis and monitored separately over a period of c.6 months, where waste analyses and questionnaire monitoring were carried out to establish baseline data. Paper Chain was designed and operated by Leeds City Council whilst the Millennium recycling scheme was designed and maintained on behalf of the project under the supervision of Bradford City

Council. Sample areas investigated had previously not been served by a kerbside recycling scheme.

The first scheme (Paper Chain), was perceived to be a low cost kerbside option for local authorities, but was relatively inconvenient to the householder and easy to 'opt-out' of. The second scheme (Millennium) was perceived to be a high cost kerbside option to local authorities, but was very convenient for the householder to participate in and more difficult to opt-out of. The third scheme SORT, is a multi-material scheme but more prescriptive in relation to permitted materials. At the time of monitoring, SORT was perceived to be performing poorly due to the low service provision (recyclables collected at 5 weekly intervals), and lack of effective communication between the council and residents. Results from this scheme are less comprehensive but complement / supplement data for the Millennium and Paper Chain schemes.

The monitoring and analysis of the 'Paper Chain' and the 'Millennium' schemes provided not only an opportunity to acquire new raw data, but was relatively unique in the comparisons and subsequent analysis that could be made as a result of the sampling protocol. Attitudes and claimed 'bring site' behaviour could not only be compared between two separate areas but the effects of two different kerbside schemes on attitudes, behaviour and scheme performance could be evaluated independently and comparisons made. Controlling these variables would help clarify their relative affect on participation and recovery levels. As self-reported and observed household behaviour were monitored during the same period, the research also provided the opportunity to clarify and potentially quantify the variation between these two reports.

Household's attitudes and behaviour were monitored as a whole and on a scheme basis. To further investigate the relationship between scheme provision, attitudes and behaviour, individuals were also categorised into 4 groups for each scheme (table 3.1). A further sub-group of households who either dropped out of a scheme or participated late were also investigated to clarify reasons for their behaviour.

Table 3.1 Sampling groups according to households recycling behaviour

Group	Bring Site Behaviour	Kerbside Behaviour
1	Recycler	Participant
2	Non-recycler	Participant
3	Recycler	Non-participant
4	Non-recycler	Non-participant

3.2.2.1 The 'Paper Chain' Scheme

The 'Paper Chain' scheme was a recently introduced single material kerbside recycling scheme introduced primarily to outer suburbs of Leeds (Wetherby and Garforth), West Yorkshire and was offered to c.20,000 households. Subsequently, the scheme was extended to other districts but eventually replaced with SORT in light of current targets. Requested materials (see appendices) were newspapers, magazines, comics and leaflets, which were required to be set out at the kerbside in a re-usable, green plastic sack (figure 3.3). Collections were bi-weekly on a different day to household's normal refuse collection day. The green sack was only replaced when householders put it out for collection or requested a new one. Scheme instructions were printed on the sack and on an instruction leaflet delivered to household 2 weeks prior to the scheme's introduction. The bags were collected by a 3 man crew in a 7.5 tonne rear closed caged non-compaction vehicle between 7.30am and c.3.00pm. Collected material was delivered twice daily to a household waste site in Thorpe Arch for interim storage (figure 3.4) before bulk transfer (unsorted) to the reprocessor.

Figure 3.3 Households re-usable sacks being collected by the 'Paper Chain' recycling scheme.

Figure 3.4 Interim storage point for recyclables, Thorpe Arch, Leeds.

3.2.2.2 The Millennium Scheme

Lack of convenience is continually cited throughout previous research as a main barrier to recycling. Traditionally, kerbside recycling schemes have been designed in relation to market availability resulting in schemes collecting only newspapers/magazines, plastic bottles (but not containers or other plastics), distinguishing between paper/card grades and generally refusing to accept glass which is one of the main materials recycled at bring sites. No scheme within the UK could be identified during the research design, which provided minimal inconvenience to the householder and collected all potentially recyclable material so that comparisons could be made with 'Paper Chain'. Therefore, the Millennium scheme was designed and introduced for

the purpose of this research and external financial support from *'Biffa Award'* landfill tax credit scheme and Bradford City Council was successfully attained.

The 'Millennium' kerbside recycling scheme adopted a 'bottom up' approach where the aim was to present a convenient, simple, easy-to-use system to the householder in order to maximise both participation and the diversion of recyclables. The scheme ran for 6 months on a pilot basis for 143 households. Each household received an information leaflet (see appendices) and a disposable white plastic sack (for interim storage) two weeks before the scheme(s) implementation. The leaflet informed households how to use the scheme and provided a help line number if assistance was required. One week later, each household received a 140 litre green wheeled bin following a notification letter identifying the delivery day and time. Households were asked to leave the green-wheeled bin out empty on the first collection day for removal if they did not wish to participate.

The leaflet requested 'all recyclables' but did not specifically list materials to remove any concerns on behalf of the householder of contaminating the recycling bin. This was designed to allow the householder to recycle without having to determine if a plastic drink bottle was accepted but a plastic container was not, i.e. removing the inconvenience of product/material identification when recycling. However, food and garden waste were specifically not requested. A reminder of both requested/non-requested materials was illustrated on both the wheeled bin and plastic sack. The bin was collected from outside each house at the kerbside weekly, on the same day as their normal refuse collection by a 3 man collection crew using a rear caged 7.5 tonne non-compaction vehicle (figure 3.5). A feedback leaflet (see appendices) was delivered c.12 weeks into the scheme providing information on household's recovery performance and a reminder of how to correctly use the scheme.

Figure 3.5 The Millennium recycling scheme.

3.2.2.3 The 'SORT' scheme

An additional scheme, 'SORT' (Sort Out your Recyclables Today) was monitored to a lesser degree utilising previous waste analyses data from REMECOM analyses (ADME, 1998). In conjunction with this data current questionnaire data undertaken with Geoffrey Leyland (an undergraduate student) to assess attitudes and behaviour on this existing and relatively poorly maintained scheme. This research was supervised as part of his thesis to collate public attitude data from SORT residents that would provide current attitudinal data for this research; (for more specific information on SORT, refer to Leyland, 2001). Unlike 'Paper Chain' and 'Millennium', the 'SORT' scheme is a well established multi-material kerbside recycling scheme within Leeds. It served c.88,000 households (1998) covering a variety of different suburbs with different socio-demographics. Initiated in 1991, it has developed from the pilot schemes SORT 4000 and SORT 12000 where households were required to sort their waste into dry recyclables, organic waste and refuse using two wheeled bins (SWAP, 1993). The current system consists of a 240-litre green wheeled bin collected monthly (or in some areas 5-weekly) at the kerbside on the same day as their normal refuse collection. Materials targeted include: newspapers, magazines, telephone directories, food cans, drink cans, pet food cans, plastic bottles and more recently cardboard packaging. Households are provided with a sticker (see appendices) to place on the lid of their recycling bin indicating recycling collection weeks and requested materials. Until recently, collected materials were sorted at a centralised Materials Recycling Facility (MRF) in the centre of Leeds. However, materials are currently baled without sorting and sent mixed to Indonesia for reprocessing.

Various research projects have focused on the operation of the SORT scheme and the previous MRF process (Foxley, 1997). There is a general perception that the initial enthusiasm and support for the scheme by the Local Authority has diminished over time, as performance has not matched expectations and structural changes in the authority (i.e. Unitary status in 1997) occurred. It is also perceived that lack of resources to actively promote the scheme has led to resident's lack of interest and misuse of the scheme resulting in poor recoveries. A more positive approach to developing SORT is now evident since mandatory targets have been placed on local authorities as seen in (Leeds City Council, 2001)

3.2.3 Model Development

A series of specific tests through the use of questionnaires, waste analyses and scheme performance data, were undertaken under each of the four category headings. Each of the three schemes were also compared in relation to their overall scheme performance, household attitudes and claimed behaviour. Ultimately, the analysis would allow a more accurate assessment of the relative importance of these categories on participation and recovery levels.

Socio-demographics are often recognised as a potential influencing factor in both waste generation and household recycling behaviour. It is important to recognise and monitor the affect of socio-demographic factors on recycling behaviour. The size of a questionnaire is a critical factor in governing effective response and the decision was made to use ACORN, rather than loading up the questionnaire with reports of specific socio-economic data of 'known' relevance to waste management habits. Despite criticism of its use in waste management (Parfitt et al, 1994), ACORN has been widely used when reporting waste management behaviours (DoE, 1994; M-E-L, 1999). Furthermore, ACORN classifications are readily available at postcode level without the need to separate socio-demographic information from the householder. The ACORN classification system developed by CACI (1997) represents all households within an enumeration district and not at an individual property level. Therefore, reference to a household ACORN classification within the thesis refers to all the surrounding households within the enumeration district and not a single household. Households within the UK can fall into one of 6 categories from A (Thriving) to F (Striving) sub-divided into 54 household types (see appendices). In order to be definitive in any relationship between recycling behaviour and ACORN grouping, an assessment of all types, or, at least all categories, is required, however this was beyond the resources available to a PhD project. Basic demographic data was also collected from the questionnaire responses to classify households.

Previous research has implied that attitudes may be related to recycling behaviour. They were assessed through a series of specific questions within the questionnaires, using amongst other methods a 5 point likert scale and an attitude battery (Parfitt, 1997). This enabled respondents to be quickly led through a series of statements without overburdening them. Attitude scores were then developed using methods suggested by (Oppenheim, 1979; Foster and Parker,1995; Speirs and Tucker, 2001 and Tucker, 2001).

How effectively a scheme is maintained was assessed through the use of questionnaire reports which identified households' level of satisfaction, waste analyses and the development of indices for each of the schemes. Particular attention was given to the SORT scheme to gain households views and behaviour on what was perceived to be a poorly maintained scheme. Direct comparisons between household satisfaction levels are rarely undertaken (Evison and Read, 2001) and do not distinguish between kerbside and bring provision. The effect of feedback on recycling behaviour was tested on the Millennium scheme c.3 months after its inception through the use of waste analyses and scheme performance data before and after the delivery of the pictorial information leaflet. This task was undertaken due to the lack of accurate reported data within current literature.

The effect of the schemes design was determined by comparing performance data between the three kerbside schemes and utilising data from other external research i.e. Project Integra. Although the analyses were undertaken at a detailed level, i.e. comparing container type to material recoveries, the main comparisons were predominantly at a scheme level.

Due to the range of material recoveries reported within UK recycling schemes, the effect of the material itself and the presence of a potential 'ceiling effect' (Schultz, 1998) was investigated, to identify the potential cause of this phenomena. Comparisons of material recoveries between the three schemes and additional data sources were undertaken to establish if differences in individual material recoveries were influenced by scheme design or were merely dependent on factors within the home and / or a function of the materials' inconvenience.

3.3 Sampling Protocol

The timeline in the appendices shows when each of the sampling procedures was carried out on the Paper Chain and Millennium recycling schemes.

3.3.1 The Paper Chain Sample Areas.

One recycling collection day was monitored from each of the two main areas offered the schemes of Wetherby (1,648 hh) and Garforth (1,810 hh) to ensure results were representative of the whole scheme and to identify any variations between the areas as a result of the residual collection. The collection days were selected according to their compatibility with normal residual rounds (Wetherby 1,579 hh - collected by wheeled bin, Garforth 2,005 hh - collected by sack) to accurately calculate diversion levels. Identifying a household's ACORN category was a secondary criterion to minimise the effect of socio-demographics and to ensure a high proportion of households were within the D9 category. Table 3.2 identifies the number of households in each ACORN category. The scheme was monitored during the period from 8th April to 1st December 1999.

Table 3.2 Total number of households allocated to each ACORN group in each sample area

ACORN GROUP	Wetherby	Garforth
A1	383	0
B5	0	868
D9	696	732
E11	502	210
Total	1,581*	1,810

[Note] A small difference of 67 households was noted between number of households observed on the collection day and the number claimed to be on the collection day by Leeds City Council for the Wetherby sample area.

3.3.2. The Millennium Recycling Scheme Sample Area

The Millennium recycling scheme was located near Cottingley, Bradford, West Yorkshire. This area was chosen as this was one of the few remaining suburban areas in Bradford where households are still served by a rear-of-property sack residual waste collection service and where a specialised wheeled bin collection vehicle was considered to be not feasible. Households also had no history of a kerbside recycling system. The project was responsible for collecting both the residue and recyclables for the 6-month period to ensure an accurate data set and allow detailed tests to be performed. Plastic sacks used on the Millennium Scheme with a 140-litre wheeled bin ensured it was relatively easy to lift and handle the material for collection.

An ACORN category D9 enclosed estate was chosen to facilitate comparisons with Paper Chain and eliminate socio-demographic bias. Monitoring took place from 10th May to 9th November, 2000.

3.3.3 Participatory Performance

Both schemes were monitored throughout the scheme implementation phase. Addresses of households who had set their recycling container at the kerbside on the collection day were recorded for the first 8 weeks. This allowed participation and set-out levels to be calculated for each sample area (DETR, 1999). Monitoring over an 8-week period allowed the research to test claims in previous research (Tucker et al 1997a) that a 4-week period is insufficient to identify the total number of participating households, especially on a bi-weekly collection.

The same Paper Chain sample areas were also monitored over an 8-week period c.5 months after the scheme had been operating (1st September to 21st October). This was to identify any changes in participation frequency, households who had joined the scheme late or dropped out over the recommended 3-month period (Tucker, 1999a) allowing levels to stabilise. Recording

addresses enabled comparisons between participatory behaviour and questionnaire responses (i.e. attitudes and claimed behaviour) to be made and ACORN classifications to be assigned.

Figure 3.6 and 3.7 illustrates how households were classified in relation to their observed set out behaviour following the schemes' introduction. Participation was monitored during 2 separate periods for Paper Chain, but throughout the 6-month period for Millennium. Eight weeks after implementing the Millennium scheme, household participatory behaviour was classified into different categories from which the residual waste fractions were subsequently collected and weighed separately on each collection (figure 3.7).

Figure 3.6 Characterisation of participatory behaviour on the 'Paper Chain'

Plastic Re-usable recycling sack delivered to every household with an information leaflet

Retained the recycling sack in preparation for the scheme

Disposed of the recycling sack or retained for other personal use

In the first two 4 week periods had households set out at least once?

Never set out

Yes → ***Participant***

No → ***Non Participant***

In the two 4 week periods 6 months after the schemes introduction had households set out at least once?

In the two 4 week periods 6 months after the schemes introduction had households set out at least once?

Yes → ***Committed Participant***

No → ***Dropped Out***

Yes → ***Participated Late***

No → ***Non Participant***

Figure 3.7 Characterisation of participatory behaviour on the Millennium Scheme

Green bin delivered to every household

Retained the green bin or opted to use a recycling sack instead of the bin.

Returned the green bin

In a 4 week period had set out at least once

In a 4 week period had not set out

Never set out

Participant Set Out

Participant Non Set Out

Non Participant Non Set Out

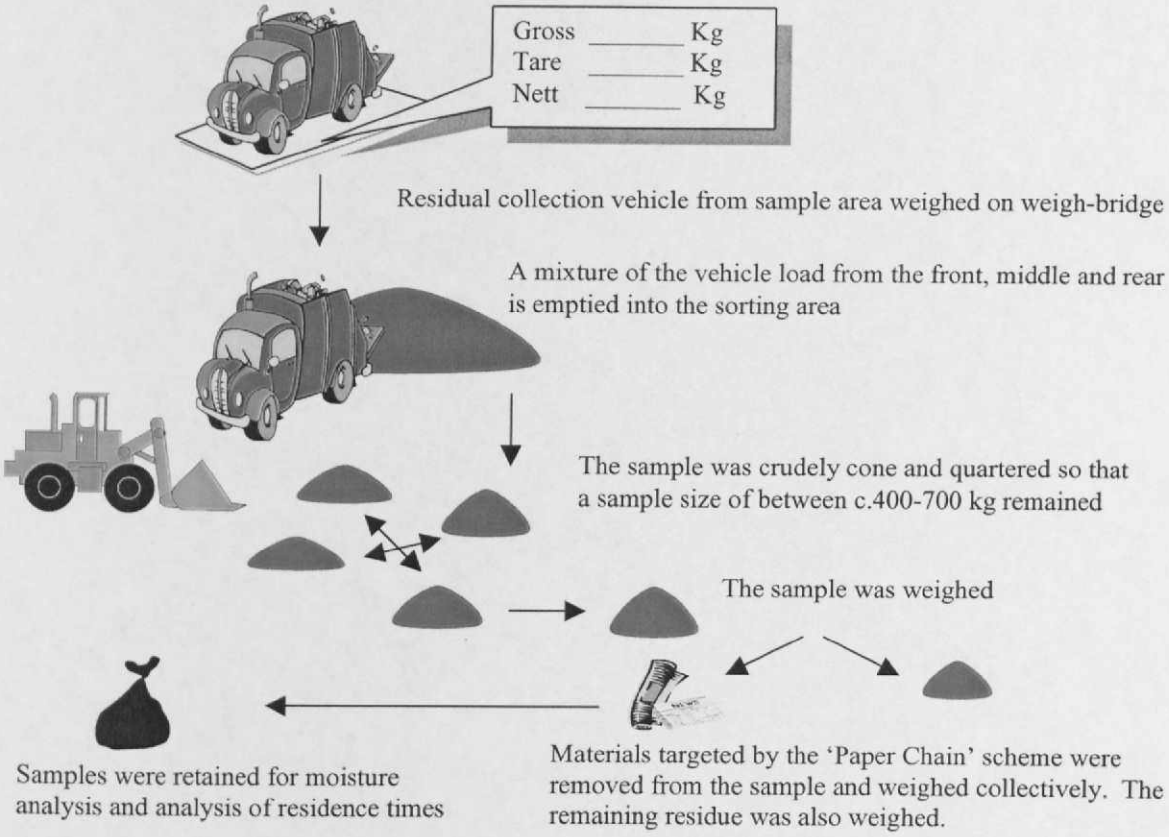
Absolute Non Participant

3.3.4 Waste Analyses – Paper Chain

A series of waste audits were carried out at the Seacroft waste transfer station (residual) and Thorpe Arch household waste site (recyclables).

Residue Fraction – Four separate waste audits were undertaken for each sample throughout the 6-month monitoring period to identify the percentage of targeted materials in the residual waste. Each audit followed the same protocol (figure 3.8). Both Wetherby and Garforth audits were completed during the same periods to minimise any seasonal variations. A total of three replicate samples were analysed on each audit day for each area and an average composition calculated.

Figure 3.8 Sampling procedure for sorting the 'Paper Chain' residual fraction



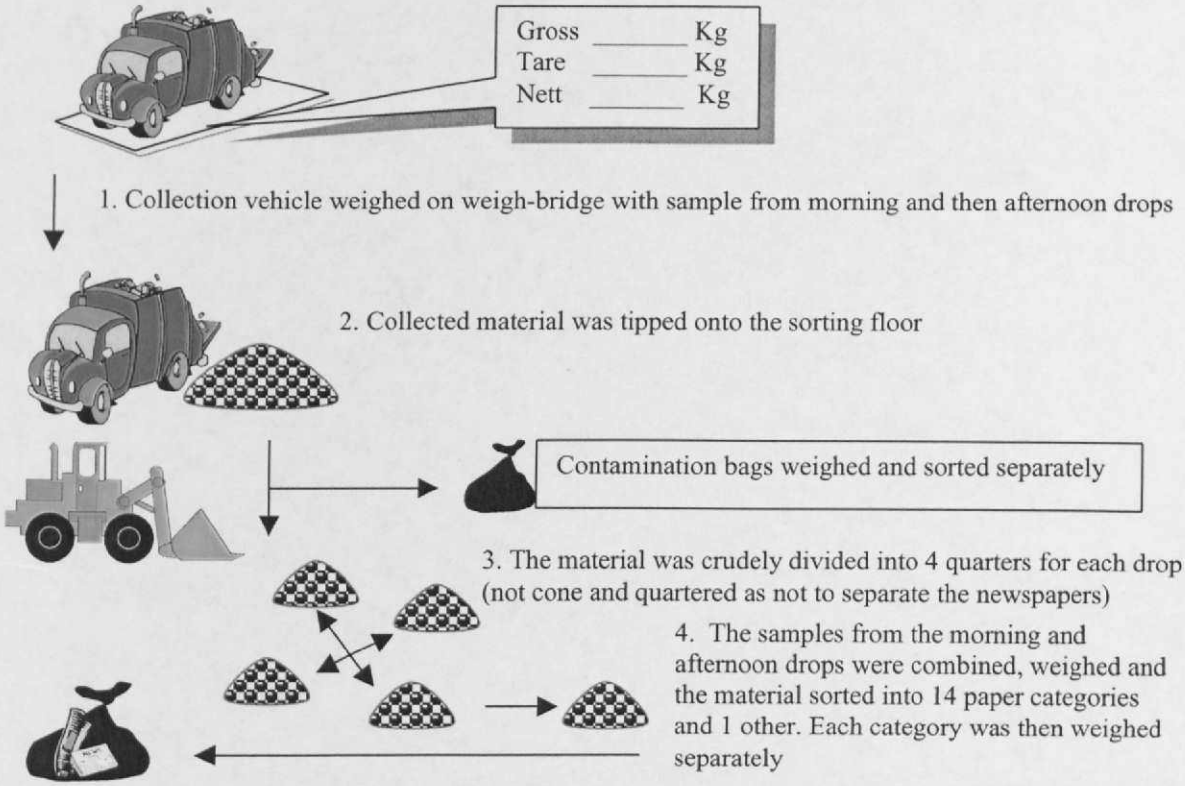
Each of the four waste audits were carried out at different stages during the six month monitoring. The first audit provided a baseline, prior to scheme introduction and before the information leaflet identifying the quantity of targeted materials in the residual waste without any kerbside scheme in operation so that the effect of 'Paper Chains' introduction could be identified. This would also highlight the effect of any additional material previously recycled at bring facilities re-entering the system. The second audit was carried out c.1-week after the delivery of the information leaflet but before the scheme started. This enabled an assessment of the leaflet's affect on household residual disposal behaviour, i.e. households retaining targeted

materials in preparation for the scheme. The third audit was undertaken following the scheme's introduction, whilst the fourth audit was undertaken approximately six months after the scheme was introduced.

Weekly residual collection round weights were recorded by Leeds City Council for each of the sample areas using vehicle numbers. Although every effort was made to retain the same collection vehicle throughout the six-month monitoring period and to note any changes made to ensure accurate diversion levels, the logistical problems for the local authority associated with day-to-day contingencies would introduce an element of data uncertainty. Comparing local authority weight data with compositional (residual and recyclables) and participation data allowed material diversion/recovery levels and participation efficiency to be calculated.

Recyclable Fraction – Two waste audits of the collected recyclables from both Wetherby and Garforth were undertaken during the same corresponding weeks to residual audits 3 and 4. The protocol adopted is shown in (figure 3.9).

Figure 3.9 Sampling procedure for sorting the 'Paper Chain' recyclable fraction



Two compositional audits of a paper bank located in Rothwell outside of the sample area were completed during the same period to establish if the two recycling methods were used

differently. Households within the catchment area of this bring site were not served by a kerbside scheme. In addition whilst households on Paper Chain have specific instructions on what paper fractions to recycle, the paper bank did not. Following the audits, newspapers were sorted into a further 6 categories and the date of each newspaper recorded to calculate residence times.

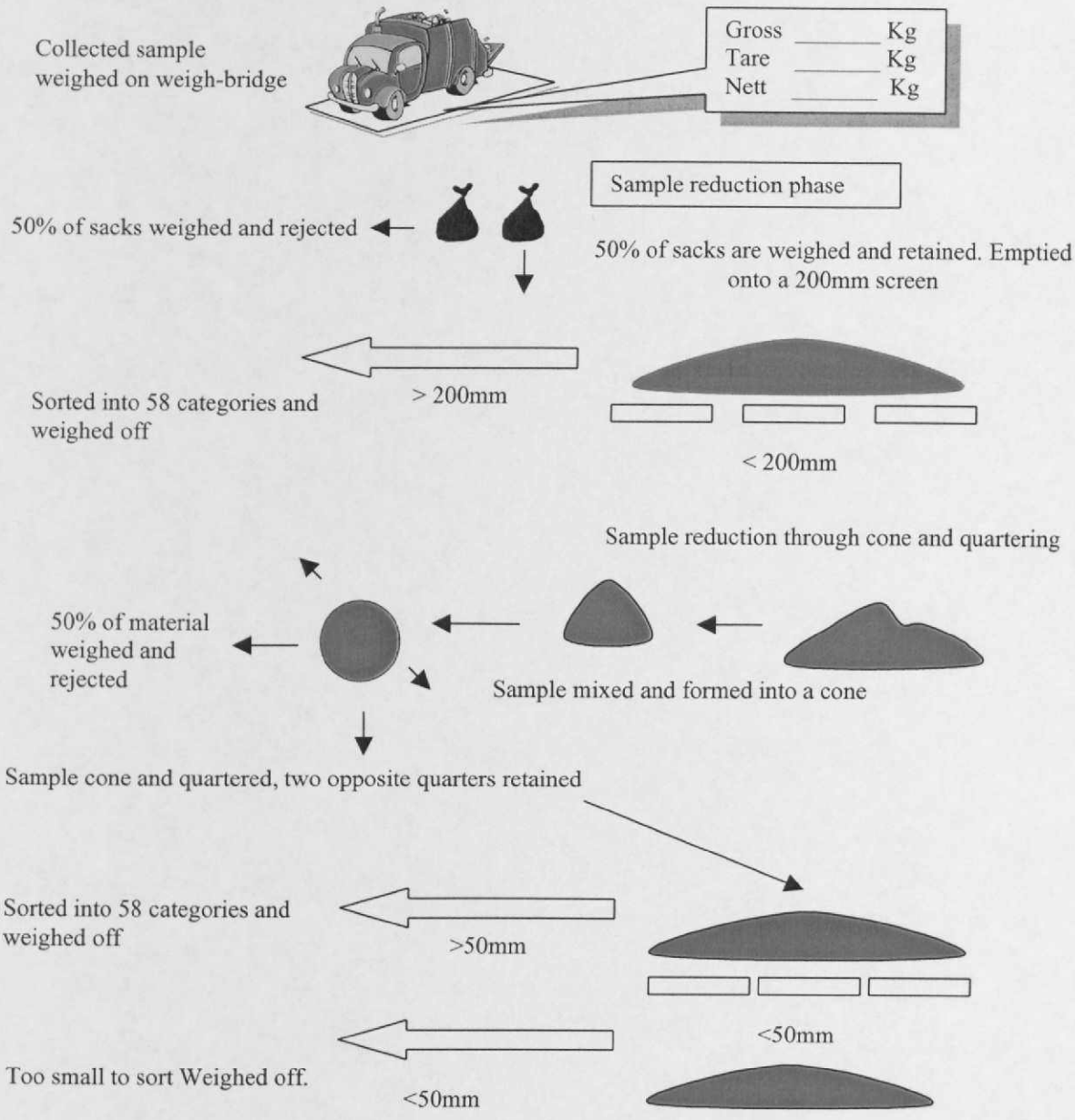
3.3.5 Waste Analyses – Millennium

Separate collection of the residual and recyclable fraction allowed waste arisings and recovery levels to be calculated. The residual fraction was collected, sorted and weighed prior to the scheme instruction leaflet, and before the scheme began, to quantify their effect on waste arisings. When compositional audits were not undertaken, a weigh bridge ticket was obtained at Bowling Back Lane MRF, Bradford and the residue fraction disposed of. The recyclables were tipped onto the MRF sorting floor to remove the glass fraction by hand before processing the material through the normal MRF operations as glass is not sorted/processed under the current MRF operation.

A common sampling procedure was adopted for all residue waste audits (figure 3.10), differing only in the number of waste categories sorted and the initial sample reduction dependant on the manageability of the quantity of waste collected. Sample sizes after the sample reduction phase varied between c.130kg and 290kg. A total of 15 residual sorts and 6 recyclable sorts were undertaken at specific stages of the project, and, in relation to households participatory behaviour, which varied in the number of sub-categories to which the material was sorted. Specific sorts on the residual fraction were undertaken in relation to household's participatory behaviour throughout the scheme. This was to identify as to whether the compositions of the waste varied. However, the overall composition of the residue and recyclables and the recovery of materials could always be calculated on a scheme basis throughout the 6-month sampling period.

All collected recyclables were sorted. Following sorting, the material was processed through the MRF as part of the contractual agreement with Bradford Metropolitan Borough Council. Sample sizes varied between 660kg and 1020kg.

Figure 3.10 Sampling procedure for the 'Millennium' scheme



3.3.6 Waste Analyses SORT

Waste compositional data collected during the European funded REMECOM (Reseau de Measurees pour la Characterisation des Ordures Menageres) project was used to identify the composition of the collected residual and recyclables waste. Only 'campaign 5' data was used for this research, which was undertaken over a period of two weeks in October 1997, and focused on 6 areas served by the sort scheme. A total of 407 households residue and recycling bin were analysed. Household ACORN classification varies between these 6 areas. Waste samples were collected from 14 separate collection rounds and combined into 6 postcode areas. This allowed waste compositions and diversions to be assessed in relation to selected ACORN groups.

3.3.7 Questionnaire Sampling

Questionnaires have been deemed to be powerful scientific instrument and a relatively simple method of collecting a range of data (Shaughnessy and Zechmeister, 1997). When designing the questionnaires, the principles identified, particularly by Oppenheim (1979), Youngman (1979), Foster and Parker (1995) and Parfitt (1997) were reviewed and adhered to. A total of 325 (Garforth – 142, Wetherby - 121, Cottingley – 62) households were interviewed with questionnaires administered (door to door) and 450 (Garforth – 212, Wetherby – 153, Cottingley 85) postal questionnaires were collected. Households within the Millennium sample area were re-visited if there was no response to increase the sample size, as only a maximum of 143 households could be approached compared to c.3,500 in the 'Paper Chain' area. For the advantages / dis-advantages of delivery methods refer to Parfitt (1997). Households within the waste analysis sample areas were approached for comparative purposes.

Pilot studies were undertaken on all questionnaires to ensure the questions posed were clear and understood by the respondents (Foster and Parker, 1995). Addresses were recorded at the top of questionnaires to enable 1) comparisons with participation data to identify potential attitude-behaviour relationships, 2) allow comparisons to be made between self reported and observed behaviour, 3) enable the enumeration district of each household to be identified and allow an ACORN class to be allocated.

The two-sided pre-scheme questionnaire (see appendices) was divided into 3 parts, 'recycling behaviour', 'attitudes and opinions' and 'personal details'. Other questionnaire surveys and designs within the literature were reviewed and similar questions asked to enable responses to be compared.

Pre-scheme questions enabled existing 'bring' behaviour and the attitudes and demographics of recyclers/non-recyclers were identified. Comparisons of the questionnaires would allow differences/similarities between the sample areas to be identified and compared with other national research findings. This would demonstrate if household attitudes and claimed behaviour were typical of the population as a whole. If consistent, then any changes in attitudes or behaviour would be a result of the schemes introduction and its design and not a result of a special population set.

The aim of the postal questionnaire (see appendices) was to identify household attitudes, opinions and claimed recycling behaviour in direct relation to the scheme provided, as well as overall recycling. Therefore, unlike the pre-scheme questionnaire, different postal questionnaires were used in the 'Paper Chain' and 'Millennium' sample areas. However, a

proportion of the two questionnaires were the same, and certain questions repeated the pre-scheme questionnaire to allow comparisons between sample areas. Any direct changes in attitudes, opinions and behaviours as a result of a particular schemes introduction could also be identified.

Both questionnaires focused particularly on household opinions and claimed behaviour in relation to the kerbside scheme offered to them in order to identify any differences between the schemes, which may arise. Households were requested to identify their participation frequency, their level of satisfaction with the scheme and information offered and what scheme design features they would change. Reasons for not participating within the kerbside scheme and motivators to participate were explored as well as recyclers (participants) reasons for not recycling prior to the scheme's introduction.

Each questionnaire included a specific section focusing on a particular inter-dependant factor of household behaviour. On the 'Paper Chain' questionnaire, households were asked to identify the number and type of free and purchased newspapers/magazines entering the house in the previous week/month. On the 'Millennium' postal questionnaire the section focused specifically on the disposal behaviour and storage location within the property for a selection of recyclable materials.

Although a variety of questionnaire data sets have previously reviewed household's attitudes served by the SORT scheme (Perrin, 1998), sample sizes were relatively small. Due to the resource demand of attaining a large questionnaire data set, a collaborative questionnaire was developed (see appendix 3) with an undergraduate student (Leyland, 2001) to identify attitudes and behaviour of households served by what was perceived to be a poorly maintained scheme. The questionnaire was sent to households in one postcode area so that more direct comparisons with prior waste analyses could make. Unfortunately, as a 3-year period has elapsed between the waste analyses and the questionnaire responses, the validity of direct comparisons is questioned. Sixty-four full responses were collected on an agreed date one week after delivery. The same demographic questions were asked at the end to compare populations.

4.0 Scheme Performance

4.1 Introduction

This chapter will present an overview of the results from each of the three schemes monitored within the thesis; Paper Chain, The Millennium Scheme and the SORT scheme. Results will be presented in the context of, 1) participation and set-out, 2) waste arisings, recoveries and composition and, 3) households attitudes, opinions and claimed recycling behaviour for each scheme.

4.2 The Paper Chain

4.2.1 Participation and Set out Rates

Participation and set out rates in Wetherby and Garforth were monitored for 2 eight-week periods at the start and end of the 6-month trial. The results are presented in table 4.1. Higher participation and set out rates are reported throughout the two separate eight week monitoring periods for Garforth (c.46%) than Wetherby (c.36%). Both levels are comparable to participation levels on other paper only schemes (Tucker et al 1997a, Ball and Tavitian, 1992). Monitoring households participatory behaviour over an eight week period allowed the accuracy of the recommended 4 week period (DETR, 1999c) to be assessed in recognising the true number of households participating in a scheme. The percentage of households who had participated on the scheme at least once during the six month monitoring were also recorded reporting levels significantly higher than the standard DETR participation rate.

The large difference between the DETR participation ratio and the percentage of households who had used the scheme at least once during either of the two eight week monitoring periods, indicates a large proportion of infrequent recyclers. This would be consistent for a scheme that only collects a single easily stored material.

Tucker et al (1997a) suggested the use of multipliers to estimate participation levels from 'spot' set-out measurements due to the large impractical resource demands of monitoring household behaviour over long periods. Similar multipliers were calculated on the Paper Chain (tables 4.2 and 4.3). Multipliers were identical between the two sample areas despite different set out rates, and were almost identical to multipliers calculated by Tucker et al (1997a). Such similarities would suggest a distinctive relationship between set out and participation on paper only schemes.

Table 4.1 Garforth and Wetherby Set out and Participation Data (First 6 months of Paper Chains operation 1999)

	Wk	Date	Number of hh's set out on a given week	Set out Ratio (%)	DETR Participation Ratio (%)*	Bi-weekly Participation Ratio (%)**	6 Monthly Participation Ratio (%) ***
Wetherby (1,648 hh monitored)	1	28/4	455	27.6	37.0	46.2%	55.4%
	3	12/5	382	23.2			
	5	26/5	433	26.3	36.2		
	7	9/6	398	24.2			
	19	1/9	440	26.7	36.1	42.5%	
	21	15/9	471	28.6			
	23	29/9	485	29.4	35.0		
	25	13/10	406	24.6			
Garforth (1,810hh monitored)	2	6/5	683	37.7	49.0	56.3%	67.1 %
	4	20/5	588	32.5			
	6	3/6	514	28.4	42.4		
	8	17/6	554	30.6			
	20	9/9	636	35.1	46.9	54.2%	
	22	23/9	642	35.5			
	24	7/10	625	34.5	45.0		
	26	21/10	537	29.7			

* Percentage of households (hh) who had set out their recycling sack at least once within a 4-week period.

** Percentage of households who had set out their recycling sack at least once within an 8-week period.

*** Percentage of households who had set out their recycling sack at least once within either the first or second 8-week monitoring periods.

Table 4.2 **Multiplier from Weekly Set-Out Rates to DETR and Bi-weekly Participation Ratios**

	DETR Monitoring Period		Bi-Weekly Monitoring Period	
	Mean Multiplication Factor	S.D	Mean Multiplication Factor	S.D
Garforth	1.4	0.1	1.7	0.2
Wetherby	1.4	0.1	1.7	0.2

Table 4.3 **Multiplier from DETR to Bi-weekly Participation Ratios**

	DETR Monitoring Period	
	Mean Multiplication Factor	S.D
Garforth	1.2	0.1
Wetherby	1.2	0.0

In both sample areas the DETR and bi-weekly participation ratio decreased slightly during the six-month period. Initially this suggests only a small percentage (c.5%) of households stopped participating / dropped out of the scheme. However, comparison of individual participants addresses throughout the six month period shows that the true number of households no longer participating could have been masked by many households joining the scheme late (table 4.4). If it is assumed that non-set-out over the eight week period indicated either true 'drop out' (in the second period), or, true 'new starts' (only monitored in second period), c. 12% of households stop using the scheme and c.10% of households appear to start participating several months after the schemes introduction.

Table 4.4 **Households 'Opt In' and 'Opt Out' Participatory Behaviour**

	Total Number of Households Monitored in Sample Area	Number of Households Participated in Both Periods	Number of Households Participated in 1st 8 Week Period Only	Number of Households Participated in 2nd 8 Week Period Only
Garforth	1810	788 (43.5%)	232 (12.8%)	194 (10.7%)
Wetherby	1648	549 (33.3%)	212 (12.9%)	152 (9.2%)
TOTAL	3458	1337 (38.7%)	444 (12.8%)	346 (10.0%)

Such 'shadowing' of drop-out behaviour may be associated with the introduction of a paper only scheme, but can not be sustained over an indefinite period where participation levels would eventually decrease by c.13%, suggested by the number of households only participating in period 1. In the long term, this fluctuation would be expected to settle down with a lower drop-out and lower start-up rate of new recyclers.

This phenomena was compared to households ACORN classification in an attempt to identify any socio-demographic effect relationship (table 4.5). No significant relationships could be identified with the exception of 1) a lower proportion of E11 households sustaining participation throughout both periods compared to the other groups and 2) the higher proportion of D9 households joining the scheme in period 2 than those dropping out of the scheme.

Table 4.5 Households 'Opt In' and 'Opt Out' Participatory Behaviour in Relation to Their ACORN Grouping

	A1 (383)	B5 (868)	D9 (1428)	E11 (712)
Participated in Both Periods	166 (43%)	349 (40%)	586 (41%)	220 (31%)
Participated in Period 1 Only	55 (14%)	135 (16%)	165 (12%)	81 (11%)
Participated in Period 2 Only	28 (7%)	64 (7%)	189 (13%)	64 (9%)

The data reports differences in participatory behaviour between the DETR and Bi-weekly monitoring period. However, the Bi-weekly period appears to be more reflective of true participation. Although comparisons with other data were made for both participation periods, relationships are more noticeable with the Bi-weekly period and, unless otherwise stated, further comment will refer to this monitoring period.

Normative influence was not directly tested or monitored within this thesis. However, a distinct variation in participation levels between streets within the sample areas was evident (figure 4.1 and 4.2) which may suggest influential behaviour patterns within streets.

However, both areas report a relatively normal distribution and there is no significant change in the pattern of distribution for either sample areas over the four periods. Wetherby possibly demonstrates a weak shift in the 30-50% intervals, but no strong relationship is evident. If normative influences were having an effect, participation levels would begin to level out in either direction over the periods. This is not the case.

Figure 4.1 Garforth DETR Participation by Street

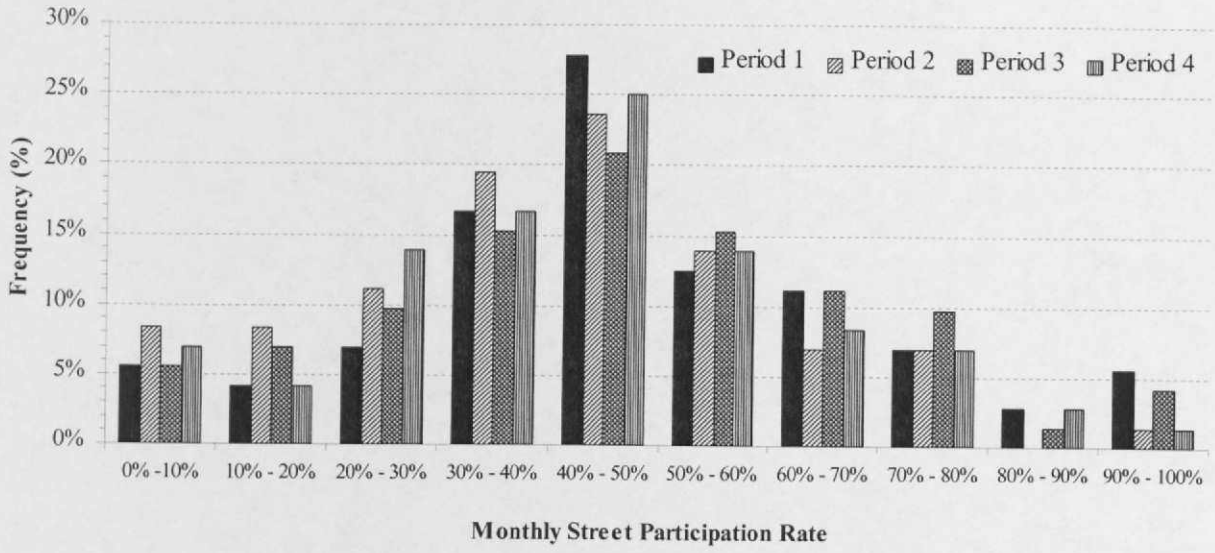
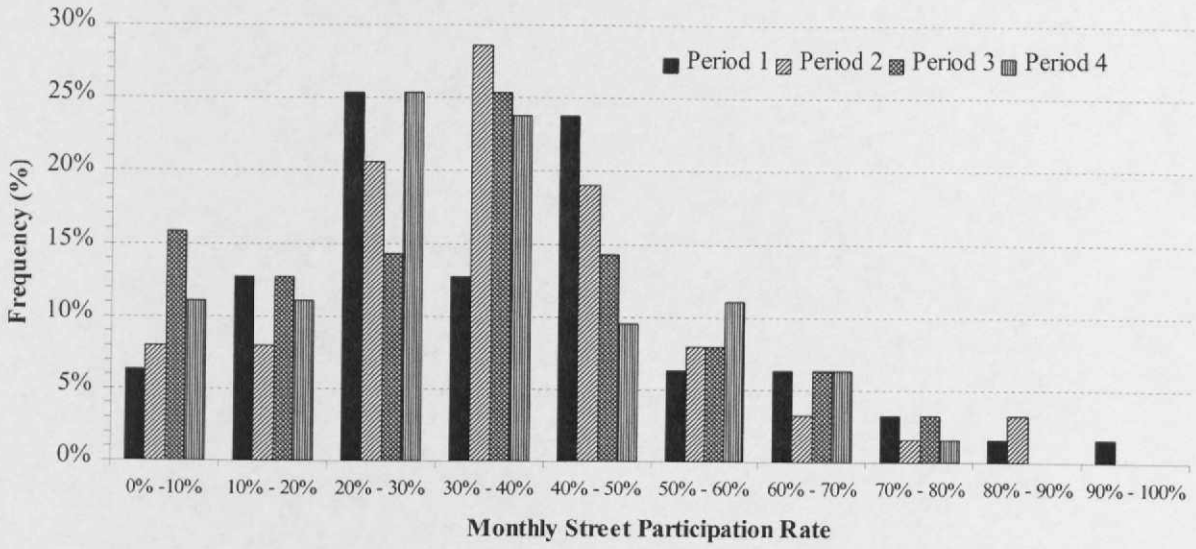


Figure 4.2 Wetherby DETR Participation by Street



In order to further investigate the effect of normative influences on participation levels, households were categorised according to their street type (table 4.6 and 4.7). No significant differences were noted other than slightly higher observed participation levels on through roads than cul-de-sacs, regardless of the monitoring period in the Garforth sample area. This may reflect the greater exposure of the recycling bags set out on through roads to other residents travelling through the sample area than cul-de-sacs. Lower levels were noted on main roads for both sample areas. No significant patterns were noticed in the Wetherby sample area.

Table 4.6 Effect of Street Type on Mean Participation Ratio (Garforth)

Street Type	Number of Households Served	DETR Period		Bi-Weekly Period	
		Mean Number of Participating Households	Participation Ratio	Mean Number of Participating Households	Participation Ratio
A = Small thru road (<20hh)	68	21	31.4%	41	60.3%
B = Long thru road (>20hh)	608	196	32.2%	350	57.5%
C = Small Cul-de-sac (<20hh)	389	121	31.0%	220	56.4%
D = Long cul-de-sac (>20hh)	716	207	28.9%	380	53.0%
E = Main Road (>20hh)	29	9	29.3%	15	51.7%

Table 4.7 Effect of Street Type on Mean Participation Ratio (Wetherby)

Street Type	Number of Households Served	DETR Period		Bi-Weekly Period	
		Mean Number of Participating Households	Participation Ratio	Mean Number of Participating Households	Participation Ratio
A = Small thru road (<20hh)	127	45	35.4%	58	45.7%
B = Long thru road (>20hh)	848	317	37.4%	388	45.8%
C = Small Cul-de-sac (<20hh)	155	46	29.4%	61	39.4%
D = Long cul-de-sac (>20hh)	321	123	38.2%	154	48.0%
E = Main Road (>20hh)	197	63	32.1%	83	42.1%

The method used to classify the streets is subjective, and may be causing bias on the results and hiding any true patterns. It was the not the intention of this thesis to quantify normative influences on recycling behaviour but to merely identify if they could be contributing to any behavioural changes. This does not appear to be the case.

To identify the overall effects of socio-demographics on participation levels, household participatory behaviour was classified according to their ACORN grouping (table 4.8). An attempt to distinguish differences between ACORN types was inconclusive. Differences between ACORN groups would appear to be clearer, although between groups this was marginal. The results suggest that participation levels of E11 households were c.10% lower than other groups. This area is characterised by both council and owner occupied properties. Logical relationships between the two will be discussed later.

D9 households appear to participate at marginally higher levels than the other two groups. These rankings, unlike comparisons with ACORN types, did not vary in relation the participation monitoring period chosen. Overall, D9 households appear to be the better performers, however differences between types within a group are as varied as between the groups themselves. From the ACORN descriptors, reasons can be postulated why participation varies between categories, e.g. the presence of young children, lack of space or time, etc. However, further research is required if such categorisations were to be used in any predictive manner for participatory recycling behaviour.

Table 4.8 Participation in Relation to Households (Wetherby and Garforth) ACORN Classification

Group	Type	No. of hh's Served	Mean No. of hh's Participating	DETR Participation Ratio	Mean No. of hh's Participating	Bi-weekly Participation Ratio
A1	1	141	63	44.7%	78	55.3%
	3	60	18.8	31.3%	24.5	40.8%
	5	182	87.8	48.2%	105	57.7%
	All	383	169.5	44.3%	207.5	54.2%
B5	14	234	118.5	50.6%	144	61.5%
	15	634	251	39.6%	306.5	48.3%
	All	868	369.5	42.6%	450.5	51.9%
D9	26	329	148.3	45.1%	180.5	54.9%
	28	561	286.5	51.1%	335	59.7%
	29	538	217.5	40.4%	261	48.5%
	All	1428	652.3	45.7%	776.5	54.4%
E11	33	712	225	31.6%	293.5	41.2%

4.2.2 Waste Arisings and Recovery

Figure 4.3 and 4.4 show the weekly household weight generation of recyclable and residual waste for the two sample areas calculated from data provided by Leeds City Council. Residual weights were monitored c.3 weeks before households were notified of the Paper Chain scheme to identify any effects of the scheme on waste arisings. Strict controls were not in place until households were informed by the scheme and therefore such baseline weights may be subject to error, e.g. only half of the round was collected, or a backup vehicle was used to substitute the normal collection vehicle etc.

Significant variations in and absence of data points, suggest errors in some of the data provided. This highlights the problem of assessing scheme recovery performance on a collection round basis from data provided by the authority. It also justifies the need for the project to be responsible for the residual and recyclable collections on the Millennium scheme for the entire monitoring period. This ensured data was collected and checked at the point of recording and the option to check on previous collected data when generated.

Figure 4.3 **Material arising and diversions in Wetherby sample area during Paper Chain's first 6 months of operation.**

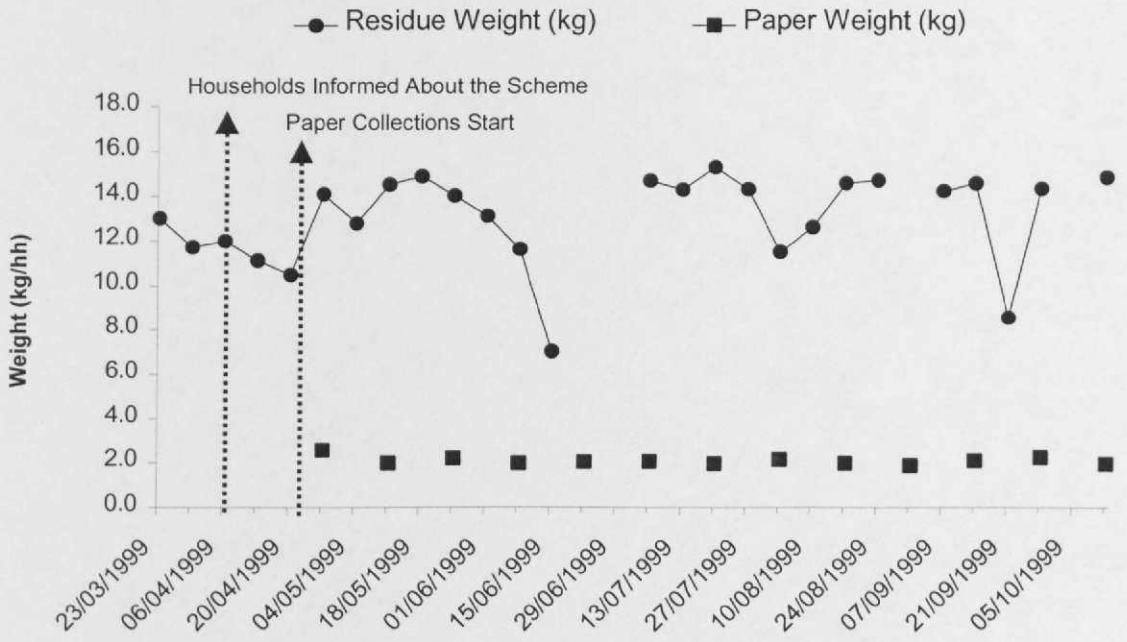
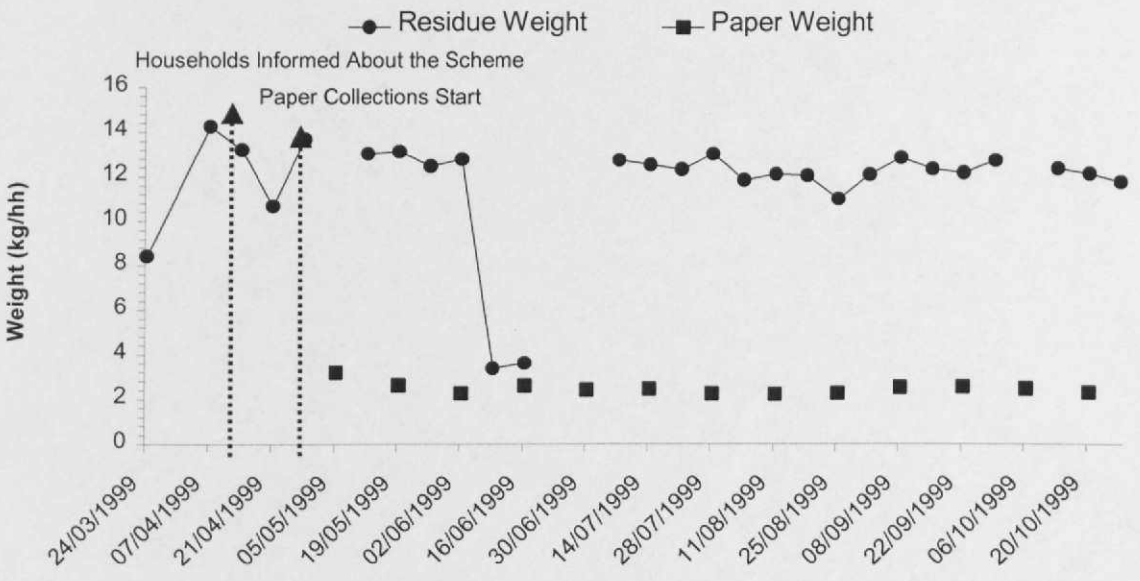


Figure 4.4 **Material arising and diversions in Garforth sample area during Paper Chain's first 6 months of operation.**



The data suggests that waste arisings increased in both areas following the introduction of the Paper Chain scheme. As expected, Wetherby households, on wheeled bins, generated more waste (c.14kg/hh/wk) than Garforth households (c.12.5kg/hh/wk). However, waste arisings for Wetherby households is lower than would be expected in comparison to other national findings on wheeled bin generations, especially considering the socio-demographics of the area. Garforth

waste generation is also low but within the expected range of a sack residual collection (Parfitt et al, 1997; UEA, 2000).

Recovery of targeted materials from the two sample areas throughout the first six months is illustrated in figures 4.5 and 4.6. Both areas show an initial 'high' during the first few weeks of the scheme with slight fluctuations throughout the remaining six month period. Garforth households recovered more materials (c.1.3kg/hh/wk) than Wetherby households (1.1kg/hh/wk). Figure 4.6 suggests that the amount of recovered material was on a decline prior to the addition of a new estate to the collection round. Therefore, an accurate assessment of the whole period (and potentially lowest recovery point) could not be identified.

Figure 4.5 Recovery of Targeted Materials from Wetherby sample area.

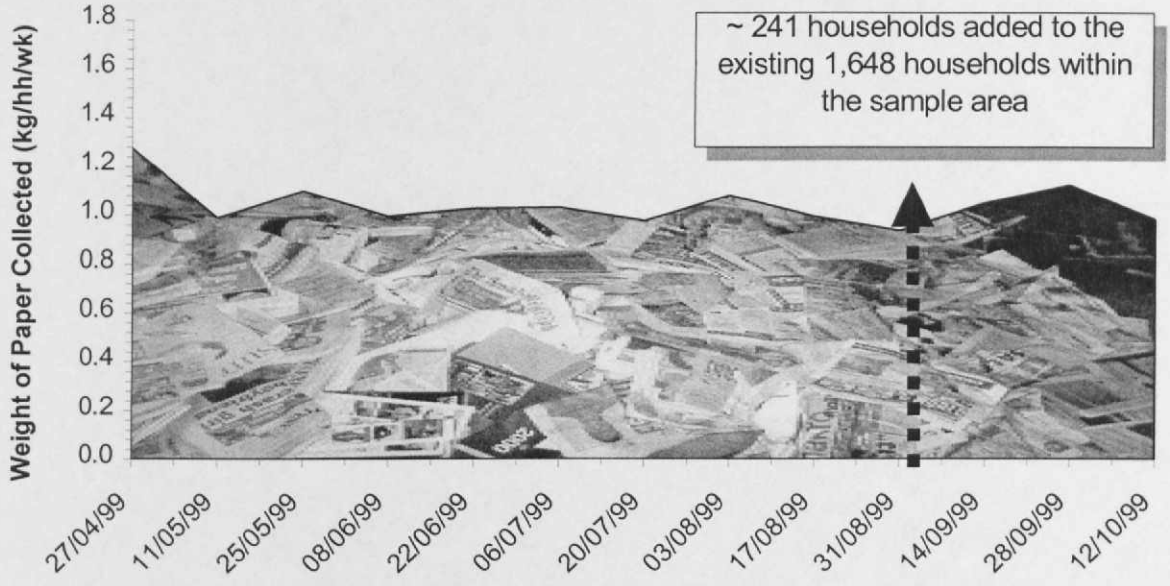
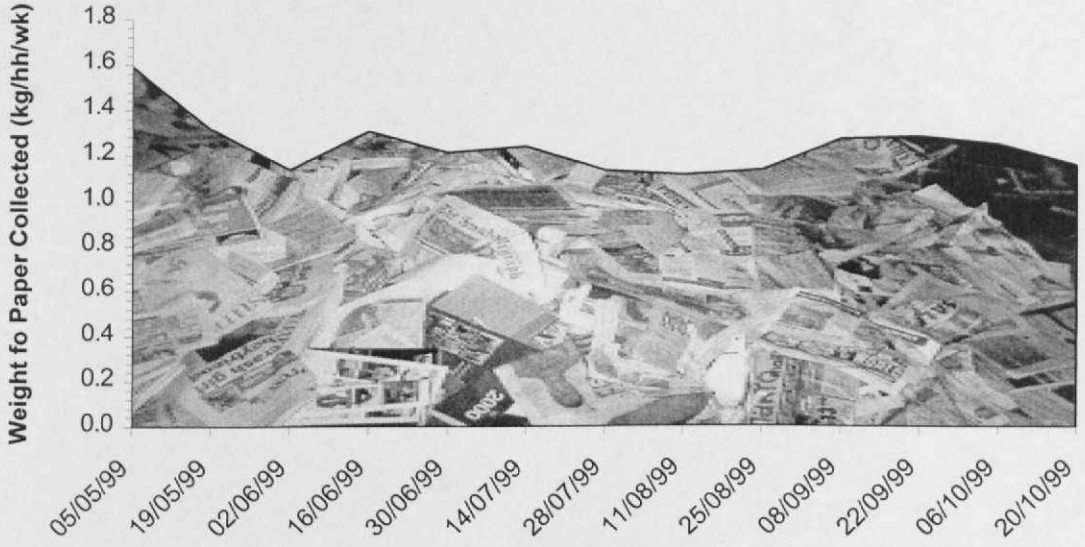


Figure 4.6 Recovery of targeted materials from Garforth Sample Area.



Following waste analyses of the residual and recyclable fraction, the unit weight of targeted materials in each waste stream was calculated (table 4.9). Different quantities of targeted materials in the residue prior to the scheme may be related to pre-existing recycling behaviour. Both areas show an increase in the total weight of newspapers once the scheme has settled, suggesting a transfer of material from bring facilities. The low weights in Wetherby at the start of the scheme may be a result of the data inaccuracies previously identified within the residual weight data, despite using assumed mean weight arisings to compensate for this.

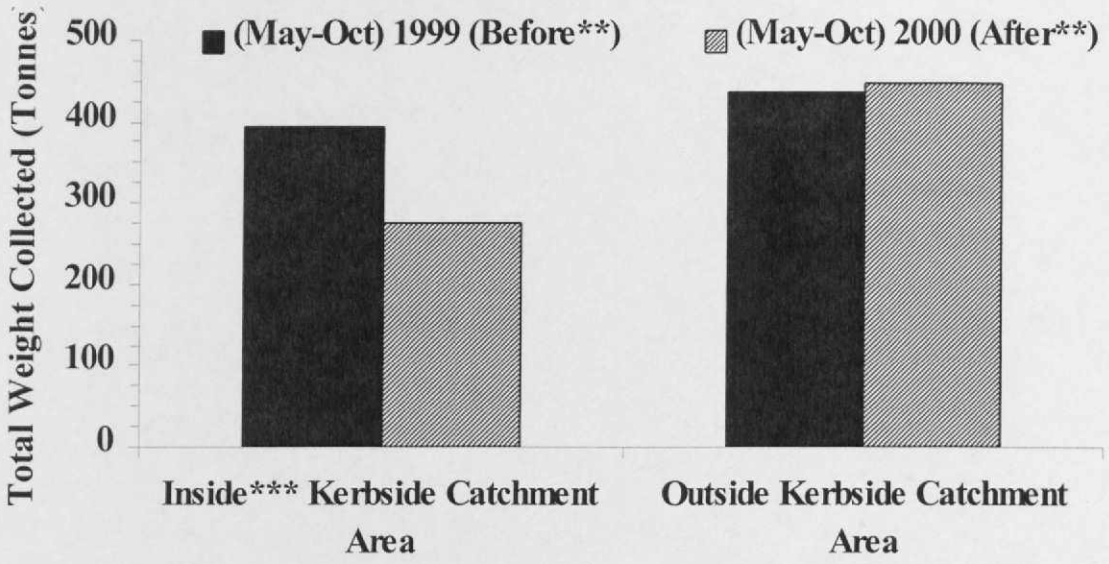
Table 4.9 Unit Weight of Targeted Materials in the Residual and 'Paper Chain' Collection Systems (kg/hh/wk)

		Baseline	After Leaflets	Start of Scheme	c. 6 months After Operation
Wetherby	Residue	1.66	1.14	0.72	1.18
	Paper	0	0	0.98	1.32
	Total	1.66	1.14	1.7	2.5
Garforth	Residue	1.44	1.21	1.26	1.19
	Paper	0	0	1.13	1.09
	Total	1.44	1.21	2.39	2.28

[Note] Diversions based on some assumed mean residual weights due to absence of data

An assessment of paper bank weights within the Leeds area, using data provided by Leeds City Council identified that the recycling scheme could be having an effect on the amount of material recycled through the paper banks. A comparison was made between paper banks located within the Wetherby and Garforth area (not just the sample areas) and the surrounding bring recycling catchment area identified by residents within the questionnaires. Figure 4.7 suggests that the Paper Chain has had an effect on materials recovered from paper banks, which may have been merely transferred to the kerbside scheme.

Figure 4.7 Paper Bank Weights* within the Leeds Area -May 1999 to October 2000



* Incomplete paper bank weights for both periods and unavailable data are excluded from this analysis. The period May to October (1999-2000) were chosen to maximise data availability

** 'Before' and 'After' refer to prior to and after the 'Paper Chains' introduction

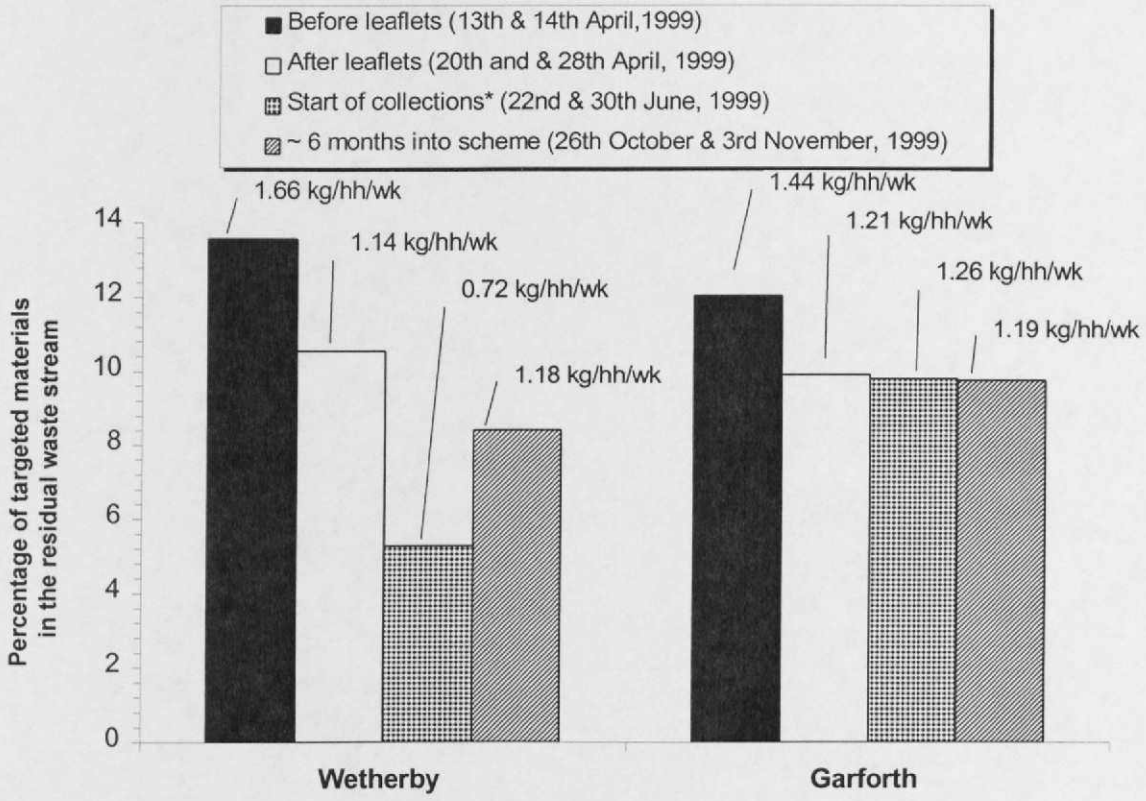
*** Inside the catchment area was defined by paper banks which were located within households claimed travelling distance to bring sites identified in the first questionnaire

4.2.3 Compositional Analysis

Figure 4.8 illustrates the mean percentage of targeted materials within the residual waste from three replicate samples on each of the sorts. Although a significant change in waste arisings is unlikely between the first two sorts, changes were expected over the six-month monitoring period, especially due to the differences in residual collection methods used. Therefore, results from table 4.9 showing calculated unit weights in kg/hh/wk are integrated into the graph.

One of the main points to mention is the decrease in the percentage of targeted materials in the residue following the leaflet calculated from the sub-samples. Initially it would appear that the sub-samples were more accurate than the weight data provided. However, caution must be taken not to misinterpret the data from the latter sorts due to the different residual collection methods between areas and the associated seasonal effects on waste arisings.

Figure 4.8 Quantity of targeted material in the residual waste stream throughout the scheme implementation process

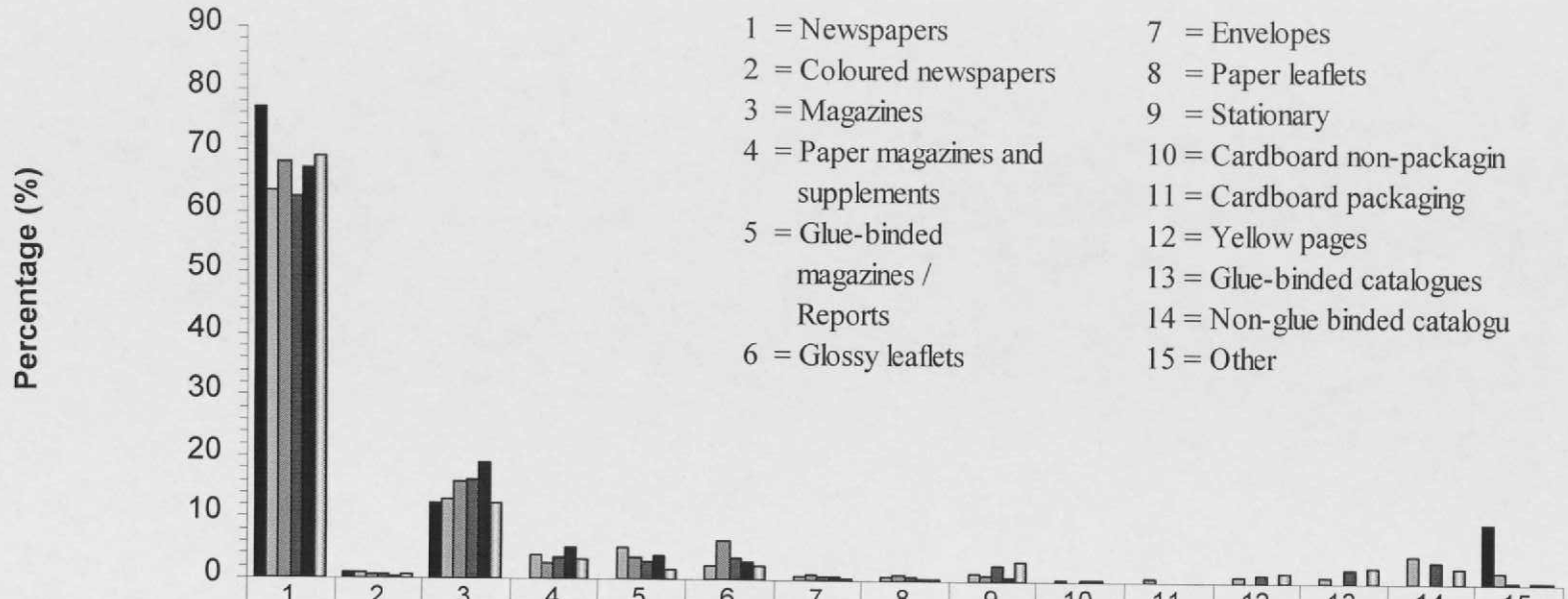


[Note] Start of collections represents c.8 weeks into the scheme to accommodate the initial influx of material into the scheme

Compositional analysis of the paper recycling schemes (figure 4.9) shows that on average 69% of material collected is newspapers and a further 15% magazines. Material and product contamination levels in both Paper Chain areas are similar with a marginal increase over time in the percentage of most non-requested materials / products in both sample areas.

The composition of material collected from the Paper Chain and an independent paper bank are relatively similar despite different levels of promotional and educational material to residents on how to use their given recycling scheme.

Figure 4.9 Composition of 'Paper Chain' Kerbside Sample Areas and Rothwell Paper Bank



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Paper Bank (S1)	76.9	0.92	12.45												9.73
Paper Bank (S2)	63.33	1.00	12.86	3.84	5.16	2.18	0.64	0.51	1.37	0.17	0.78	0.90	0.95	4.52	1.78
Garforth (S1)	67.98	0.63	15.81	2.50	3.53	6.43	0.85	0.85	0.92	0.07	0.11	0.00	0.00	0.00	0.33
Garforth (S2)	62.46	0.52	16.16	3.39	2.80	3.53	0.65	0.66	2.40	0.24	0.08	1.12	2.21	3.62	0.15
Wetherby (S1)	67.21	0.43	19.13	5.05	3.88	2.73	0.52	0.22	0.48	0.17	0.00	0.00	0.00	0.00	0.19
Wetherby (S2)	69.03	0.73	12.22	3.19	1.64	2.13	0.34	0.43	3.08	0.14	0.06	1.73	2.38	2.53	0.35

S1 = Sort 1, S2 = Sort 2. Paper Bank (S1) only sorted into 4 categories. **Sample Sizes = Paper Bank (S1) – 196.36 kg, Paper Bank (S2) – 204.55 kg, Garforth (1) – 136.00, Wetherby (1) – 269.45, Garforth (2) – 481.30, Wetherby (2) – 415.20 kg.**

4.2.4 Residence Times

Storage and handling issues have been shown to be a barrier to participation and potentially a barrier to the effectiveness at which households participate. Recycling a material can often require a comparably longer storage period than choosing to dispose of it. Understanding how long different materials remain within the home, identifying differences dependent on the final disposal/recycling method chosen, is an interesting concept. Certainly it could provide some insight on collection frequency optimisation and is an aspect which should be explored in the future.

Tucker et al (1998) began to address the age distribution of newspapers to explain `leakage` from a kerbside recycling scheme and understanding the mass flows of material through the household. No other published material has addressed the retention period (residence times) of newspapers or other materials and certainly not between disposal options, i.e. residue versus recycling.

Newspapers are unique, as date stamps can identify their duration within the home. Monitoring these dates can identify any differences in residence times between the disposal/recycling method chosen; the duration and storage of other materials storage within the home is not as identifiable. Best before dates provide an indication, although these vary dependent on the product contained. Even then this can be misleading, as the product/material could have been frozen or re-used i.e. jam jars prior to disposal with these dates becoming obsolete. A comparison between all materials would rely on self-reports and the memory of individuals to identify any differences. This would be questionable in its validity. Relying on individuals to remember previous events in detail can be problematic (Foster and Parker, 1995).

To pursue this issue, a practical comparison of the inconvenience levels between materials would require an assessment of the residue and recycling wastes of materials, which are least likely to be diverted or re-used. Other than newspapers, this could only practicably be assessed on a waste analysis basis on a limited number of materials. For example, plastic milk bottles, yoghurt pots, i.e. materials that contain perishable products. This would provide some independent evidence of storage as the product is likely to be used relatively soon after purchase. Sell by dates on plastic bottles (i.e. milk bottles) could be compared from those in the residue, on a plastic kerbside collection and plastic bring sites. Comparing ratios between methods would indicate if households are prepared to store the material and for what period of time. Shorter residence times would be indicative of more storage inconvenience.

Table 4.10 shows the mean, mode and median residence times of newspapers in relation to the route where they were discarded. Figure 4.10-4.19 illustrates the purchase dates of newspapers collected in relation to the collection route and newspaper type. The number of collection opportunities missed are highlighted as this is an important issue regarding recycling. Tucker (2001d) suggests, it is at this point that the householder decides to retain the material for the next collection or disposed. The more opportunities missed suggest the material is more acceptable for storage.

Differences between residue, kerbside and paper bank collections are reported. Residue collections report the lowest mean residence times, followed by kerbside then the paper bank collections. This suggests different storage behaviour in relation to the method chosen and their collection frequency; households are prepared to store their newspapers for longer periods of time if necessary. However, the mean residue residence time for both sample areas is greater than the collection frequency of 7 days. This may result from one of two factors. Firstly households inherently store their newspapers in for example newspaper racks, and the material is not immediately disposed of after use, regardless of the method chosen.

Alternatively, Tuckers (2001d) theory may be applicable where households store their papers, but miss the fortnightly recycling collection, reach their 'maximum threshold' and dispose of them in the normal refuse bin, thus increasing the mean residence time. Household less frequently use of paper banks compared to kerbside recycling due to the additional inconvenience and transportation issues, may result in papers being stored and taken in bulk rather than recycling a small quantity.

Potential collection days have been missed on all methods. This is most evident on paper bank collections and least evident on residue collection. Although a series of analyses could be undertaken using these data, the relevance of these findings to the thesis are that households are willing to and do store newspapers for long periods of time and do not immediately dispose of them. They are prepared (indicated by varying residence times) to store the materials for different periods, depending on the method and the frequency in which they use it. Therefore for a paper only scheme to use a fortnightly or monthly collection is unlikely to cause too many storage implications and a reduction in recoveries.

Table 4.10 Residence times of all newspapers

		Mean	Mode	Median
Sort 1	Garforth Residue	9.8 days	7 days	10-11 days
	Wetherby Residue	8.2 days	7 days	6-7 days
	Garforth Kerbside	16.6 days	13 days	20 days
	Wetherby Kerbside	16.2 days	8 days	11-12 days
	Rothwell Paper bank	22.8 days	27 days	28-29 days
Sort 2	Garforth Residue	10.5 days	6 days	5-6 days
	Wetherby Residue	10.5 days	7 days	6-7 days
	Garforth Kerbside	16.7 days	14 days	12-13 days
	Wetherby Kerbside	11.7 days	12 days	10-11 days
	Rothwell Paper bank	20.5 days	6 days	13-14 days

Figure 4.10 Wetherby Residue Residence Times (Sort 1)

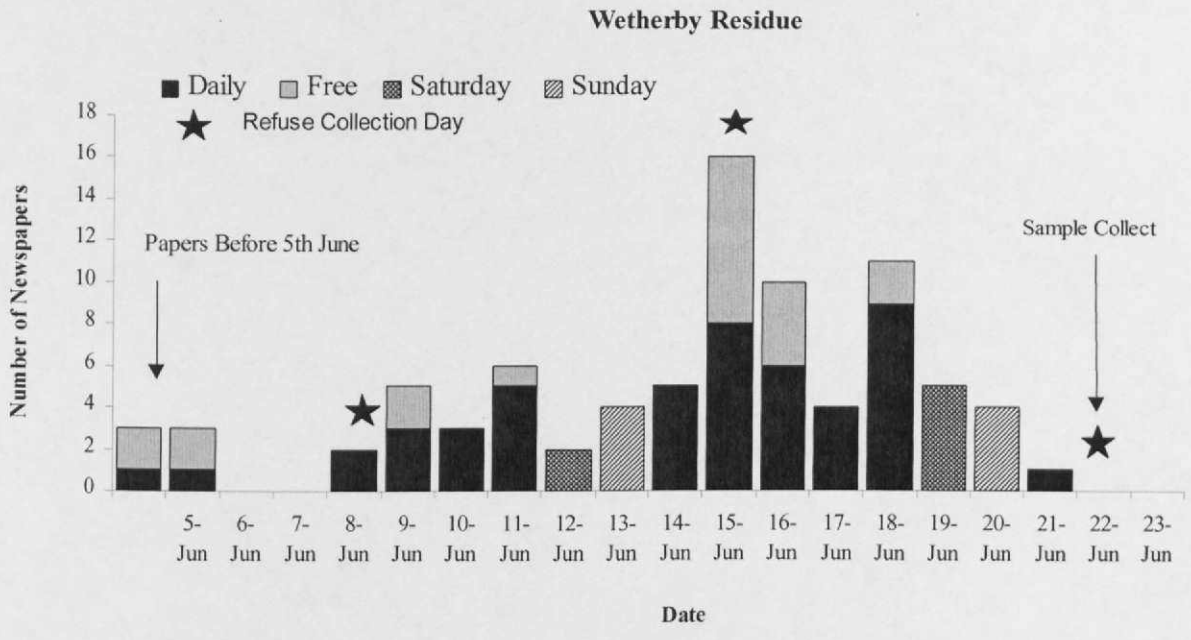


Figure 4.11 Garforth Residue Residence Times (Sort 1)

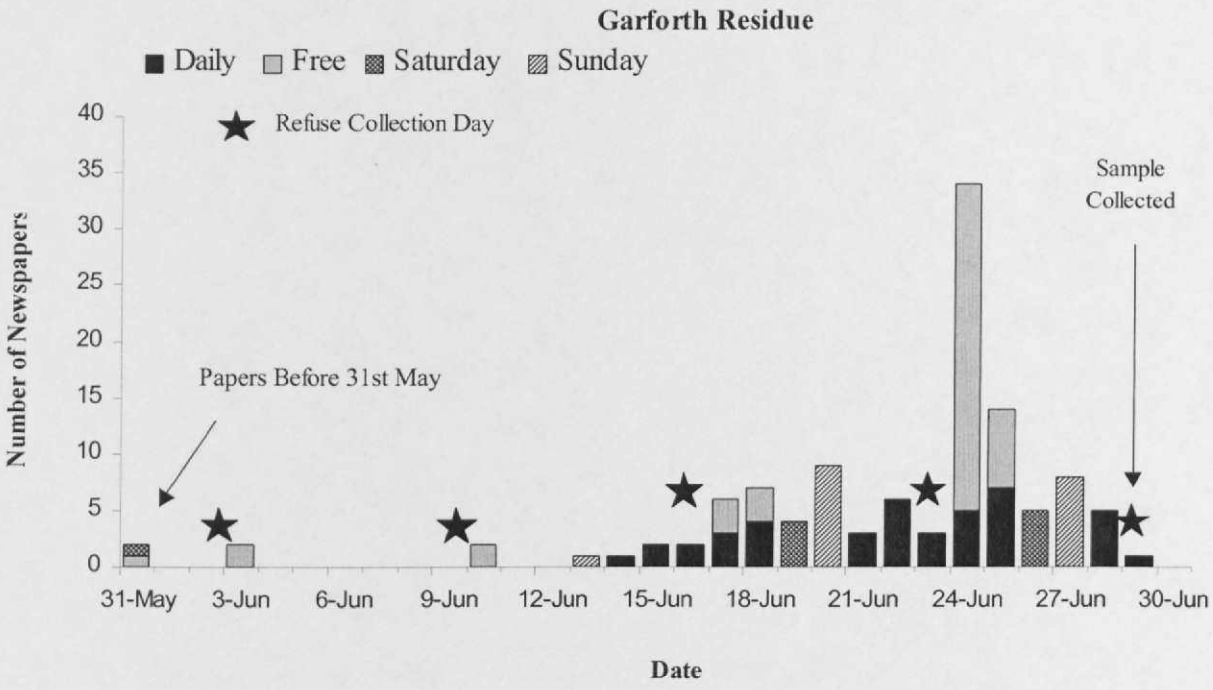


Figure 4.12 Rothwell Paper Bank Residence Times (Sort 1)

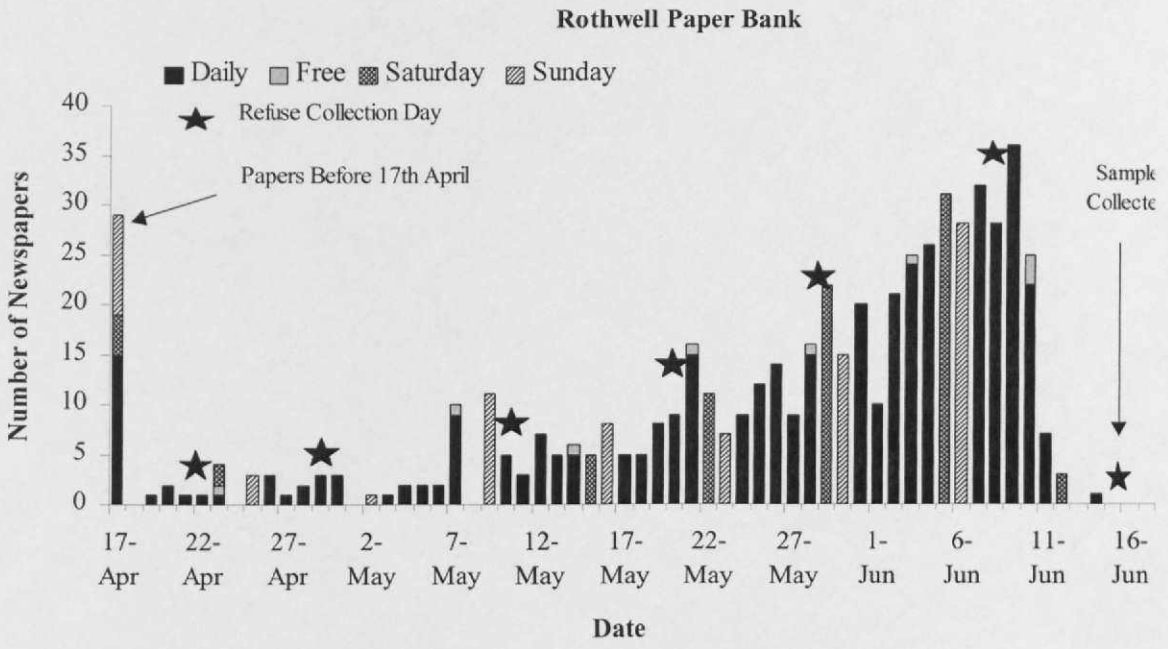


Figure 4.13 Garforth Kerbside Residence Times (Sort 1)

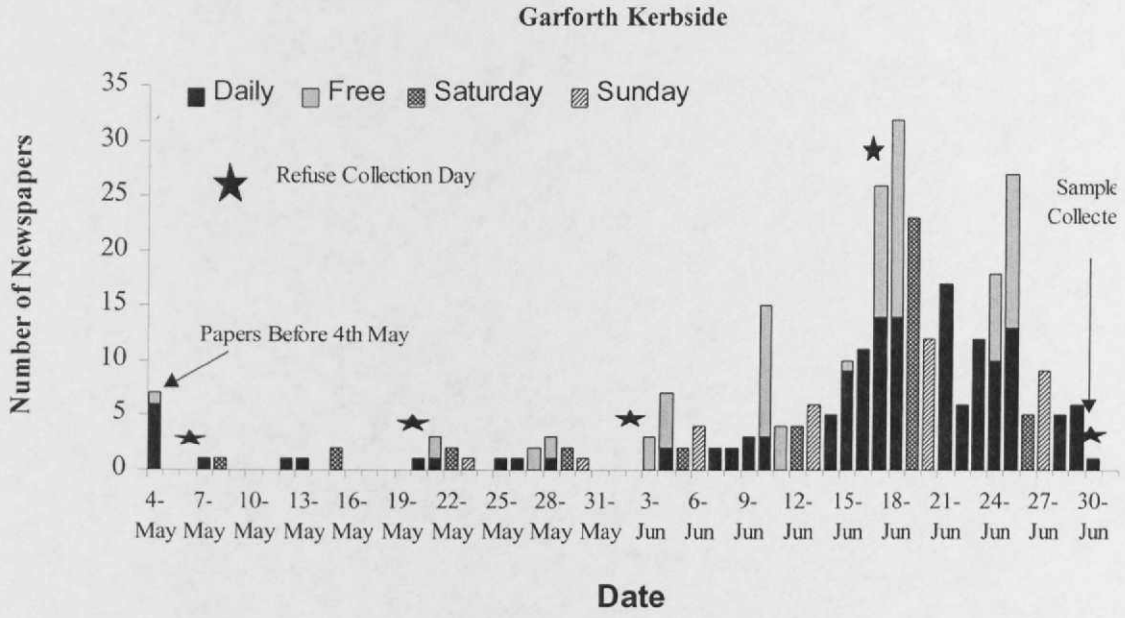


Figure 4.14 Wetherby Kerbside Residence Times (Sort 1)

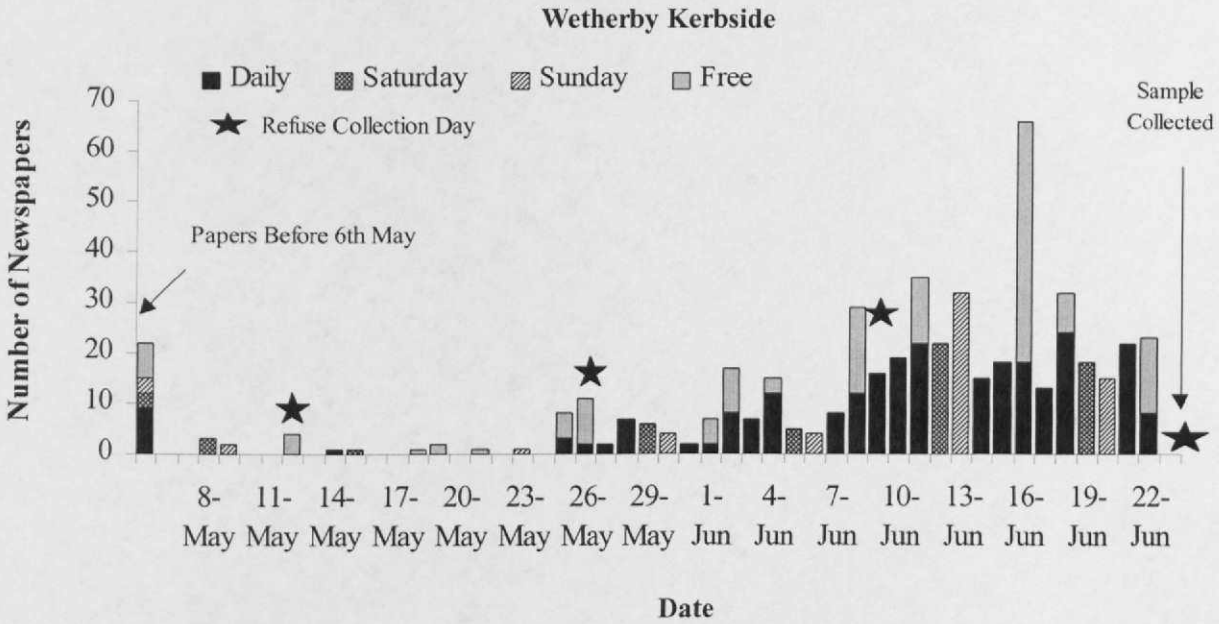


Figure 4.15 Wetherby Residue Residence Times (Sort 2)

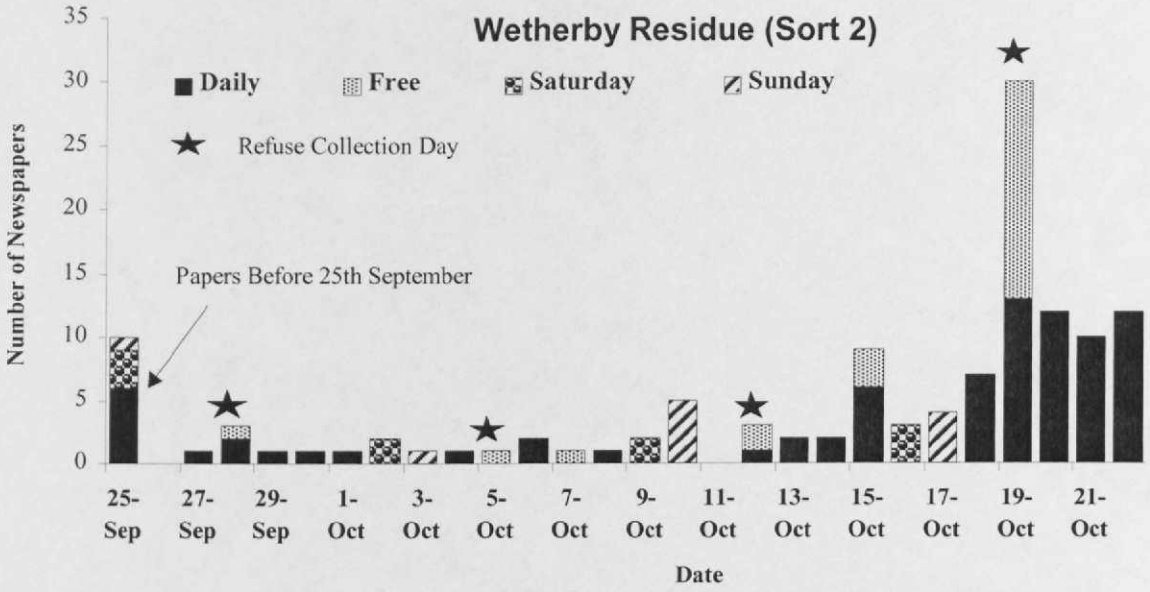


Figure 4.16 Garforth Residue Residence Times (Sort 2)

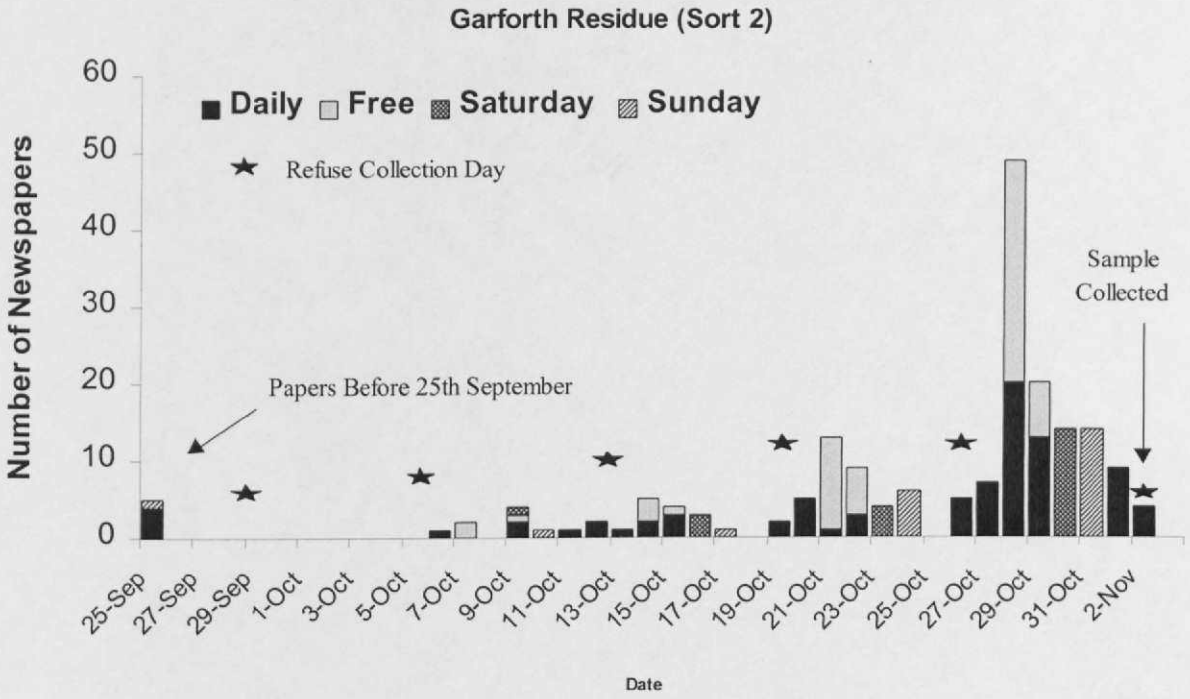


Figure 4.17 Wetherby Kerbside Residence Times (Sort 2)

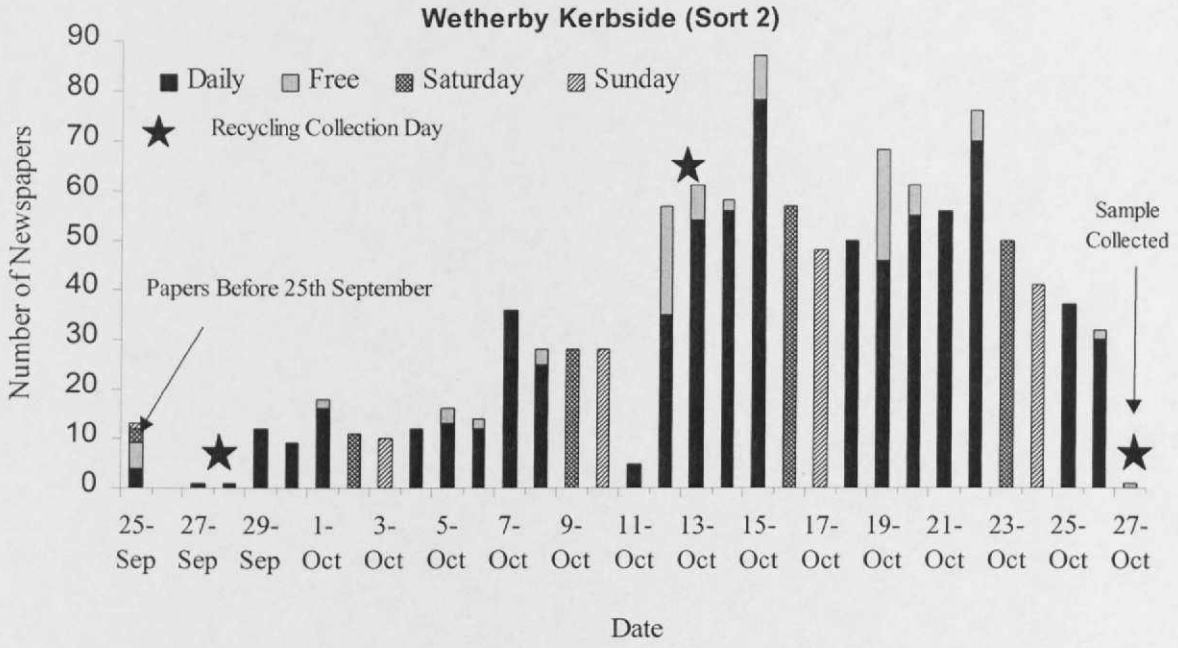


Figure 4.18 Garforth Kerbside Residence Times (Sort 2)

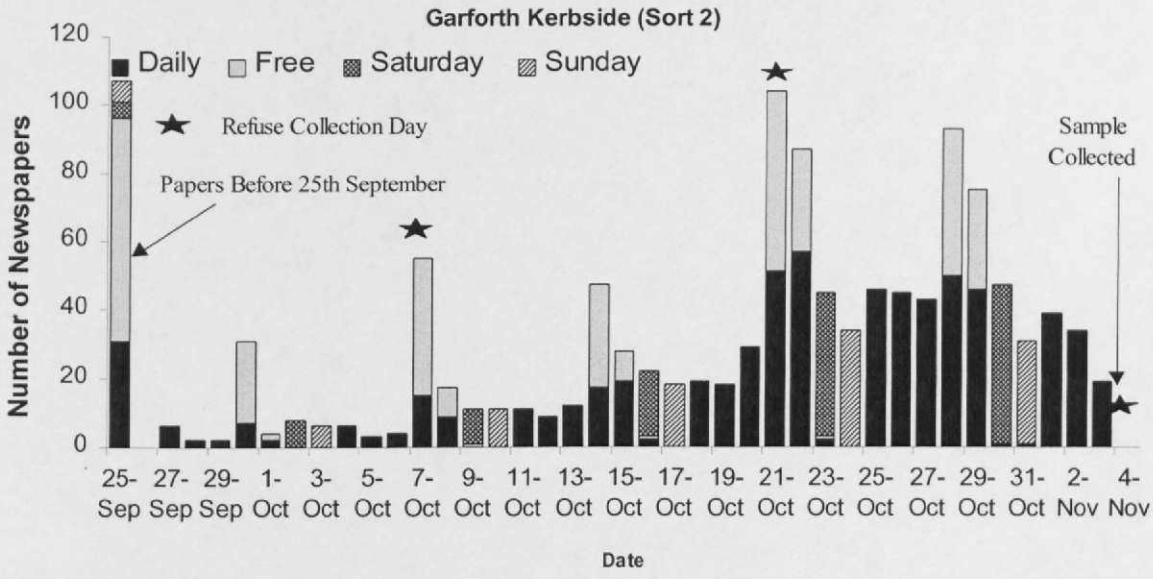
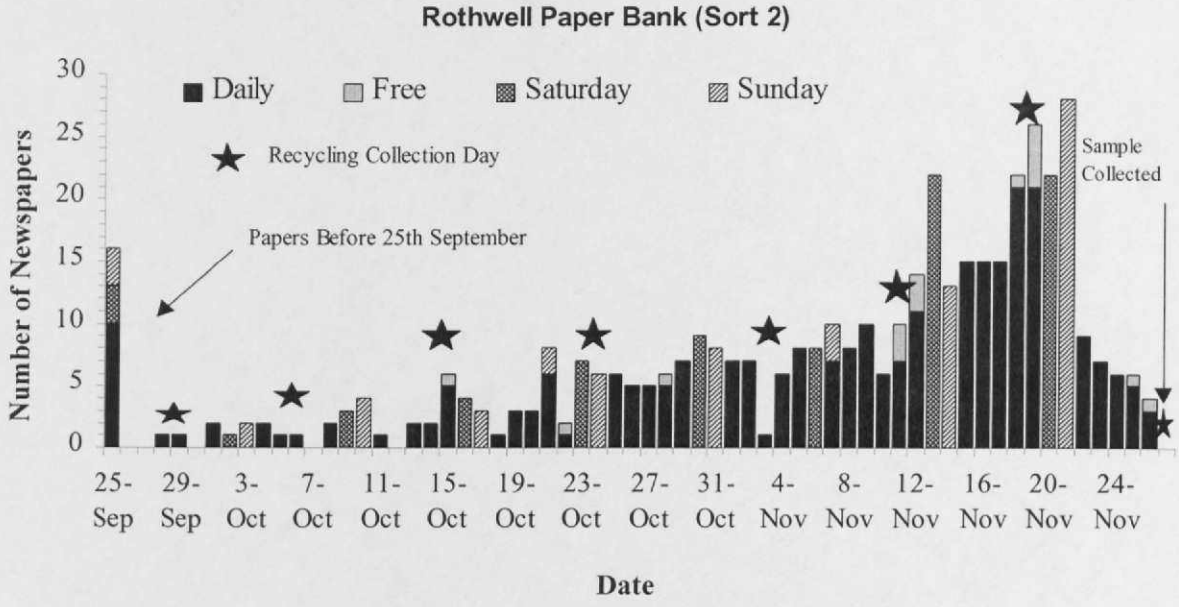


Figure 4.19 Rothwell Paper Bank Residence Times (Sort 2)



4.2.5 Questionnaire Analysis

4.2.5.1 Claimed Recycling Behaviour

Before the Paper Chain scheme was introduced 69.8 % of households claimed to recycle; this increased to 87.3 % following the schemes introduction. Proceeding and after the schemes introduction, a higher proportion of households within the Garforth sample area claimed to recycle, although not all recyclers chose to participate within the scheme (table 4.11).

Table 4.11 Claimed Recycling Behaviour Before and After Paper Chain

			Recycle		
		Don't Recycle	**Scheme participant**	**Scheme Non-participant**	**Total**
Before	**Garforth**	24.5 %	-	-	75.5 %
	Wetherby	38.0 %	-	-	62.0 %
	Total	**30.2 %**	-	-	**69.8 %**
After	**Garforth**	8.6 %	74.6%	16.7 %	91.4 %
	Wetherby	18.8 %	68.8 %	12.5 %	81.3 %
	Total	**12.7 %**	**72.2 %**	**15.0 %**	**87.3 %**

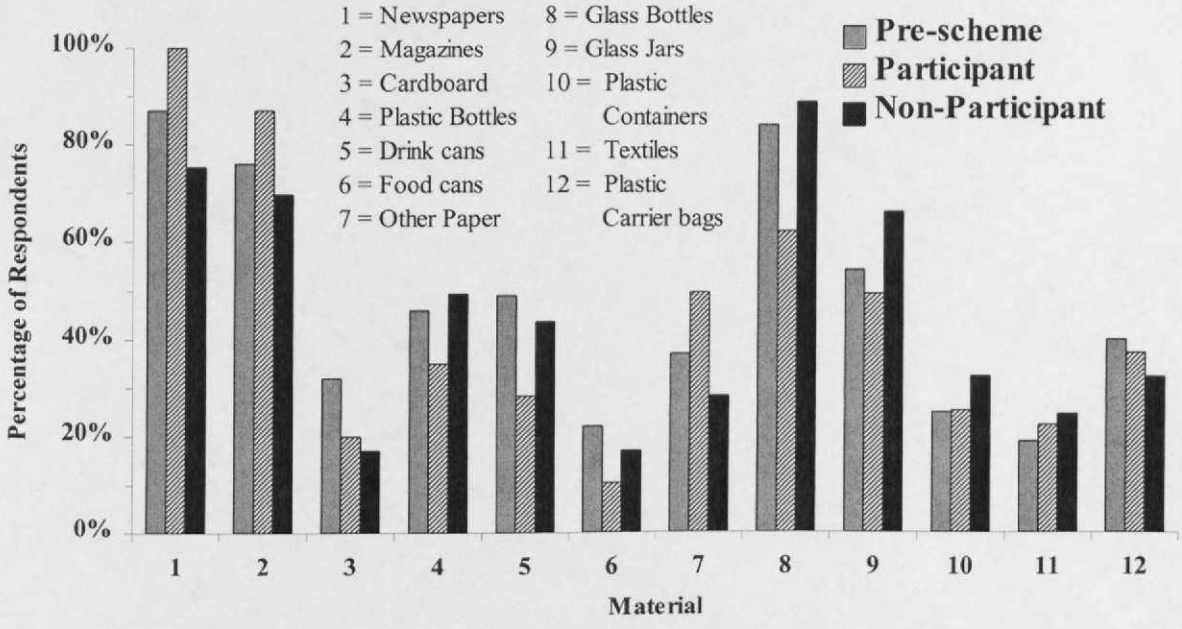
Prior to scheme introduction, 92.6% (Garforth) and 89.3% (Wetherby) of people asked, thought they would use a kerbside scheme 'regularly' or 'all of the time', yet only 74.6% (Garforth) 68.8% (Wetherby) of respondents claim to use the scheme once it was introduced. Measured

DETR participation levels of only c. 46% (Garforth) and c.36% (Wetherby), suggest respondents anticipated using the scheme more than they actually did. Potentially the scheme failed to meet household's needs. Only 1.9% (Garforth) and 1.3% (Wetherby) of respondents claimed they would never use a kerbside scheme, which is lower than the claimed or observed behaviour following the schemes introduction.

Households were asked prior to the scheme to indicate their level of agreement to the statement "I would recycle more if a door-to-door kerbside collection scheme was in place". There was a strong level of agreement with the statement; 81.8% of the sample agreed or strongly agreed. Responses between sample areas were similar (Garforth - 81.6%, Wetherby – 81.8%). However, a difference between recyclers (75.7%) and non-recyclers (96.8%) suggests that a proportion of recyclers feel as though they are already recycling at their maximum level. 14.7% of recyclers disagreed or strongly disagreed with the statement compared to 1.1% of non-recyclers. The lack of kerbside recycling facilities appears to have been a major barrier, reinforced by the level of support previously shown with households anticipated use of a scheme.

Figure 4.20 illustrates the materials respondents claimed to recycle before and after the schemes introduction. Pre-scheme recycling behaviour is consistent with current bring facility provision and material recovery levels within the UK, as well as results from other national research projects. Respondents predominantly recycle newspaper, magazines, glass bottles and jars, and to a lesser extent plastic bottles, drink cans and plastic carrier bags with other materials at minimal levels.

Figure 4.20 Claimed Materials Recycled in Relation to Claimed Participation in the 'Paper Chain' Recycling Scheme and Pre-scheme Recycling Behaviour

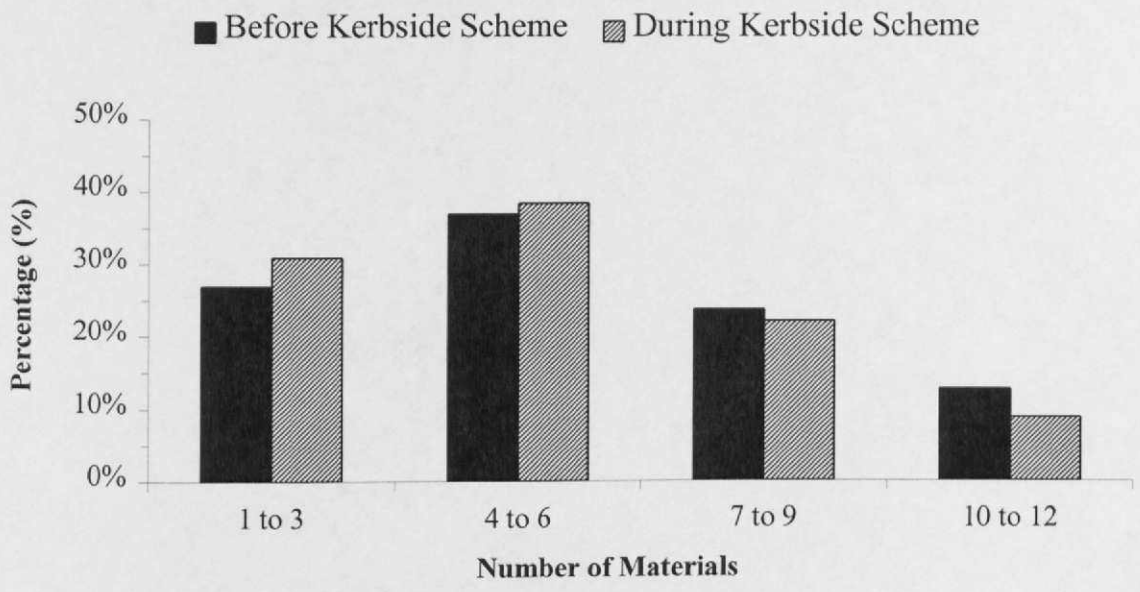


Following the introduction of the Paper Chain scheme, recyclers are now categorised as either a 'participant' or 'non-participant' recycler. The 'participant' category includes the additional stimulated recycling behaviour of previous non-recyclers following the schemes introduction. The results show that the percentage of participants claiming to recycle all the materials requested by the scheme, i.e. paper fraction, is higher than the non-participants, and also higher than previous claimed bring behaviour. The main exceptions to this are cardboard and plastic carrier bags. Households may have been confused about whether cardboard was targeted by the scheme when questioned and claimed recycling of carrier bags may refer to households re-using rather than recycling them.

A higher percentage of non-participants are claiming to recycle materials not targeted by the scheme compared to participants especially for glass bottles/jars, plastic bottles and drink cans; materials most associated with bring sites other than paper. If such claims are correct, many non-participants decision to boycott the scheme was a positive choice, to recycle a greater variety of materials at bring sites.

Figure 4.21 shows that the Paper Chain scheme had little effect on the number of materials that a household claims to recycle. There is a slight decrease in the proportion of households recycling more than 7 materials and an increase in the number of households recycling less materials. The introduction of the scheme has not stimulated an increase in the number of materials recycled as only paper is targeted by the scheme; any increase would require a change in household's use of existing bring facilities. This is unlikely and appears not to have happened, as the original barriers to using bring facilities remain for the other materials.

Figure 4.21 The Number of Materials that Households Recycle



4.2.5.2 Motivators and Barriers Towards Recycling

Consistent with national findings (Aylesford, 1998; Oxford Brookes, 1999; Burnley and Parfitt, 2000), environmental reasons were cited before and after the introduction of the scheme as the main reason for recycling (table 4.12). The proportion of households citing good facilities nearby increased slightly but not to the extent expected. Peer pressure/duty on both questionnaires was cited as the least effective method of inducing recycling behaviour. Scheme participants and non-participants reasons are similar with the exception of 'good facilities nearby/convenient' (table 4.13). A higher percentage of recyclers not participating in the scheme cite this as a reason for recycling, suggesting many were satisfied with their bring facilities and the paper only scheme failed to meet their needs.

Table 4.12 Reasons for Households Recycling Before & After Schemes Introduction

	Before			After		
	Wetherby N = 75	Garforth N = 108	Total N = 183	Wetherby N = 117	Garforth N = 191	Total N = 308
Good facilities nearby / Convenient	45.3%	53.7%	50.3%	50.4 %	59.2 %	55.8 %
For the future environment / Generations	73.3%	73.1%	73.2%	69.2 %	69.2 %	67.2 %
Saves waste / Landfill space	58.7%	60.2%	59.6%	61.5 %	64.9 %	63.6 %
Personal satisfaction / Habit	62.7%	43.5%	51.4%	48.7 %	46.1 %	47.1 %
Save dustbin space	34.7%	47.2%	42.1%	37.6 %	39.8 %	39.0 %
Peer pressure / Duty	9.3%	6.5%	7.7%	2.6 %	3.7 %	3.2 %

Table 4.13 Scheme Participants and Non-participants Reasons for Recycling

	Participant	Non-participant
	N= 255	N= 53
Good Facilities Nearby / Convenient	53.7 %	66.0 %
For the Future Environment / Generations	66.7 %	69.8 %
Saves Waste / Landfill space	63.9 %	62.3 %
Personal Satisfaction / Habit	47.8 %	43.4 %
Save Dustbin Space	39.6 %	35.8 %
Peer Pressure / Duty	3.1 %	3.8 %

Comments from residents (when questionnaires were collected) indicated that all recyclables were stored together and it was more convenient for them to recycle all the materials at the same place, than separating papers and recycling them using one method and recycling other materials via another.

Table 4.14 identifies householders' reasons for not recycling prior to the schemes introduction. The sample size is relatively small posing obvious limitations and probably reflects unwillingness of non-recyclers to answer the questionnaires, rather than the lack of non-recyclers within the sample areas. Generally inconvenience, whether in terms of time, facility provision, transportation or storage of recyclables is cited as the main reason for failing to recycle, all reasons that are typically associated with bring sites.

Table 4.14 Reasons for households not recycling prior to the schemes introduction

	Wetherby N = 46	Garforth N = 33	Total Paper Chain N = 79
Inconvenient/Not time	50.0%	51.5%	50.6%
Facilities too far away/Inadequate	52.2%	45.5%	49.4%
Storage/handling problems	34.8%	36.4%	35.4%
Lack of Information	19.6%	42.4%	29.1%
Never really thought about it	17.4%	30.3%	22.8%
Not enough materials to recycle	21.7%	21.2%	21.5%
Too much effort	21.7%	9.1%	16.5%
Other	6.5%	12.1%	8.9%

Following the introduction of the scheme the main barrier of inconvenience/inadequate facilities remained and rankings were relatively similar to those prior to the scheme with two main exceptions (table 4.15). The barrier 'storage/handling problems' has now emerged as a primary reason, for not recycling which may reflect the scheme's design, e.g. as a bag; does it stay inside or outside the property? If dirty it may be put outside, but then papers get wet, whilst storage of a bright green heavy-duty bag under the coffee table is inappropriate. Also, having to carry the bag full of newspapers to the kerbside may be too heavy for the older householders. Another reason, which has increased in rank, is 'not enough materials to recycle'. Households may be focusing only on paper given the schemes design. If they do not purchase newspapers they may feel as though they can not recycle, no longer making the connection between recycling and other materials. Other reasons could be postulated, but it is clear that the main barriers associated with bring sites remain.

Table 4.15 Reasons for households not recycling once served by Paper Chain

	Wetherby	Garforth	TOTAL
	N = 27	N = 18	N = 45
Storage/Handling Problems	63.0 %	44.4 %	55.6 %
Facilities Too Far Away/Inadequate	40.7 %	27.8 %	35.6 %
Inconvenient/Not time	37.0 %	27.8 %	33.3 %
Lack of Information	29.6 %	33.3 %	31.1 %
Not Enough Materials to Recycle	18.5 %	50.0 %	31.1 %
Never really Thought About it	25.9 %	11.1 %	20.0 %
Too Much Effort	14.8 %	16.7 %	15.6 %
Other	7.4 %	16.7 %	11.1 %

Not enough materials to recycle has previously been quoted as a reason for not recycling or using a kerbside scheme (Boldero, 1995). The postal questionnaire asked households to indicate the quantity of free newspapers delivered to their house and the number of newspapers purchased within the last full week to assess if the quantity of targeted recyclable material generated (i.e. newspapers) influenced recycling behaviour. Table 4.16 suggests that there is no significant difference between recycling behaviour and the number of free newspapers received, obviously due to their blanket delivery regardless of recycling behaviour. However, recyclers would appear to purchase more newspapers than non-recyclers and scheme participants purchase more newspapers than non-participant recyclers. Although average generation levels are still high enough to warrant participation, these data indicated that perceived 'lack of material' may well be a valid reason.

To further test this hypotheses, newspaper purchases of non-recycling households who had indicated that 'they did not have enough materials to recycle' were compared to non-recycling households who had not indicated this as a reason for their behaviour (table 4.17); effectively a small sub-set of non-recyclers. No significant difference can be found when reporting in such detail, although the small sample number may influence this.

Table 4.16 Mean Quantity of Claimed Weekly Newspaper Generation Rates

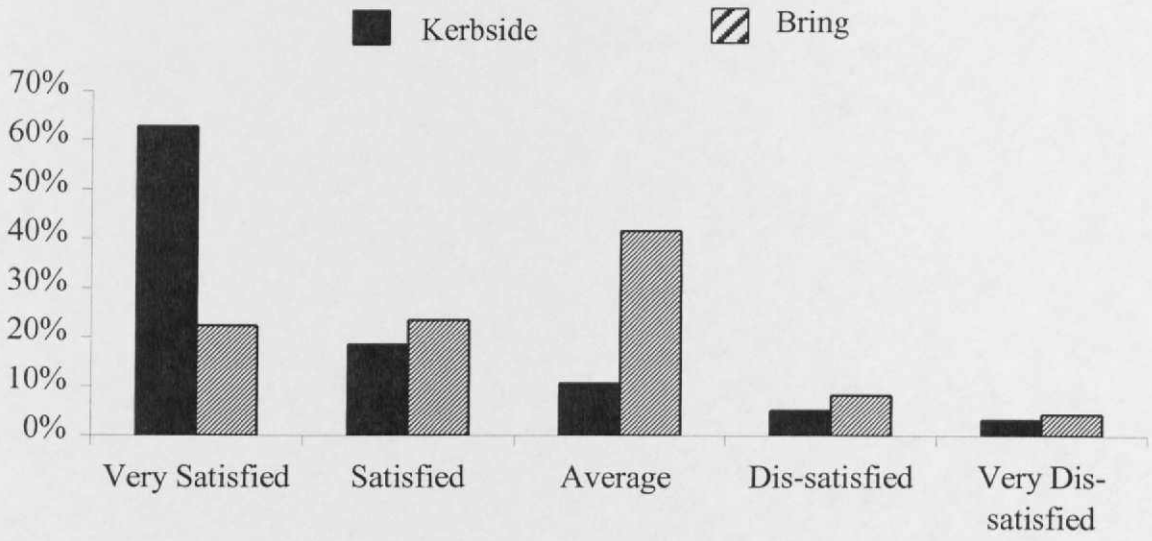
			N =	Mean Qty. of Free Newspapers Delivered	Mean Qty. of Newspapers Bought per Week
Garforth	**Recycler**	Participant	156	1.9	5.9
		Non-participant	35	1.7	5.5
		Total	**191**	**1.9**	**5.8**
	Non-recycler		**18**	**2.2**	**2.9**
Wetherby	**Recycler**	Participant	99	1.5	6.3
		Non-participant	18	1.7	3.8
		Total	**117**	**1.5**	**5.9**
	Non-recycler		**27**	**1.4**	**3.4**
TOTAL	**Recycler**	Participant	255	1.8	6.1
		Non-participant	53	1.7	4.9
		Total	**308**	**1.7**	**5.9**
	Non-recycler		**45**	**1.7**	**3.2**

Table 4.17 Newspaper purchases in relation to non-recycling households claimed reason of 'not having enough materials to recycle' for not recycling

	Garforth Non-recyclers		**Wetherby Non-recycler**		**TOTAL**	
	Indicated Reason	**NOT Indicated reason**	**Indicated Reason**	**NOT Indicated Reason**	**Indicated Reason**	**NOT Indicated Reason**
N =	9	9	5	22	14	31
Mean	2.3	3.6	5.4	2.9	3.4	3.1

Overall satisfaction with the Paper Chain scheme is relatively high, with 63% of respondents very satisfied and 18% satisfied (Figure 4.22). However, households were not necessarily dis-satisfied with bring facilities, whilst a high proportion have no strong views at all.

Figure 4.22 Satisfaction with Scheme Provision



When assessing household level of satisfaction with the Paper Chain scheme in relation to their participatory behaviour, it becomes clear that recycler's non-participation might have been deliberate in favour of bring facilities (figures 4.23 and 4.24). As expected, participant's satisfaction with the kerbside scheme is high, but the level of satisfaction of non-participant recyclers is similar to non-recyclers. Non-participants support for bring facilities is significantly higher than the kerbside scheme.

Figure 4.23 Satisfaction with Paper Chain in Relation to Participatory Behaviour

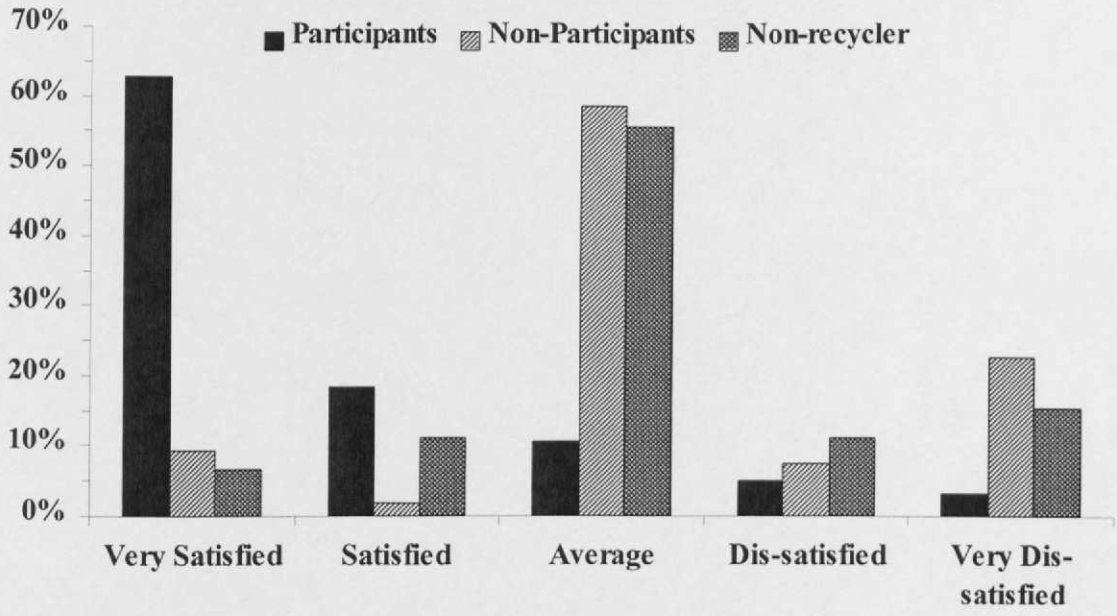
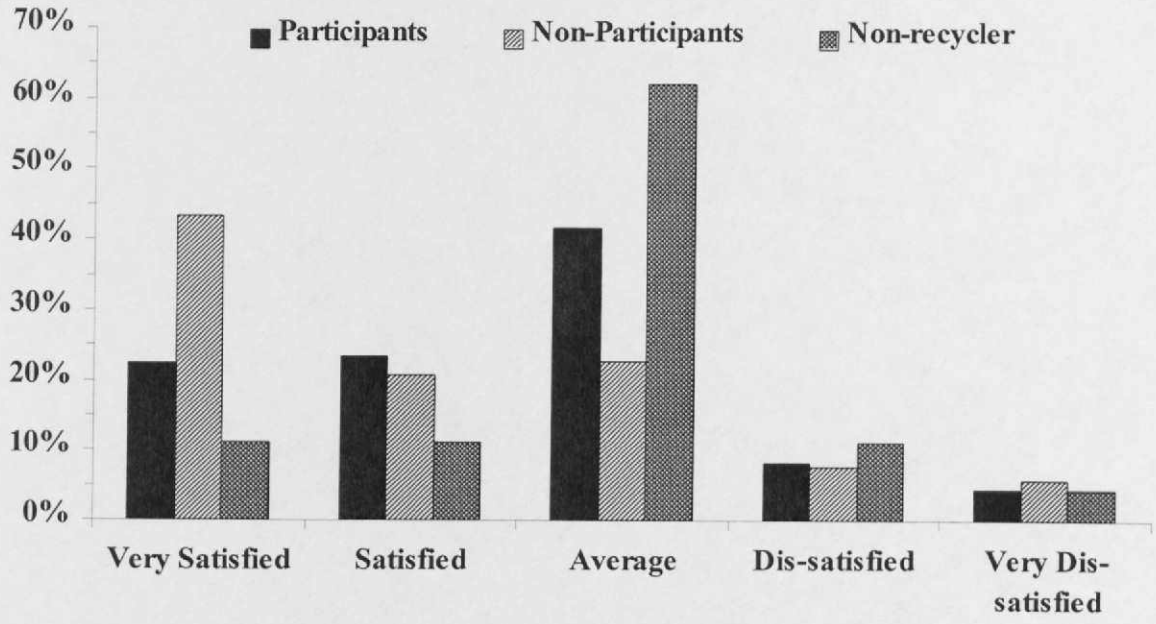


Figure 4.24 Satisfaction with Bring Facilities in Relation to Participatory Behaviour



Although households (at least those participating) are satisfied with the Paper Chain scheme, suggested changes to the scheme relating to the design, e.g. materials collected, more frequent collections and the collection container (table 4.18). These would require fundamental structural and logistical changes to rectify. Most of the 'other' responses indicated they were satisfied with the scheme as it was. The 'no answer' column also assumes residents do not wish to change the scheme. The least popular change was to extend the collection frequency to a monthly collection. The most popular desired change to the scheme (in both areas) was to include more recyclable materials in the scheme highlighting households desire to have a convenient service in order to 'do more'.

Desired changes to the scheme are relatively similar between sample areas, if not in percentage of responses to each change, in the ranking of the change in relation to the other options. A higher proportion of Garforth residents wanting the bags collected from beside the normal bin may reflect the different residual collection methods used in the two areas. Wetherby residents have become accustomed to placing their wheeled bin at the kerbside, whereas Garforth residents have their sacks collected from the rear of their property.

Table 4.18 Changes Residents Would Like to See Happen to the Scheme (Post-scheme questionnaires)

	Wetherby N= 144	Garforth N= 209	Total N= 353
Include more recyclable materials in the scheme	66.3 %	66.5 %	66.3 %
Having the bags collected from beside normal bin	36.1 %	43.5 %	40.5 %
Fortnightly to weekly collection	35.4 %	30.1 %	32.3 %
Change from bag to bin	29.2 %	22.5 %	25.2 %
Improve information about the scheme	19.4 %	22.0 %	21.0 %
Increase size of bag	16.0 %	10.5 %	12.7 %
Other	11.8 %	13.4 %	12.2 %
No answer	12.5 %	14.4 %	9.6 %
Change from fortnightly to monthly collection	9.0 %	2.3 %	5.4 %

Prior to the scheme, households indicated their ideal scheme design which was not significantly different from Paper Chain in terms of collection frequency and container used. Although both areas preferred a bin (Garforth – 39.7%, Wetherby – 36.4%), support for a bag was relatively strong (Garforth – 28.4%, Wetherby – 31.4%). Boxes were preferred by 29.1 % (Garforth) and 29.8% (Wetherby) of residents. The remainder consisted of other methods suggested by the individual. On collection frequency, weekly (Garforth – 46.1%, Wetherby – 38.8%) or fortnightly (Garforth – 38.3%, Wetherby – 43.8%) collection were preferred to a monthly (Garforth – 14.9%, Wetherby – 17.4%) or longer period (Garforth – 0.7%, Wetherby – 0%) collection.

Five of the most requested materials to be included in a kerbside scheme were newspapers (87%), glass bottles (83%), magazines (60%), plastic bottles (54%) and drink cans (42.0%). Households undoubtedly recognise these as the most recyclable materials and although paper was the most popular choice, clearly residents expected a multi-material scheme and not the one provided. These five materials are also the most convenient to recycle from the twelve offered and are the cleanest. It is interesting to note that a lower proportion of inconvenient and food contaminated materials were requested. For example, food cans (39%), card (19%), glass jars (38%), plastic containers (18%), textiles (5%), plastic carrier bags (28%) and other paper (21%).

Before the scheme was introduced, a high proportion of respondents claimed they would not mind cleaning/rinsing materials prior to recycling them. Recyclers attitudes (89.6%) were more positive than non-recyclers (75.9%) but this appears to be widely accepted, although it could be argued that given the lower demand for the material had less desire to recycle them.

4.2.5.3 Information on Recycling

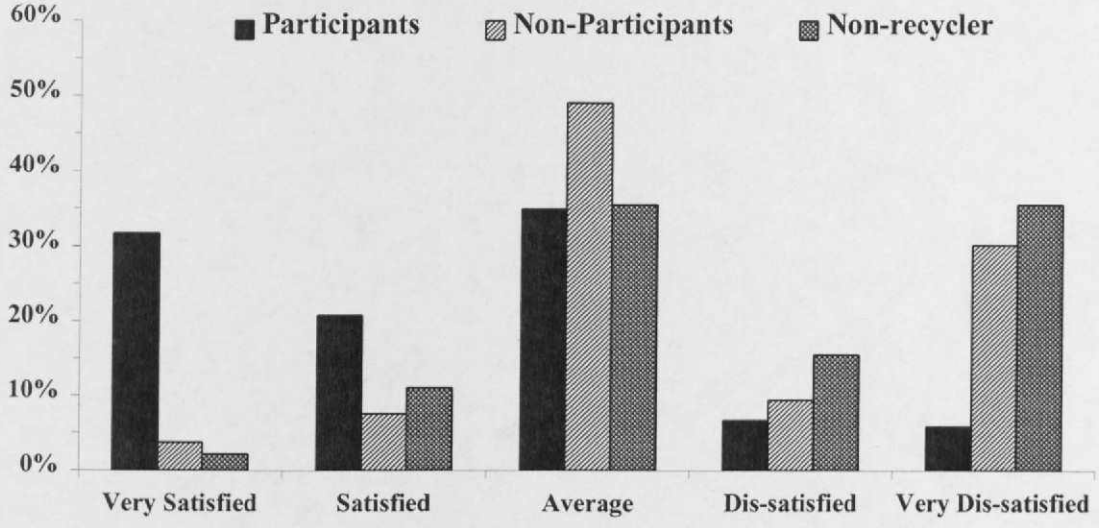
The questionnaires revealed that households were generally dissatisfied with the level of information provided about recycling within Leeds (table 4.19). Although the number of households agreeing (54.2%) or strongly agreeing (13.7%) with the statement decreased to 41.1% and 12.2% respectively following the schemes introduction, households still felt poorly informed about recycling. This was statistically significant (chi square 18.6 at 0.01 significance). 31.1% of non-recyclers compared to 9.4% of recyclers strongly agreed with the statement. This may show that non-recyclers primary reason for not recycling was their lack of knowledge and understanding of how to use the scheme or may simply reflect that this is a convenient excuse. Differences between the recycler and non-recycler were only statistically significant after the schemes introduction (Chi-square 18.0 significant at 0.001 confidence level).

Table 4.19 Agreement with the Statement that "the Quality and Amount of Information on recycling in Leeds is Insufficient" Before and After Scheme Introduction

		Strongly Agree	Agree	Average	Disagree	Strongly Disagree
Before	**Recycler n = 183**	12.0%	54.1%	18.6%	14.8%	0.5%
	Non-recycler n = 79	17.7%	54.4%	13.9%	13.9%	0.0%
	Total n = 262	13.7%	54.2%	17.2%	14.5%	0.4%
After	**Recycler n = 308**	9.4%	42.2%	31.5%	14.9%	1.9%
	Non-recycler n = 45	31.1%	33.3%	22.2%	13.3%	0.0%
	Total n = 353	12.2%	41.1%	30.3%	14.7%	1.7%

When households were asked specifically about the information on the Paper Chain scheme, only 21.5% of households were dissatisfied or strongly dissatisfied and 37.1% believed it to be average. A comparison of household satisfaction in relation to their recycling behaviour (figure 4.25) shows that households using the scheme were skewed from average to satisfied and those not using the scheme skewed average to dissatisfied. Again non-participants opinions are similar to non-recyclers potentially explaining scheme non-participation.

Figure 4.25 Respondents Level of Satisfaction with the Information Provided About the Paper Chain Scheme



Only 25.6% of households agreed or agreed strongly that recycling facilities were a long way from their place of residence. 66% disagreed or disagreed strongly. This differed in relation to recycling behaviour; 51.9% of non-recyclers were more inclined to agree or strongly agree with this statement compared to 14.2% of recyclers, suggesting the distance of recycling facilities is a perceived barrier. This was statistically significant with a chi-square value of 54.9 (confidence 0.001).

Both recyclers (69.4%) and non-recyclers (82.3%) agree or strongly agree that bring facilities should be more adequately sign posted and better managed. Unsurprisingly, a greater proportion of recyclers (73.7%) than non-recyclers (48.1%) agree or strongly agree that bring facilities are overflowing and untidy, probably reflective of recyclers being more aware as a result of using the facilities. The difference was statistically significant with a chi-square value of 30.3 (confidence 0.001). These results suggest, that households (recyclers and non-recyclers) are aware of the location of their recycling facilities, but feel they could be improved and they should be more informed about recycling in general and specific facilities offered to them.

4.2.5.4 Environmental Attitudes

One view of the major benefits of getting householders to actively recycle is that the experience will stimulate and improve awareness and behaviour towards other environmentally friendly activities. Elements of this were investigated by comparing responses before and after scheme introduction and are reported in table 4.20. Households perceive themselves to be more

environmentally conscious following the scheme introduction with the percentage of households agreeing and strongly agreeing to the statement slightly increasing from 77.5% to 85.5%. A chi-square of 19.2 with strong statistical significance (0.001 significance) supports this difference.

Non-recyclers would appear to recognise that their lack of recycling behaviour does not allow them to strongly agree with the statement and a higher percentage certainly disagree. However, there are still a high percentage of non-recyclers agreeing with the statement, before (50.6%) and after (55.6%) the scheme. In relation to both recyclers and non-recyclers, a chi-square test indicates the increase is significant for both groups and an equally high proportion having no opinion stated by 20.3% and 26.7% of respondents respectively. A chi-square of 53.3 (0.001 significance) before and 39.3 (0.001 significance) after supports these differences. As both groups have increased, the reported increases may not be a result of participation in the scheme.

Table 4.20 Environmental Attitudes Before and After Scheme Introduction

			Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
I Regard myself as somebody who is environmentally conscious	Recycler	Before	23.0%	63.9%	8.7%	4.4%	0.0%
	Non-recycler	Before	5.1%	50.6%	20.3%	21.5%	2.5%
	Total	Before	**17.6%**	**59.9%**	**12.2%**	**9.5%**	**0.8%**
	Recycler	After	26.6%	63.0%	9.4%	1.0%	0.0%
	Non-recycler	After	2.2%	55.6%	26.7%	8.9%	6.7%
	Total	After	**23.5%**	**62.0%**	**11.6%**	**2.0%**	**0.8%**
I always try to buy the most environmentally friendly products	Recycler	Before	2.7%	33.9%	15.8%	43.2%	4.4%
	Non-recycler	Before	3.8%	24.1%	8.9%	58.2%	5.1%
	Total	Before	**3.1%**	**30.9%**	**13.7%**	**47.7%**	**4.6%**
	Recycler	After	5.8%	34.1%	38.3%	20.1%	1.6%
	Non-recycler	After	2.2%	20.0%	51.1%	26.7%	0.0%
	Total	After	**5.4%**	**32.3%**	**39.9%**	**21.0%**	**1.4%**
The recycled content of a product / packaging influences what I buy	Recycler	Before	1.6%	18.6%	7.7%	60.7%	11.5%
	Non-recycler	Before	0.0%	15.2%	11.4%	67.1%	6.3%
	Total	Before	**1.1%**	**17.6%**	**8.8%**	**62.6%**	**9.9%**
	Recycler	After	1.9%	14.3%	41.6%	39.6%	2.6%
	Non-recycler	After	0.0%	11.1%	40.0%	24.4%	24.4%
	Total	After	**1.7%**	**13.9%**	**41.4%**	**37.7%**	**5.4%**

Although statistically attitudes have changed, behaviour has not. The introduction of the scheme did not appear to influence purchasing behaviour. In both statements, respondents would appear more uncertain as their response have shifted to 'no opinion'. They are now less inclined to disagree or strongly disagree with the statements following the schemes introduction. This was statistically significant for both the purchase of environmental products (chi-square 76.5 significant at 0.001) and the recycled content of a packaging (chi-square 83.3 significant at 0.001). A comparison of purchasing behaviour to recycling behaviour would suggest that recyclers are slightly more inclined to buy environmentally friendly products than non-recyclers, both before and after the schemes introduction, yet this finding was not statistically significant. Recyclers again were slightly more influenced in the recycled content of a product/packaging before and after the scheme. This was only statistically significant after the scheme (chi-square 38.4 significant at 0.001).

Overall, although a moderate proportion of respondents indicate that they consider the environment during their purchases, when realising the consequences of that commitment i.e. the recycled content of a product/packaging, their support weakens. Considering the high proportion of households agreeing or strongly agreeing with the statement that they are environmentally conscious both before (77.5%) and after (85.5%) the scheme, this is not necessarily reflected in their purchasing behaviour.

4.2.5.5 Legislative Drivers

Direct charging of householders for the waste they produce, similar to other "essential" services such as gas, electricity and water, has been proposed to encourage minimisation and recycling. Views of householders on the scheme were canvassed along with other drivers for encouraging change, as acceptance would require substantial structural changes in the waste management and fiscal infrastructure. Table 4.21 reports households views in relation to recycling behaviour.

Households were not in favour of being charged separately for their refuse collection like other utilities, for example gas, regardless of their recycling behaviour, where 28.3% disagreed and 45.0% strongly disagreed with the suggestion. Only 11.6 % of households agreed or strongly agreed. There was a similar lack of support for variable charging, where 56.1% of respondents before and 61.7% after disagreed or strongly disagreed to the suggestion (chi-square 36.9 significant at 0.001) suggesting any future structural changes in the waste tax system would face significant public opposition.

Surprisingly, a higher proportion of non-recyclers agree or strongly agree to the suggestion before (Non-recyclers – 38.0%, Recyclers – 25.7%) and after the scheme (Non-recyclers –

26.6%; recyclers - 18.2%). This may suggest non-recyclers feel they require the 'legislative/fiscal stick' to motivate them to recycle. Recyclers however may be more aware of the practical implications of such measures and the additional effort on the householders, which the increased levels would dictate. A significantly higher proportion of recyclers disagreed or strongly disagreed with the suggestion following the introduction of the scheme (Non-recyclers – 48.9%, Recyclers – 63.6%). Results between recyclers and non-recyclers before the scheme were statistically significant (chi-square 36.9 significant at 0.001). Results after the scheme were not.

Table 4.21 Opinions on Recycling Laws and Waste Charging Before and After the Scheme.

			Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
We should still recycle even if it costs more than landfill	Recycler	Before	15.8%	72.1%	9.3%	2.7%	0.0%
	Non-recycler	Before	20.3%	67.1%	7.6%	3.8%	1.3%
	Total	Before	**17.2%**	**70.6%**	**8.8%**	**3.1%**	**0.4%**
	Recycler	After	28.9%	50.6%	14.6%	4.5%	1.3%
	Non-recycler	After	15.6%	44.4%	26.7%	6.7%	6.7%
	Total	After	**27.2%**	**49.9%**	**16.1%**	**4.8%**	**2.0%**
A law should be introduced to make people recycle more	Recycler	Before	6.0%	37.2%	11.5%	38.8%	6.6%
	Non-recycler	Before	3.8%	36.7%	12.7%	36.7%	10.1%
	Total	Before	5.3%	37.0%	11.8%	38.2%	7.6%
	Recycler	After	11.4%	29.2%	26.3%	24.7%	8.4%
	Non-recycler	After	13.3%	22.2%	42.2%	11.1%	11.1%
	Total	After	**11.6%**	**28.3%**	**28.3%**	**22.9%**	**8.8%**
Households should be charged directly by the amount of waste they produce	Recycler	Before	2.7%	23.0%	19.1%	42.1%	13.1%
	Non-recycler	Before	3.8%	34.2%	3.8%	38.0%	20.3%
	Total	Before	**3.1%**	**26.3%**	**14.5%**	**40.8%**	**15.3%**
	Recycler	After	3.9%	14.3%	18.2%	30.2%	33.4%
	Non-recycler	After	2.2%	24.4%	24.4%	15.6%	33.3%
	Total	After	**3.7%**	**15.6%**	**19.0%**	**28.3%**	**33.4%**

4.3 The Millennium Recycling Scheme

Only the results relevant to the central concept of the thesis are presented within this chapter, and later discussed in relation to the other two kerbside schemes. For a wider discussion on the general findings of the Millennium scheme and its benefits/implications within the wider context of waste management regarding compositions, diversions, treatment options, markets, costs etc. reference should be made to Barton et al (2001). This report was produced as part of the requirements of the Biffa landfill tax monies awarded during the PhD, to conduct the research and to disseminate the information into the public domain. A summary of scheme performance over the 6-month monitoring period is shown in table 4.22.

4.3.1 Participation and Set out Rates

Throughout the scheme, the participation rate was consistent at around 90% (figure 4.26). This is high for a kerbside-recycling scheme in comparison to reports within the literature. The set-out rate was also very high for a scheme offering weekly collection, starting at 58% for the first week and peaking at 84%. The feedback leaflet in week 15 had a positive, statistically significant effect on the set-out rate, which prior to feedback was averaged at 73% (S.D. 5%) compared to 80% (S.D. 4%) after feedback. Increases of c.2% on already high participation levels were reported following the feedback. The scheme design and maintenance made it easy for the residents to become involved, and, along with feedback ensured a high and consistent participation level throughout the period.

Figure 4.26 Participation and Set Out Rates for the Duration of the Scheme

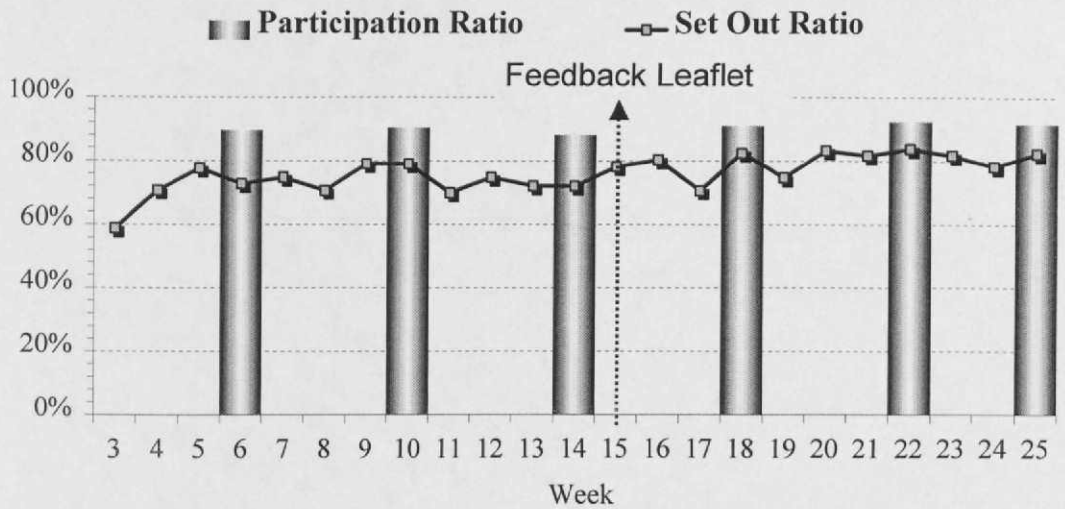


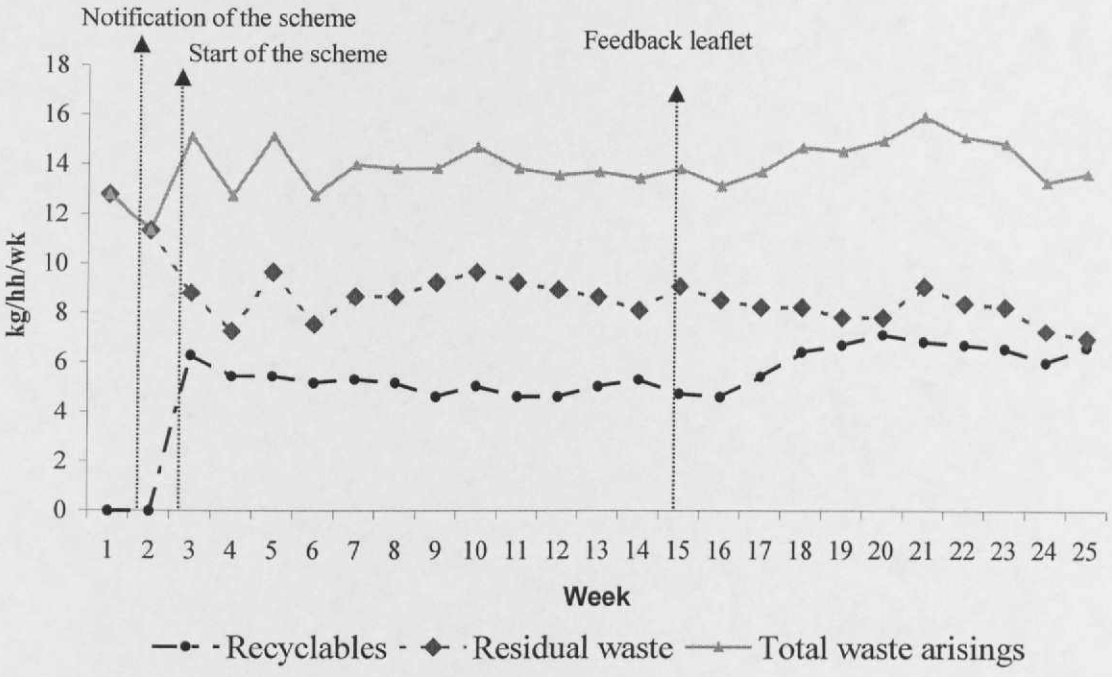
Table 4.22 Scheme Performance Summary

Week No.	Date	Participants Residue (kg)	Non-set out Residue (kg)	Absolute Non-participant Residue (kg)	Recyclables (kg)	Scheme Recovery/ (kg/hh/wk)	Total Waste Generation (kg/hh/wk)	Scheme Diversion (%)	Participation Ratio (%)	Set out Ratio (%)	Qty. of Recyclables per bin (kg)
1	18/5	-	-	1830	-	-	12.8	-	-	-	-
2	25/5	-	-	1620	-	-	11.3	-	-	-	-
3	1/6	780	480	-	900	6.3	12.8	41.7	89.5	58.7	10.7
4	8/6	840	200	-	780	5.5	11.3	42.9		70.6	7.7
5	15/6	1080	300	-	780	5.5	15.1	36.1		77.6	7.0
6	22/6	880	200	-	740	5.2	12.7	40.7		72.7	7.1
7	29/6	980	260	-	760	5.3	14.0	38.0	90.2	74.8	7.1
8	6/7	1040	200	-	740	5.2	13.9	37.4		70.6	7.3
9	13/7	1100	220	-	660	4.6	13.9	33.3		79.0	5.8
10	20/7	1200	180	-	720	5.0	14.7	34.3		79.0	6.4
11	27/7	1040	280	-	660	4.6	13.9	33.3	88.1	69.9	6.6
12	3/8	960	320	-	660	4.6	13.6	34.0		74.8	6.2
13	10/8	960	160	120	720	5.0	13.7	36.7		72.0	7.0
14	17/8	920	140	100	760	5.3	13.4	39.6		72.0	7.4
15	24/8	1020	160	120	680	4.8	13.9	34.3	90.9	78.3	6.0
16	31/8	1000	120	100	660	4.6	13.1	35.1		80.4	5.7
17	7/9	940	160	80	780	5.5	13.7	39.8		70.6	7.7
18	14/9	970	70	140	920	6.4	14.7	43.8		82.5	7.8
19	21/9	860	150	120	960	6.7	14.6	46.2	92.3	74.8	9.0
20	28/9	980	60	80	1020	7.1	15.0	47.7		83.2	8.6
21	10/5	1140	60	100	980	6.9	15.9	43.0		81.8	8.4
22	10/12	1080	40	80	960	6.7	15.1	44.4		83.9	8.0
23	19/10	980	100	100	880	6.2	14.4	42.7	91.6	81.8	7.5
24	26/10	860	100	80	860	6.0	13.3	45.3		78.3	7.7
25	2/11	840	100	80	920	6.4	13.6	47.4		82.5	7.8

4.3.2 Waste Arisings

Figure 4.27 shows the weekly household weight generation of recyclable, residual and total wastes for the area starting one week prior to the householder being informed of the scheme (i.e. two weeks prior to the first collection day). A feedback leaflet was delivered following collection on August 24th (week 15). The last weight data was collected on November 2nd (week 25). Table 4.23 provides average weight arising data for these periods.

Figure 4.27 Change in the Weight of Total Arisings, Recyclables and Residue Waste Throughout the Scheme



Within the initial period, there was a drop in total waste arisings from 12.8 to 11.3 kg/hh following notification that a scheme was to be introduced, with a jump to 15 kg/hh on the first collection day. Recyclables that week recorded a high of 6.3 kg/hh, suggesting that householders began to save materials as soon they received notification that a scheme was to start. After week 3, weights of recyclables settled at around 5 kg/hh, residues at 8.7 kg/hh, giving a total waste arising of 13.8 kg/hh for the period up to the feedback leaflet (week 15). The final period saw recyclable weights increase by 1.3 kg/hh to an average of 6.3 kg/hh, with a peak of 7.1 kg/hh at the end of September (table 4.22). A smaller drop in the average residual waste weights (from 8.8 to 8.1 kg/hh) meant that overall waste arisings also increased during this period to 14.4 kg/hh. The weight of waste arisings within the Millennium sample area are typical of nationally reported arisings for household waste collected by sack at c. 13.3 kg/hh/wk (UEA, 2000).

Table 4.23 Average Weekly Household Weight Arisings During the Scheme

	Pre-collection Weeks 1&2	Before feedback (BF) Weeks 4**-15		After Feedback (AF) weeks 16-24		Change (AF)
Waste stream	Kg/hh/wk	Kg/hh/wk	SD	Kg/hh/wk	SD	
Recyclables	-	5	0.3	6.3	0.8	+ 26%
Residue waste	-	8.8	0.8	8.1	0.6	- 8%
Total waste	12.7*	13.8	0.7	14.4	0.9	+4.3%

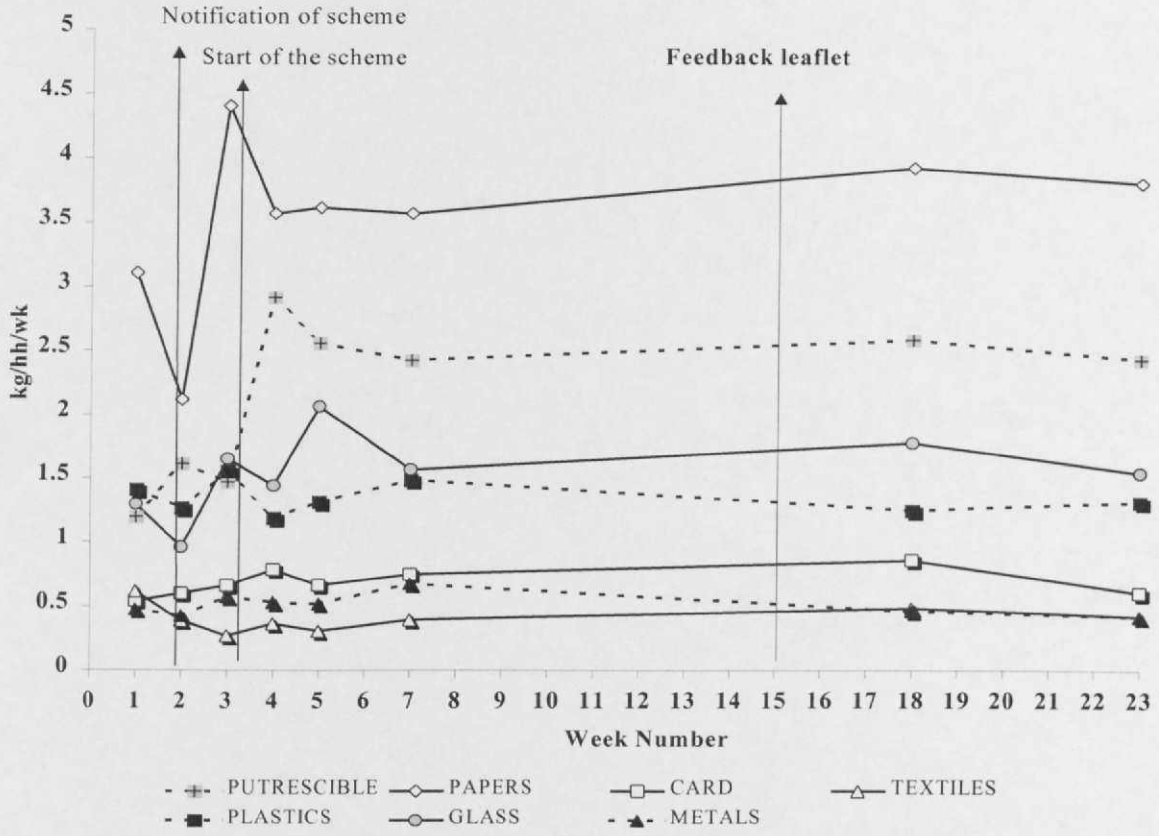
* Average includes estimated 1.3 kg of "saved" recyclable waste from week 2 prior to the first collection day, week 3

** First collection day, week 3 exclude from data set.

Standard deviations (SD) reported in table 4.23 confirm that week 3 recyclable weight of 6.3 kg/hh is significantly different (+ 99.9% confidence level) than the average, before feedback, of 5kg (SD 0.3). Thus the additional 1.3 kg has been added to week 2 total waste arising to give a baseline of 12.7 kg/hh prior to scheme start. Week 3 data has then been ignored in calculating the 'before-feedback' averages. Considering the 'before-scheme total' compared to the before and after-feedback data, it would also appear that there has been a significant increase in total waste arising. Before the scheme weights are almost 2 standard deviations below post scheme average weights for both periods showing this increase is due to changes in disposal behaviour rather than a normal fluctuation in weekly arisings. Materials that had been disposed of or recycled by other methods, (i.e. not to the dustbin) would appear to have been diverted to the Millennium collection system.

The overall increase in waste arisings after feedback of 4.4% is small and may not represent a significant further change in diversion habits of householders. However, it was noticed that a few items such as carpets, books and toys, which previously had not been in the waste stream, began to appear after the feedback leaflet. The leaflet may have stimulated households to dispose of materials that are recyclable but that are traditionally stored for long periods of time within the house or taken to the tip. Although this may reflect a temporary change in behaviour, further research is required beyond the 6 month period to identify if this represents a permanent shift in behaviour.

Figure 4.28 Weight Arisings of the Main Categories



Reference to the waste analyses undertaken during the 6-month project highlight some potential reasons behind increases in overall weight arisings. Figure 4,28 illustrates the weights of the main categories for which weight waste analyses were completed. These data clearly show that putrescible waste, papers, glass and metals made the major contributions to the overall increase observed once the scheme started. Increases in putrescible waste (effectively kitchen and garden waste), supported from detailed subcategory data shown in table 4.24, show that the increase noted is probably due to natural seasonal factors, e.g. higher consumption of fresh vegetables / salads, more gardening activity. The main increase (and subsequent decrease) in garden waste reflects the socio-demographics of the area and the period in which the scheme was undertaken.

Reasons for the continual increase in food waste are unclear. However the increased disposal volume capacity offered by the Millennium recycling scheme may also have persuaded householders to dispose more of their putrescible fraction in the residual waste bin rather than take it to the tip or compost / burn such waste at home. Given the recycling message communicated by the scheme, essentially food and garden were the only main materials to dispose of in the residual bin. As CA bring sites were no longer required for recyclables, it is understandable that garden waste (traditionally taken to CA sites) were diverted to the residue.

This could be a concern if garden waste was no longer being centrally composted at the CA site as a result of the schemes introduction.

Table 4.24 Putrescible Waste Arisings (kg/hh/wk)

	Before Scheme		During Scheme					
	18th May	25th May	1st June	8th June	15th June	30th June	15th Sept	19th Oct
Food Waste	1.02	1.10	0.81		1.51		1.57	1.54
Garden Waste	0.17	0.51	0.66		1.04		1.01	0.89
TOTAL PUTRESCIBLE	**1.20**	**1.61**	**1.47**	**2.91**	**2.56**	**2.43**	**2.58**	**2.43**

Papers, glass and metals are traditional materials taken to bring recycling sites and diversion of these fractions to the Millennium recycling bin would be expected given the convenience offered by the scheme. Table 4.25 reports the increases of specific materials commonly associated with 'bring' recycling, highlighting households transfer of behaviour from bring to kerbside. One of the most noticeable changes is the increase in newspapers and magazines showing households familiarity and convenience associated with paper recycling. What is interesting to note is the minimal increase in waste arisings of food and drink cans, highlighting minimal levels of recycling of these materials consistent with claimed behaviour and national reported findings.

Taking the full period of the scheme an additional 1.4 kg/hh/wk of material reported to the Millennium recycling scheme (14.1kg/hh compared to 12.7 kg/hh/wk), of which c.0.8 kg/hh/wk was due to an increase in the putrescible content. This result suggests that the area was recycling c.5 % of its dry recyclable materials, 0.6 kg/hh/wk, before the scheme was introduced, most noticeable newspapers, magazines and glass bottles.

Table 4.26 presents the overall weight results as diversion rates. For a scheme targeting dry recyclable materials when compared to other best practice of UK kerbside schemes, these diversion rates are amongst the highest recorded. However, it should be recognised that the scheme was small in size and the household types served represent a single ACORN group (D9) and therefore a limited spectrum of socio-economic characteristics. What is evident from table 4.26 is that the feedback leaflet had a positive effect and stimulated householders to improve performance (discussed in more detail later). As these results are based on many weeks' data during scheme operation, it is clear that the large increase (26%) in recyclable recovery and reduction (8.7%) in residual waste represent real changes in behaviour. All recyclable categories

recorded some increase with the metal, plastic and card categories benefiting most from feedback.

Table 4.25 Waste Arisings of Selected 'Common' Bring Site Materials

	Before Scheme		During Scheme			
	18th May	25th May	1st June	15th June	15th Sept	19th Oct
Newspapers	1.73	1.21	2.61	2.06	1.96	1.67
Magazines/Ads/Glossy/Brochures	0.92	0.47	1.13	1.06	1.31	1.43
Green glass packaging (Beer Bottles)	0.07	0.23	0.07	0.22	0.30	0.18
Green glass packaging (Wine Bottles)	0.45	0.11	0.53	0.63	0.48	0.53
Green glass packaging (Non-alcoholic)	0.04	0.00	0.01	0.03	0.02	0.01
Green glass packaging (Spirit bottles)	0.03	0.03	0.05	0.04	0.07	0.05
Green glass packaging (Food Packaging)	0.03	0.00	0.01	0.00	0.00	0.00
Total green glass packaging	***0.67***	***0.37***	***0.67***	***0.92***	***0.86***	***0.76***
Brown glass packaging (Beer Bottles)	0.08	0.11	0.17	0.17	0.08	0.11
Brown glass packaging (Wine Bottles)	0.03	0.06	0.04	0.04	0.10	0.09
Brown glass packaging (Non-alcoholic)	0.00	0.00	0.01	0.01	0.00	0.00
Brown glass packaging (Spirit bottles)	0.00	0.00	0.02	0.01	0.01	0.00
Brown glass packaging (Food Packaging)	0.01	0.01	0.00	0.01	0.01	0.01
Total brown glass packaging	***0.13***	***0.18***	***0.24***	***0.23***	***0.21***	***0.22***
Clear glass packaging (Beer Bottles)	0.00	0.02	0.03	0.05	0.06	0.01
Clear glass packaging (Wine Bottles)	0.07	0.08	0.10	0.09	0.11	0.09
Clear glass packaging (Non-alcoholic)	0.01	0.00	0.03	0.07	0.01	0.01
Clear glass packaging (Spirit bottles)	0.03	0.00	0.06	0.06	0.09	0.08
Clear glass packaging (Food Packaging)	0.33	0.30	0.45	0.43	0.37	0.33
Total clear glass packaging	***0.44***	***0.41***	***0.67***	***0.71***	***0.63***	***0.54***
Ferrous Drink Cans	-	0.03	0.03	0.04	0.06	0.04
Ferrous Food Cans	-	0.26	0.16	0.26	0.27	0.23
Aluminium Drink Cans	-	0.03	0.01	0.03	0.03	0.04
Aluminium Food	-	0.01	0.07	0.12	0.07	0.07

Table 4.26 Diversion Rates During Scheme Operation

	Lowest	Highest	Average	Before feedback leaflet	After feedback leaflet
Diversion Rate (Weight %)	33%	46%	42%	37%	44%

4.3.3 Compositional Analysis

Not all waste analyses provide full coverage of sub categories and for general discussion table 4.27 reports the average for the main categories along with an estimate of the typical composition of UK waste (UEA, 2000). The major difference between the scheme area and the UK data is the fines category, with Bradford reporting 13.7%, compared to 6.8% nationally. This is an artefact of the analysis procedure, the Millennium fines are based on materials below 50 mm in size compared to 20mm for the UK data. The main effect of this underestimates the amount of putrescible waste present as this category dominates the smaller size fractions. Taking putrescibles and fines together as a single category shows very similar values (30 and 27 %) and considering the data overall, it is clear that waste from the householders is typical of UK waste.

Table 4.27 National and Millennium Recycling Scheme Household Composition Data

	National Typical Percentage by weight*	MRS Percentage by weight	MRS Materials as a percentage of recyclables**
Paper**	26%	26%	46%
Card**	8%	5%	8%
Plastic**	11%	10%	16%
Glass**	9%	11%	19%
Metal**	7%	4%	6%
Textiles**	2%	2%	5%
Putrescibles	20%	16%	
Fines	7%	14%	
Miscellaneous combustible and non combustibles	10%	12%	
Total	100%	100%	100%

* (UEA, 2000; DoE, 1994)

** Dry recyclable materials targeted by the Millennium Recycling Scheme

Of the categories suitable for materials recycling, the six major recyclable materials paper, glass, card, textiles, metals and plastics represent 58% of the waste. Thus the maximum diversion rate for the dry recyclable scheme was 58% at 100% recovery efficiency for all materials.

The Millennium recycling scheme was only concerned with the dry materials but the efficiency of householders to recover these affects the proportion and type of materials associated with the wet, putrescible materials that remain in the residual waste. This has implications for the management of the residues whether by landfill or other technologies such as Anaerobic Digestion and Energy from Waste.

4.3.4 The Recovery Rates Achieved by the Scheme

Basic material diversions are shown in table 4.28. It is clear that both paper and glass are diverted efficiently into the green bin with on average 76% of paper and 70% of glass recovered. The high recovery rates achieved for paper and glass can be attributed to the fact that they are easily recognised as recyclable by the householders and are traditionally recycled at civic amenity and bring sites. This was reinforced by the previous compositional analysis. These materials can easily be stored in the house prior to being thrown out, increasing the chance that they will be placed in the recycling bin. Both the plastics and metal fractions report the lowest recoveries. These materials are perhaps not recognised as being as recyclable as glass and paper by the householder but as a general category description, they are widely targeted by both bring and kerbside schemes.

Table 4.28 Recyclable Category Recoveries During the Scheme.

	1st June (wk 3)	8th June (wk 4)	15th June (wk 5)	30th June (wk 7)	15th Sept (wk 18)	19th Oct (wk 23)	Average
Papers	73%	76%	78%	71%	78%	80%	***76%***
Card	41%	66%	51%	57%	72%	74%	***60%***
Textiles	64%	46%	52%	44%	72%	42%	***53%***
Plastics	13%	26%	26%	24%	42%	39%	***35%***
Glass	72%	78%	59%	67%	71%	75%	***70%***
Metals	30%	21%	30%	36%	50%	45%	***39%***

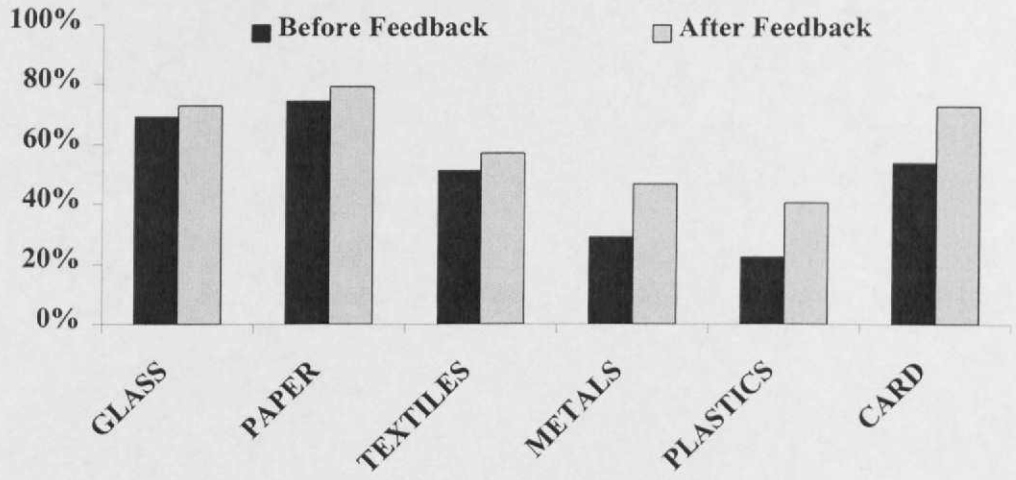
Card and textiles are recovered with some degree of efficiency at 60% and 53% respectively. These materials are obviously recognised by most households as "recyclable". Given the broad requested materials message, households may not have been aware that the scheme wanted all dry items, especially given that not all card and textiles have been targeted in bring or collect schemes. Also, clothing may be viewed more in the context of whether or not it is fit for wearing rather than recycling the fibre content. Larger corrugated cardboard boxes are obviously recyclable but card used for food packaging is often composite (e.g. plastic sleeves or

liners), laminated (e.g. aluminium / plastic layers) or contaminated with food; householders may feel they are unsuitable for recycling. Items of waste produced in a higher stress environment, for example, during meal preparation are more likely to be disposed of quickly in kitchen bins.

Plastic and metals report the lowest recoveries of 35% and 39% respectively. Plastics are widely used as food packaging and as such are generated within the house at stressful times. Such items may be dirty and smelly and a significant hygiene risk (e.g. fresh meat packaging); therefore, unless washed, these items will not be stored within the house prior to disposal. This makes them more likely to be thrown straight into the normal kitchen refuse bin. For metals, cans dominate this fraction (ferrous tinplate and aluminium). Drink cans are relatively clean but food cans fall to the same problem noted for packaging plastics, they are opened in the kitchen during meal preparation and would require rinsing if stored in-house, thus lower recovery rates are achieved.

Figure 4.29 presents the average recovery before and after the feedback leaflet was distributed in week 15 (August 24th). All material categories benefited from the feedback. The most notable increases were for the metals, plastic and card. Feedback had a very positive effect on card, increasing recovery from an average of 53% to 73%. This suggests that households did not realise that all card items could go in the recycling bin. Textiles were only moderately affected by the feedback and table 4.28 shows an erratic fluctuation in the percent of textiles being recovered. This may be because clothes are long life items and tend to be subject to specific "clear-out" events rather than steady discard. Items such as dish-clothes, underwear, tights, shoes etc. were generally observed to be discarded in the residual waste.

Figure 4.29 Material Recovery Rates



Feedback information had a small positive effect on paper and glass. The high recovery rates already being achieved left little room for improvement and it would appear that 80% recovery of any material is close to the maximum that can be expected at the participation rate of 90% achieved during scheme operation.

Assessing material recoveries at a broad category level highlights a general picture on recycling behaviour and the effect of feedback. However an assessment at a more detailed material level shows how product categories (as well as the material) may be influencing recycling behaviour and thus recovery levels. Table 4.29 shows the effect of material recoveries at a more detailed level. The results show that prior to the feedback, the higher recoveries of materials are those traditionally associated with recycling and bring sites, i.e. newspapers, magazines, glass bottles and drink cans. Although prior to feedback overall diversions were high as a result of all categories being requested, individual material recoveries are similar to reports of the better performing kerbside schemes requesting those material categories.

Table 4.29 The Effect of Selected Material Category Recoveries

	Before Feedback*	After Feedback*	Increase as a Ratio	Difference	
Plastic Bottles	35.1%	64.9%	1.8	29.7%	
Ferrous Food Cans	23.9%	47.3%	2.0	23.4%	
Food / Drink Card (& Card Composite) Packaging	36.5%	56.4%	1.5	19.9%	
Plastic Food Containers	11.8%	28.6%	2.4	16.7%	> 10%
Aluminium Food Cans	3.8	20.4%	5.4	16.6%	
Other Paper & Card	57.0%	69.7%	1.2	12.7%	
Magazines / Ads / Glossy / Brochures	75.8%	86.2%	1.1	10.4%	
Glass Jars	54.6%	60.8%	1.1	6.2%	
Glass Bottles	72.6%	77.5%	1.1	4.8%	
Textiles	57.3%	59.0%	1.0	1.7%	
Aluminium Drink Cans	66.0%	66.5%	1.0	0.5%	< 10%
Newspapers	81.6%	81.7%	1.0	0.2%	
Paper Packaging	12.7%	12.7%	1.0	0.0%	
Ferrous Drink Cans	60.8%	60.3%	1.0	-0.5%	

* Based on weeks 3 and 5 waste analyses
** Based on weeks 18 and 23 waste analyses

Following the feedback leaflet, the most notable increases (i.e. differences greater than 10%) were reported for the more 'inconvenient', traditionally less recognisable recyclable materials, i.e. plastic and beverage and food packaging. Food packaging materials particularly increased by at least twice and for certain products up to 5 times the amount recovered prior to feedback.

Materials traditionally associated with recycling show marginal or no increase. The importance of feedback can not be under-estimated and although differential material recoveries are reported, individual material recoveries are high in relation to other schemes, which along with high participation, has aided high diversion levels.

Several reasons can be postulated for such increases following feedback. The most notable is that the biggest differences reported were for materials less commonly known as 'recyclable'; households were confused and unaware that these materials were accepted. Residents raised concern about the initial information leaflet being confusing. The feedback leaflet however was clearer and more prescriptive, with colour pictures and encouraging information, reinforcing scheme instructions. The leaflet may have allowed households to recognise exactly what materials were recyclable and place more materials in the recycling bin. As individual material recovery information was provided in the leaflet, households could identify where improvement was needed and where credit was due.

Plastic bottles reported one of the greatest increases following feedback. Plastic bottles present the same level of difficulty to the householder to recycle as glass bottles and drink cans as they can be stored relatively safely for medium periods without rinsing and do not require immediate disposal. Reasons for such low recoveries prior to feedback were thought to be a lack of knowledge by households of their acceptance in the scheme and once 'reminded/educated' similar recoveries were achieved. Glass bottles and drink cans are well recognisable recyclables (and were not particularly effected by the feedback); plastic bottles are a relatively new addition. Plastic bottle bring sites are less common and plastics, as a material are less recognisable as a recyclable. Therefore, given the uncertainty of what materials were requested prior to feedback, plastic bottles may not have been placed in the recycling bin by all households.

A significant message included in the feedback leaflet was to "empty containers" but, "I don't have to be clean to be in the recycling scheme". This message goes against common practice, which usually stresses the need to rinse / wash all containers. The message was an intentional test to make the scheme more convenient to households removing this barrier and establishing if recoveries of soiled packaging materials increased. Households would clean materials to their own accepted level for hygienic reasons / internal storage and handling but not pre-determined by the scheme. As the scheme is a weekly collection and metals in particular can be sorted automatically, there were no significant technical or hygiene reasons for this practice, currently a requirement of kerbside collection schemes within the UK.

The main increases were noted for food contaminated items, i.e. food cans and plastic food containers compared to materials where cleaning was not an important factor and minimal increases reported. Aluminium food containers reported the lowest recoveries and greatest increase following feedback. A large majority of this material consists of either pet food cans (particularly cat food) or foil trays, (i.e. take away food). Rinsing pet food cans where meals are prepared could be seen as unhygienic. Take away trays reflect a quick, easy and convenient meal. Therefore, rinsing or washing the tray would defeat this purpose as it is quickly disposed of after use. However, emptying the food contents for use and placing the empty container in the recycling bin is no more inconvenient than disposing of it.

As noted, there are numerous factors that could explain poorer initial recovery and reasons for increases following feedback. The large improvement suggests that households did not realise they could recycle all materials in these categories or did not feel sufficiently motivated to do so effectively. Further research is required to clarify to what level these increases in materials were a result of removing the barrier of cleaning materials or that households were more aware of what was accepted and recognising their behaviour was being monitored. However, even following feedback, significant differences are reported between materials. This suggests that it is not just information or scheme design that prevents them being segregated effectively.

Newspapers reported the most consistent recoveries during the monitoring period. Newspapers are the 'easiest' material to recycle and present few problems regarding storage and recognition of their recyclability, often reporting the highest recoveries on recycling schemes. Effectively, if newspaper recoveries are poor, it is unlikely that other materials will be performing well. Other material recoveries taken from the detailed waste analyses were normalised against the newspaper recoveries to identify any potential relationships (table 4.30). Newspaper recoveries are taken as 1. Other material recoveries are reported as a ratio against the newspaper recovery percentage. All 'normalised' figures from this point on within text are based on this format.

A clear distinction between material recoveries is identified. What is interesting to note is that for each material, i.e. glass, metal and plastic, the beverage containers report higher ratios than the food container irrespective of the material. For example, glass bottles have a mean ratio of 0.93 compared to glass jars with an average ratio of 0.71. However, the magazine ratio is parallel, if not better than newspaper recoveries, although the two are consistently higher than the other materials. Again, the high fluctuation in ratios for textiles would support the view that a separate behavioural pattern to other materials is taking place.

Table 4.30 Normalised Materials Recovery Ratios

	1st June	15th June	15th Sept	19th Oct	*Mean*	*S.D*
Newspaper Diversions	80.7%	81.0%	80.0%	82.4%	*81.0%*	*0.01*
Magazines Ratio	0.90	1.00	1.05	1.13	*1.02*	*0.10*
Glass Bottle Ratio	0.93	0.88	0.96	0.95	*0.93*	*0.04*
Drink Can Ratio	-	0.88	0.83	0.76	*0.82*	*0.06*
Card Ratio	0.53	0.70	0.83	0.87	*0.73*	*0.15*
Glass Jar Ratio	0.86	0.48	0.69	0.80	*0.71*	*0.17*
Textile Ratio	0.78	0.66	0.91	0.53	*0.7*	*0.16*
Plastic Bottle Ratio	0.32	0.54	0.79	0.79	*0.61*	*0.23*
Food Cans Ratio	-	0.23	0.55	0.49	*0.42*	*0.17*
Plastic Food Container Ratio	0.10	0.22	0.39	0.30	*0.25*	*0.12*

Overall recovery and ratio data suggests that even with high participation levels and a high level of information and encouragement to the householder, different materials will have different diversion rates. Materials that are 'inconvenient' to recycle are recovered with less efficiency. Factors that effect ease of recycling included size / volume of items, location / time and how the waste is generated / stored and the level of cleaning needed to permit storage and keep the waste hygienic. These factors will be discussed in detail later in the thesis. However, whatever the reasons for differential recoveries, it is clear that plastics and metals (particularly food packaging) are more difficult for the householder to recycle despite a convenient scheme design and intervention strategies, thus lower recoveries are achieved.

4.3.5 Questionnaire Analysis

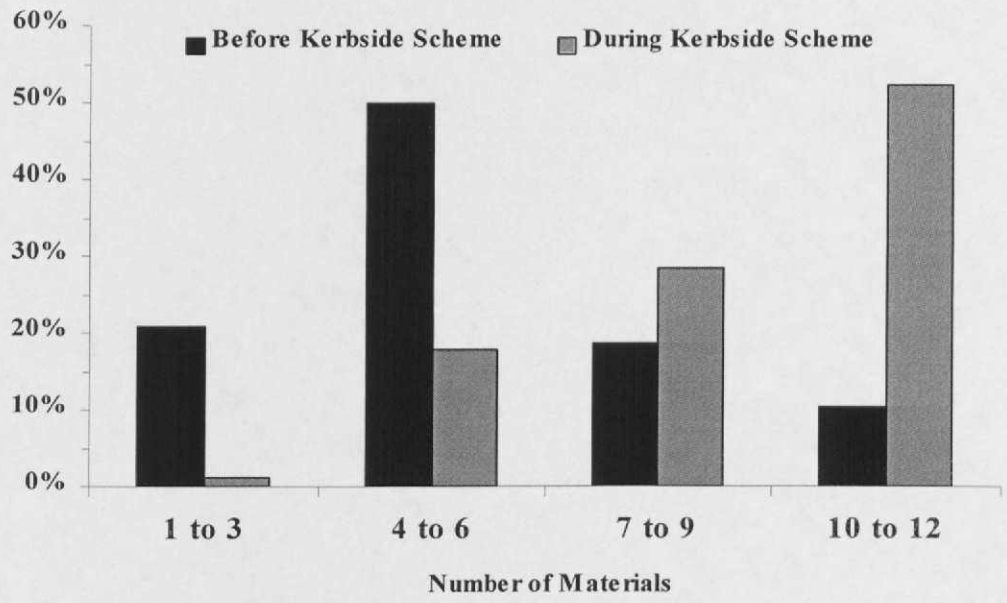
4.3.5.1 Claimed Recycling Behaviour

Only 38% of people asked thought they would use a kerbside scheme "all the time" if introduced, yet 97% of participants claimed to use the Millennium recycling scheme "all of the time" once introduced. This suggests that households have integrated the scheme into their normal refuse habits better than they expected, even if not setting out their bin for collection every week (set out rates c. 70%). A further 47% of people before the scheme thought they would use the recycling scheme regularly and 13% said they would use it occasionally. The remaining 2% said they would not use the scheme (consistent with the number of people claiming not to use the scheme). Responses of "regularly" or "occasionally" drop away sharply and are replaced by "all of the time". Pre-scheme responses may have reflected behaviour / timeframes associated with using bring facilities; the kerbside scheme is always "available for use" even if householders don't put the bin out for collection every week.

The proportion of households claiming to recycle within the pilot area increased from 77% to 97% following the introduction of the Millennium recycling scheme. The measured participation level was c. 90% for the whole area but it was noted that non-participants did not respond to the second questionnaire and therefore identifying reasons for non participation are limited. The waste analysis data reveals that, although 77% of people claim to recycle before the scheme, the estimated pre-scheme diversion of recyclables stands at c.5-6% maximum. This would suggest that overall, people claiming to use bring site facilities are recycling very inefficiently. The post-scheme diversion rate stands at c.42% and clearly shows that the Millennium recycling scheme has increased the efficiency of the recyclers as well as the number of households recycling.

Figure 4.30 shows the Millennium recycling scheme has increased the number of materials that a household recycles. The number of households recycling less than 4 materials has dramatically dropped since the scheme introduction from 20.8% to only 1.2%. At the other end of the scale there has been a corresponding increase in the number of households recycling over 9 materials from 10.4% to 52.4%. This increase can be attributed to the fact the kerbside scheme is designed to collect 'all recyclables'.

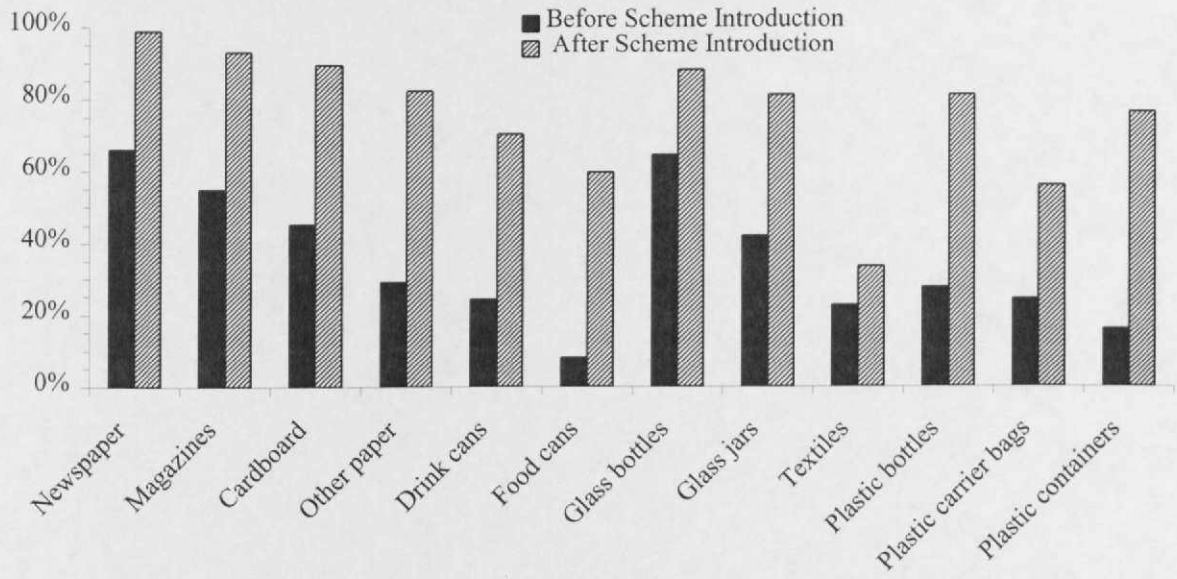
Figure 4.30 The Number of Materials that Households Recycle



Pre-scheme recycling behaviour is reflective of bring provision and the recognition of commonly recyclable materials (figure 4.31). The claimed recycling of every material category increased with the introduction of the scheme. The only materials that remain notably low are textiles (33%), plastic carrier bags (55%) and food cans (59%). These materials must pose the

largest barriers to households for recycling. Materials that were previously not recycled by many included all plastics and metals, textiles and other paper (such as envelopes and leaflets). These are not always accepted at bring sites and/or may be dirty or too small to store easily.

Figure 4.31 Percentage of Respondents Recycling each Material



If the diversion rate for each material is compared with the number of people claiming to recycle their materials then an idea can be gained about how efficiently different materials are recycled. Paper and glass are efficiently recycled with only small differences between the number of people claiming to recycle them and the diversion rates achieved (table 4.31). This implies that the people who recycle paper and glass manage to place most of these materials in their recycling bin. Plastics and metals reveal a large difference in the diversion rates achieved and the number of people claiming to recycle them (with a relative difference of 50% and 55% respectively). This suggests that people who say they recycle plastics and metals are not very efficient at recovering them. A large proportion of the plastic and metals generated end up in the residual bin.

Data for the textile category is unexpected; less people claim to recycle textiles than evident from material actually recovered. This may be because of the confusing nature of the category. People might distinguish between various textiles such as dishcloths, clothes and carpets that may be seen as non-recyclable, reusable or recyclable. Due to the large differences in size between these textile categories, and the small amount of textiles thrown away in total, recovery rates can be heavily influenced by one or two large items. Throughout this project it has become clear that textiles do not conform to the patterns found for the other waste categories.

Table 4.31 Recovery Rates and Claimed Recycling Behaviour

	Respondents claiming to recycle each material	Average recovery rate during the MRS	Difference (%)	Relative difference
Papers	90%	76%	-14	-16%
Card	88%	60%	-28	-32%
Textiles	33%	53%	+20	61%
Plastics	70%	35%	-35	-50%
Glass	83%	70%	-13	-16%
Metals	64%	29%	-35	-55%

Storing materials for recycling can be a major issue (particularly for kerbside schemes with non-weekly collections), and storage availability / location could influence households decision to recycle a particular material. Table 4.32 illustrates where households store a particular material prior to recycling it. The design of the Millennium recycling wheeled bin provided households with an additional storage point outside of the house. Other scheme designs would usually require a storage point to be found for a box or bag etc. within the home.

Table 4.32 Claimed Immediate Storage Point of Recyclables After Use*

	Directly into the Recycling Bin	Kitchen	Hall/ Porch	Elsewhere Indoors	Garage / Garden	Other	Don't Recycle this Material**
Newspaper	54%	25%	5%	9%	6%	1%	0
Magazines	54%	22%	5%	11%	1%	5%	4
Card	60%	20%	1%	6%	11%	1%	4
Glass Bottles	62%	23%	4%	3%	8%	1%	7
Glass Jars	61%	24%	4%	3%	7%	1%	14
Plastic Bottles	62%	24%	3%	4%	6%	0%	15
Plastic Containers	62%	25%	4%	4%	4%	0%	17
Plastic Bags	46%	31%	3%	12%	5%	2%	26
Textiles	27%	13%	4%	22%	27%	7%	40
Food Cans	59%	31%	2%	3%	5%	0%	26
Drink Cans	58%	30%	1%	3%	6%	0%	19

* Percentages calculated from the number of households who recycle that particular material and not the entire questionnaire sample.

** Number of households from the 85 questionnaire sample who indicated not recycling the material and therefore no storage point indicated.

The results show that a significant proportion of households choose to place their recyclable materials directly into the recycling bin. This is particularly the case for the packaging fractions where consistently c.60% of households claim to do this. Lower values are reported for papers, plastic bags and textiles. Interestingly, none of these materials have direct contactwith a product i.e. foodstuffs or liquid. Effectively they are the product.

Newspapers and magazines report marginally higher values for storage in other indoor locations. Effectively they can be easily stored anywhere. Plastic bags report higher values in the kitchen and elsewhere indoors where they can be stored easily for long periods. Textiles report higher values elsewhere indoors / garage and low values for the kitchen. This may allow for an accumulation of, for example, old clothes, for long periods of times and support the view that textiles are disposed of / recycled in bulk, thus causing fluctuations in recovery data, with material only being discarded when reaching a high threshold.

Card reports a marginally higher value of 11% for storage in the garage. This probably reflects corrugated cardboard boxes rather than flat packaging card i.e. cereal packets. Interestingly, both drink and food cans remain with the kitchen in comparison to other materials. The results would suggest that the disposable sack provided for interim storage was used in either the kitchen or remained within the wheeled bin. Different storage patterns between materials can be identified and these may ultimately affect recycling behaviour regarding recovery efficiency, however more research is required to be conclusive.

4.3.5.2 Motivators and Barriers Towards Recycling

Consistent with parallel and national findings, the greatest reason cited for recycling both before and during the scheme was for the future environment and generations (table 4.33). Another environmental reason, 'it saves waste/landfill space', and intrinsic reasons such as good facility provision and personal satisfaction were also ranked highly. The answers to these questions were ranked rather than expressed as a percentage due to slight differences in the phrasing of the question asked in the two questionnaires.

There appears to be no difference in ranking following the scheme introduction, with the exception of 'facilities nearby/convenient and 'saving waste/landfill space'. This is perhaps the result of households turning to the "moral" reasons for recycling once the practical issues had been effectively addressed by scheme design. In both questionnaires 'saves dustbin space' and 'peer pressure/duty' were not cited as significant reasons for recycling.

Table 4.34 identifies household reasons for not recycling prior to the scheme introduction. Only 14 households claimed not to recycle and therefore the results pose obvious associated

limitations. However, reasons are similar to the Paper Chain results suggesting typical attitudes of non-recycling households towards bring systems. Issues associated with householders' failure to recycle are associated with inconvenience in relation to time, available storage and handling of the materials and inadequate facility provision. As far as possible, all of these issues were addressed with the introduction of the Millennium recycling scheme.

Table 4.33 Reasons for Recycling Before and After the Scheme Introduction.

	Before MRS (n=48)*	Ranking	During MRS (n=84) **	Ranking
Good facilities nearby / Convenient	28	2	49	3
For the future environment / Generations	39	1	58	1
Saves waste / Landfill space	25	3	54	2
Personal Satisfaction / Habit	25	3	41	4
Saves dustbin space	16	5	23	5
Peer pressure / Duty	3	6	2	6

* Respondents were asked to tick three reasons

** Respondents were asked to tick up to three reasons

Table 4.34 Reasons for Not Recycling Prior to the Millennium Recycling Scheme

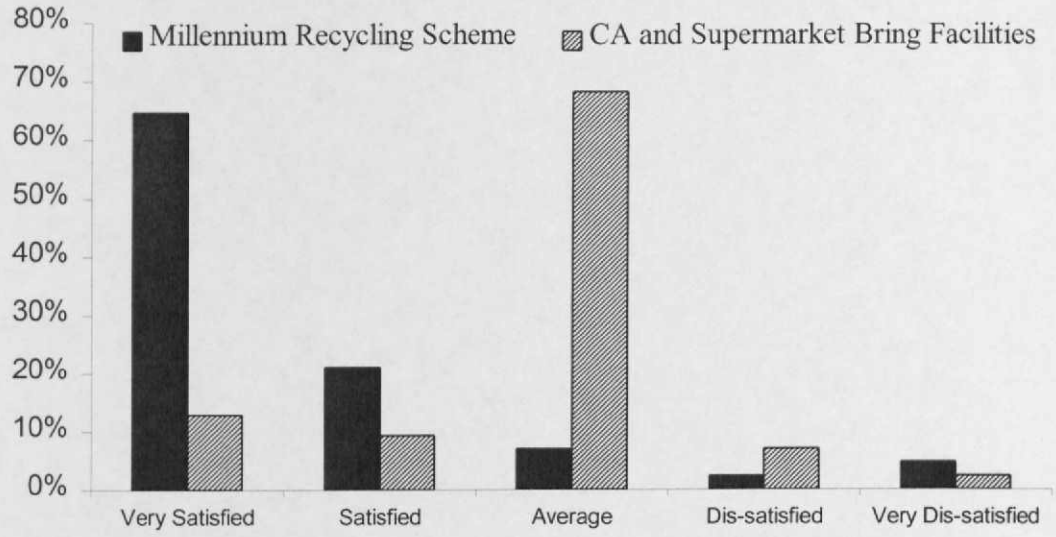
	Before the Millennium Recycling Scheme (n=14)
Inconvenient / No time	64%
Storage / Handling problems	50%
Facilities too far away / Inadequate	43%
Lack of information	29%
Not enough materials to recycle	14%
Never really thought about it	7%
Too much effort	7%

Most of these issues are normally overcome with the introduction of any kerbside scheme, though the degree to which they are resolved may depend on the number of materials collected as well as a scheme's design refinements. For example, a single material kerbside scheme still

presents the same 'most important barriers' to all other materials the householder wishes to recycle. As 'all recyclables' were requested by the Millennium recycling scheme there were no remaining barriers on any dry materials and only the most 'stubborn' non-recycler failed to participate.

As figure 4.32 indicates, households were not necessarily dissatisfied with bring facilities, they simply accepted the provision as the "norm". However, there was a much greater level of satisfaction amongst respondents for the Millennium recycling scheme where 21% were satisfied and 65% were very satisfied. It is interesting to note that although 14% of respondents' satisfaction was 'average' to 'very dissatisfied' with all bar the exception of 1, participated in the scheme on a regular basis.

Figure 4.32 Millennium Households Response to Scheme Provision



Household preferred changes to the recycling scheme (table 4.35) were encouraging, as suggested changes were relatively minor and could be and were (as far as possible) rectified through an information /feedback leaflet. It would appear that households were satisfied with the more concrete elements of the scheme design such as the collection frequency, collection time, the container used and its size; all aspects that would require significant structural and logistical changes to rectify. Households' acceptance of the wheeled bin is somewhat surprising as only 30% of households claimed they wanted a wheeled bin for recyclables prior to the scheme (24% bag / sack, 42% box, 4% other). Clearly the reality of the wheeled bin was better than the pre-conception.

Although the most desired change was 'the type/size of the Millennium collection sack' it was felt (after the focus group) that this was partly the result of communication failure rather than

just a dislike to the sack and its intended purpose. Households felt that the sack was for placing around the top of the wheeled bin and not for interim storage because the first leaflet had requested households to place the bag inside the wheeled bin on collection day. It must be noted that these households had never previously experienced a wheeled bin and perhaps highlights the importance of clear, effective communication and the danger of incorrect information / being too presumptuous about households' knowledge and familiarity with waste and recycling.

Table 4.35 Changes that Residents Would Like to See Happen to the Scheme

	Percentage of people voting for each change (n = 85)
Change the type/size of the Millennium collection sack	52%
Provide more detailed instructions about exactly what materials to put in the recycling bin	51%
Have the wheeled bin collected from beside the normal bin	35%
Introduce household feedback about the scheme	24%
Provide an additional indoor recycling bin	20%
Increase the size of the wheeled bin	12%
Other reasons	8%
Change from a wheeled bin to a re-usable bag or box	6%
Change from morning to afternoon collection	6%

The second most requested change was 'providing more detailed instructions about what to put into the bin'. This again was thought to be a communication failure from the first leaflet. All recyclables were accepted by the scheme, however there was no indication on the first leaflet of individual materials. A high proportion of households requested having their wheeled bin collected from beside their normal bin. Although this is understandable considering their lack of previous experience/habit with a wheeled bin and would make the scheme easier to use, the reality is that such a change is very unlikely to be introduced, as the major cost-benefit of wheeled bins is curtilage collection. Overall, households appeared to be satisfied and accept the Millennium recycling scheme and its current design.

4.3.5.3 Information on Recycling.

The questionnaires revealed a general dissatisfaction with the amount of information available on the recycling facilities in Bradford both before and after the recycling scheme was introduced. Before the recycling scheme, 61% agreed or strongly agreed with the statement 'the quality and amount of information about recycling in Bradford is insufficient', falling to 56% following the schemes introduction. When households were asked specifically about their

satisfaction with the amount of information on the Millennium recycling scheme, only 20% were dissatisfied or strongly dissatisfied but 40% thought it was average. However, as the questionnaire was completed before households received the second information/feedback leaflet, this response is based on the first information leaflet only, which has now been recognised as having its limitations.

There is a need for an increase in the amount of information provided to households about recycling, as households clearly feel that they are poorly informed. Prior to the Millennium recycling scheme, 79% agreed or agreed strongly that more could be done to improve the level of recycling within Bradford; 21% of households agreed or agreed strongly that recycling facilities were a long way from their place of residence, and 71% disagreed or strongly disagreed. This suggests households are aware of the location of their recycling facilities but feel that the council should provide more information about recycling in general and its purpose, as well as improve the quality of information about the facilities offered. There is significant room for improvement in relation to information about both the Millennium recycling scheme and recycling in general. Providing more information at a local, regional or national level could rectify this.

4.3.5.4 Environmental Attitudes

Consistent with the Paper Chain analyses, environmental specific attitudes were also investigated. Responses were compared before and after scheme introduction and are reported in table 4.36. From the results it would appear that the proportion of householders regarding themselves as 'environmentally conscious' changed little following the introduction of the scheme although there is a slight increase in those who strongly agreed with the statement.

Although there would appear to be a relatively even mix of opinion in relation to the purchasing of environmentally friendly products, the recycled content of a product/packaging did not appear to have much influence in purchasing decisions. The introduction of the Millennium recycling scheme did not appear to have changed these behaviours dramatically although a general increase in claimed environmental purchasing behaviour was noticed. For example, the proportion of households disagreeing with the statement that recycling labels encouraged them to recycle fell from 42% to 22 % but most transferred to the "no opinion" option rather than to positively stating being influenced to select such products. This is perhaps understandable given the recycling logo tends to be generally present or absent depending on the product / packaging type rather than offering consumers a recyclable, as opposed to non-recyclable version of the same product. Given the scheme instructions (requesting all recyclables) households may have

become more aware of recycling logos, which they used to identify product recyclability and thus, acceptability for the scheme.

Table 4.36 Environmental Attitudes Before and After Scheme Introduction

	Questionnaire	SA	A	N	D	SD
I regard myself as someone who is environmentally conscious*	Before	18%	63%	15%	5%	0%
	After	29%	54%	15%	1%	0%
I always try to but the most environmentally friendly products**	Before	3%	31%	24%	36%	6%
	After	5%	32%	41%	20%	2%
The recycled content of a product/packaging influences my purchasing decision***	Before	3%	15%	15%	60%	7%
	After	1%	12%	40%	40%	7%
Recycling labels printed on the packaging encourages me to recycle it****	Before	7%	36%	11%	42%	5%
	After	13%	31%	32%	19%	6%

* Chi-square value 4.25 Not significant.
** Chi-square value 7.96 Significance level 0.10
*** Chi-square value 12.24 Significance level 0.02
**** Chi-square value 15.01 Significance level 0.01

The proportion of households disagreeing that the recycled content of a product influenced what they buy, decreased from 67% to 47%. Again this suggests that the scheme's introduction made households more aware of their purchasing habits although the result is certainly not conclusive as, again, the main shift has been to the "no-opinion" option and the proportion agreeing with the statement has actually reduced.

Overall, the results indicate that although a large proportion of households believe they are environmentally conscious, their claimed purchasing behaviour suggests otherwise and participation in the recycling scheme has not made a dramatic difference. It is perhaps in this area, had the scheme continued, further feedback to households would could have addressed these aspects. In the longer term quantifying such behaviour is needed to ensure that the materials collected find secondary markets. This is an area that warrants further study by those involved in marketing / information provision / encouraging behaviour etc. in order to close the loop.

4.3.5.5 Legislative Drivers

Similar to the Paper Chain, analyses of households' views on the scheme were canvassed regarding legislative drivers for encouraging change. These views are reported in table 4.37. A high proportion of households both before and during the scheme claimed that we should recycle even if it costs more than landfill. As one of the main motivators of household recycling behaviour appears to be for overall environmental improvement, this figure is not surprising. However, it would appear that households (once served by the scheme) do not expect this extra cost to be borne by them directly, as 60% disagree or disagree strongly with being charged directly according to the amount of waste they produce (table 4.37). The proportion of households agreeing or strongly agreeing with variable charging decreased following the schemes introduction from 34% to 13% and the proportion of households disagreeing or strongly disagreeing with such charges increased from 57% to 60%. This may be a result of households recognising the amount of waste they produce and realising the potential financial cost could be high. Alternatively, households may expect the council to provide a recycling service, which they now recognise they are paying for already in their council tax and feel they should not be expected to pay more. Other reasons could be postulated, but it is clear that households do not accept the idea of variable / direct charging, which is consistent with other National findings (Burnley and Parfitt, 2000) and responses with households on the Paper Chain scheme.

Table 4.37 Opinions on Recycling Laws and Waste Charging Before and After Scheme Introduction

	Questionnaire	SA	A	N	D	SD
We should still recycle even if it costs more than landfill*	Before	25%	65%	5%	5%	0%
	During	22%	62%	12%	2%	2%
A law should be introduced to make people recycle more**	Before	13%	24%	13%	45%	5%
	During	13%	32%	33%	15%	7%
Households should be directly charged for their waste***	Before	7%	27%	19%	36%	11%
	During	6%	7%	27%	33%	27%

* Chi-square value 4.41 Not Significant
** Chi-square value 18.35 Significance level 0.01
*** Chi-square value 14.85 Significance level 0.01

The response to the question 'the introduction of a law to make people recycle more' was also affected by participation on the scheme. Although the strong positive and negative attitudes remained relatively similar following the introduction of the scheme there would appear to be a gradual shift in the proportion of households agreeing rather than disagreeing with the idea. This may be a result of households now having a kerbside service, therefore complying with mandatory recycling would not be difficult. However, it is still not overwhelmingly popular and introduction could be counterproductive given that good service provision achieves such high participation on a voluntary basis anyway.

4.3.6 Focus Group

No focus group analysis was undertaken during the Paper Chain and SORT scheme although qualitative comments were made during questionnaire surveys and the collection of scheme performance data. A more structured approach was adopted during the Millennium scheme, confined to eight residents from the scheme. Views expressed can only be taken as indicative. However, this method has the major benefit of gaining in-depth feedback from the participants to support and understand questionnaire returns and scheme performance data. The group addressed many topics and responses are presented below.

4.3.6.1 Behaviour and Attitudes Towards Recycling Prior to Scheme Introduction

It was revealed that although most people said they did recycle before the Millennium recycling scheme they admitted to only recycling *"a little bit'* or *'not on a regular basis"*. Further investigation suggested that facility provision and awareness were the main barriers to recycling rather than attitude. Group members suggested that it was *"the inconvenience more than anything"* which prevented them from using the bring recycling facilities. However the sample area also contained a relatively high proportion of elderly residents who expressed having problems with *"the carrying of recyclables, and having no transport"*. The provision of the kerbside scheme not only addressed the issues of convenience by providing a door-step service, but by accepting all recyclables including glass it allowed the previous recycler to recycle more efficiently. Prior to the schemes introduction it was noted that some people just *"hadn't thought about it before"* but they were *"really excited about this and really took it on board"*. This suggests that with the scheme's combination of being easy to use and being able to tap into a certain amount of enthusiasm it managed to motivate the non-committed recycler.

4.3.6.2 The First Leaflet - How Residents Felt and Acted Towards the Scheme and the Information Given to Them in the First Few Weeks of Operation.

The attitude towards recycling shown at the focus group was very positive. All the residents present voted to being in favour of recycling. Comments such as *"we were delighted that there*

was a scheme" and *"it was lovely"* suggest that households were excited and pleased that the Millennium recycling scheme had been set up.

The discussions throughout the meeting suggested that although the scheme was welcomed there was some initial confusion over the term 'recyclable' and what materials were accepted by the scheme. The first information leaflet did not specify the materials that could and could not go in the bin, with the exception of the obvious contaminants of food and garden waste. The residents voiced their confusion over the term 'recyclable' and felt that they needed a bit more help to identify what was recyclable. One of the residents said *"this bin is lovely and we wanted to use it but weren't quite sure what could go in it"*. A lot of people panicked and didn't want to contaminate the bin with unwanted items. Although the scheme removed the barrier of only targeting marketable materials and limiting peoples views about what can be recycled, such a wide message appeared to only cause panic and uncertainty. Materials initially placed in the recycling bin were therefore only those products they were sure about were i.e. newspapers, magazines, glass bottles etc.

Suggestive images of recyclable materials were integrated into the design on the front page of the leaflet, although it was felt households would have preferred a little more guidance. Households' reserved behaviour, fearing the contaminating of the recycling bin, is perhaps re-assuring for schemes requesting specific materials. However, this illustrates the importance of effective and informative communication, as an uncertain public can either lead to a low participation efficiency or high levels of contamination; both reducing the overall effectiveness of any kerbside recycling scheme.

Households that recognised what was recyclable, for example through experience, labels or conversation, were still unsure if things like cans were *"really wanted"*. Some of the confusion appears to have been due to previous national, regional and local information campaigns and conversations with friends and family served by different kerbside scheme. One resident said *"I remembered from watching Blue Peter that only aluminium cans were recyclable"*. The resident therefore was not sure if tin cans were wanted. Similarly others looked for the recyclable arrow on food packs to identify if something was recyclable, ruling out lots of recyclable materials especially the plastics. Communicating different messages at a national or local level through information provision or simply marginal differences in scheme design may cause confusion. This may restrict behaviour and result in households recycling what they are certain is 'always' collected in recycling schemes, i.e. paper.

The residents felt that the Millennium recycling scheme had increased the overall number of people who recycled. Individually, all group members felt that their intensity, frequency and range of materials recycled had increased as a direct result of the scheme introduction. Although there was some confusion over materials accepted by the scheme, there was a general consensus that the scheme allowed them to recycle more materials, more frequently. Once recognising that all recyclable material were accepted, residents felt as though the scheme met all their recycling needs. Comments such as "I *definitely recycled more in terms of quantities and type of material* and *"It's alright going to ASDA, you have your bottles, textiles etc, but what about the Wheetabix packet, that always went in the bin"* reinforces this point.

4.3.6.3 Charging for Waste Services Provided to Householders

The questions about charging the householder for scheme provision or by household waste production provoked very little response. People seemed to be unsure what they thought about the idea in relation to whether they fully understood it and to whether they agreed with its principles and practical application. Following further explanations it was thought to be "*a good idea, but unworkable"*. Some members were strongly opposed to the idea, believing that any charges should be included in the rates/council tax, and that it was unfair on certain groups of population and large families. The overall feeling was that people didn't mind the cost being added to the council tax, providing it was bellow £1 per week, but would be unhappy to pay separately for a recycling service, especially if it was to a private company. Residents did recognise that there was a certain 'cost' paid by households that recycled without a kerbside scheme. It was commented that effectively they were paying already; "*It's costing us at the moment to go down to the tip in both time and petrol, so its better to have it on the council tax".* Comments were similar to questionnaire responses in that the idea of variable charging is unpopular and controversial.

4.3.6.4 The Second Leaflet - The Effect of the Feedback Information

The initial leaflet had confused people over what to put in the bin; the second leaflet gave pictures and a list of the major categories that could go in the bin along with the recovery percentages that they had achieved for each material fraction. The residents preferred this leaflet saying it was "*very simple and clear"* and "*the pictures made it easy to understand".* This information led them to use the bins more effectively as they realised the range of materials that they could recycle. They expressed a wish that this level of information had been delivered at the beginning of the scheme, highlighting the need for clear information.

It would appear that the low recovery of fractions such as plastics and metals was, in part, due to a lack of communication at the beginning, but the feedback leaflet also prompted their

memories and made them more aware that they could do more. The recovery percentages were welcomed and were seen by residents as *"a pat on the back, it's a goal, you have achieved something"*. It was noted that there was a community *"feel good factor"* shared amongst the neighbours. It seems that the feedback leaflet had a substantial effect on participant's attitudes towards the scheme and their behaviour and should therefore not be under-estimated.

4.3.6.5 Perceived Advantages and Disadvantages of the Scheme

The main disadvantage that the group came up with was the size of the white Millennium sack. This was designed to be kept in the house but a large number of residents thought they were meant to fit inside the green bins, similar to their refuse bins. This was due to a communication error at the start of the scheme assuming that households were aware of how to use a wheeled bin. Asking households to place the sack inside the wheeled bin on collection day was intended to protect the sacks and ease collections. However, this highlights how what is perceived as a simple instruction can be interpreted by the recipient as confusing and cause them to behave in a way unexpected. The other comment was about the need for more detail in the information leaflet provided at the start of the scheme regarding this issue. Overall, the residents were all very satisfied with the scheme, citing convenience, range of materials collected and ease-of-scheme-use as advantages to bring sites and CA sites.

4.3.6.6 The Running of the Scheme and its Future

Most of the residents thought that the scheme was council run until the second leaflet was delivered and the second questionnaire collected. The residents said that the fact it was a pilot scheme played no part in how effectively they used the scheme and they would have responded in the same way to a council scheme that provided a similar service. They all said they would continue to be interested in and use the scheme now it has been passed on to Bradford Council. Many voiced their disappointment that glass would no longer be collected. The lack of kerbside glass collection may decrease the recovery of this fraction substantially as the residents seemed unsure whether they will now take their glass to be recycled. One resident remarked that *"it will depend how I am feeling, if I am feeling benevolent then they will go to ASDA, if its weather like this they will go in the bin.* This is of great concern and one which warrants further research to address this issue in order to identify if the removal of / change in a kerbside scheme in relation to the materials collected, results in households not returning to their previous recycling habits. Many multi-material kerbside recycling schemes exclude glass from their collections due to perceived current market and safety issues. More research is required to establish the potential effect that introducing 'multi-material' schemes which exclude glass city-wide will have on bottle bank recycling.

4.4 SORT

Unlike the Paper Chain and Millennium schemes, set-out and participation rates were not calculated for the SORT scheme. When samples were collected for waste analyses, an estimated set out/participation rate of 90% was assumed. Results from the questionnaire analysis suggest a c.92% participation rate and set-out rate of c.75-85%. Although not calculated, a figure of c.85% +/- 10% is accurate. However, investigating relationships between participation and other variables could not be undertaken for this scheme.

Reported waste arisings, diversion and compositions are adapted from the original data collected for the REMECOM study (ADME, 1998). Specifically, campaign 5 data is used, as the same households were sampled in both questionnaire analyses reported within the thesis. Attitude responses, reported in the questionnaire analyses section, were collected from the campaign 5 sample area, number 1, (the most successful area), although not all households approached had been selected for the waste analyses.

4.4.1 Waste Arisings and Diversions

Waste data used for this analysis is taken from a specific campaign during the REMECOM analysis project that related directly to the SORT area where questionnaires were completed. 'Campaign 5' data were analysed during a previous Masters thesis (Perrin, 1998) and categories have been aggregated where necessary to provide more simple material classifications within the context of the thesis.

Sample area performance data is presented in table 4.38 for each of the 10 sample areas. The dominant ACORN classification group is shown for comparison. A significant variation in waste arisings between sample areas is evident from 10.66 to 24.26 kg/hh/wk. Similarly, a significant range of diversions are reported. Overall, contamination levels are relatively high, particularly in areas 4 (ACORN B5) and 10 (ACORN F4). The lowest levels of between 9-18% are reported in the D9 areas. The effective diversion levels, which takes into account the diversion level in relation to the degree of contamination, are relatively low, especially for sample area 10 where both a low diversion and high

Table 4.38 Individual Campaign 5 Sample Area Performance (Adapted from ADME,1998)

		Weight Arising kg/hh/wk					Targeted Materials Only		
Sample (Area) Number	Dominant ACORN Group	Green Bin	Black Bin	Total +	Diversion %	Contamination %	Effective Diversion %	Potential Diversion %	Diversion Success %
1	D9* (50%)	3.62	8.36	11.98	30	10	27	36	76
2	A1	4.37	19.49	23.86	18	27	13	26	53
3	A1	3.69	11.98	15.67	24	18	19	29	67
4	B5	2.46	8.20	10.66	23	31	16	28	56
5	D9	3.80	19.05	22.85	17	18	14	27	51
6	D9* (66%)	3.24	10.28	13.52	24	9	22	35	63
7	A1	3.26	21.00	24.26	13	22	10	24	43
8	A1	2.93	16.06	18.99	15	20	12	25	49
9	E11* (68%)	2.82	11.68	14.50	20	23	15	27	56
10	F14	2.83	18.78	21.61	13	32	9	25	36
Sum	n/a	33.02	144.88	177.90	n/a	n/a	n/a	N/a	n/a
Average	n/a	3.30	14.49	17.79	20	21	16	28	55
Deviation	n/a	0.45	4.39	4.52	4	6	4	3	9
% Deviation	n/a	13.76	30.29	25.43	22	29	27	11	16

* Sample area contains other ACORN groups (Number in brackets indicates percentage of sample households in that ACORN group)

\+ The total weight excludes glass generated outside of the collection system

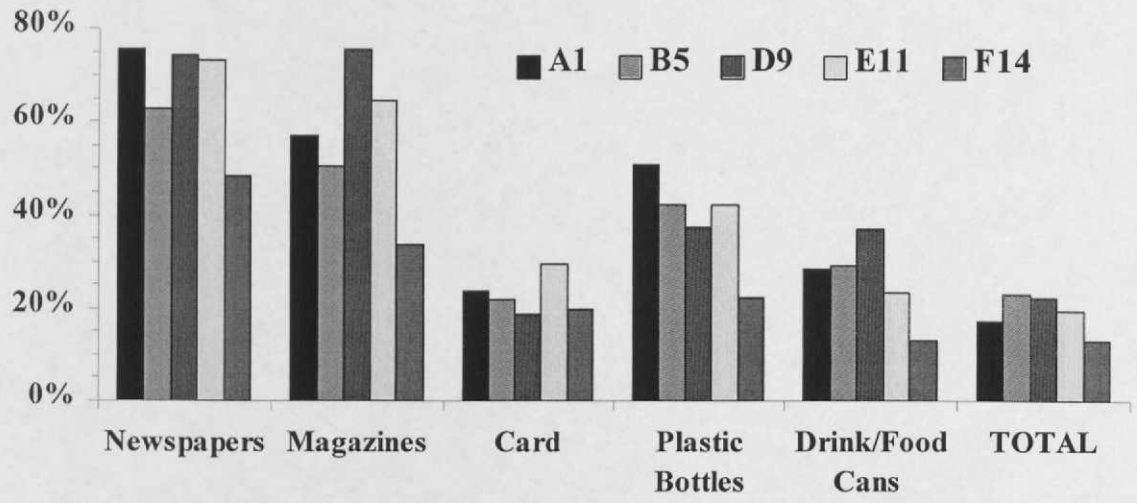
contamination have resulted in an effective diversion level of only 8.96%. Only 3 of the sample areas have achieved over 60% diversion success (which is a measure of the effective diversion in relation to the amount of material available, i.e. potential diversion).

Many reasons could be postulated about the various scheme performance relationships noticed, but it is clear that overall the scheme is only performing at half its potential. For example, the average contamination level of c.21% can have severe adverse implications on the downstream MRF operations and product quality. On introduction, the scheme initially 'cherry picked' and was only offered to the more affluent areas. The less affluent areas, i.e. sample 10, illustrate the potential implications of rolling such a scheme out city wide in its current design and scheme maintenance. An average effective diversion level of 15.83% would only meet statutory performance standards for 2003/04 (assuming the scheme was rolled out city wide and performed at the same level), but would fail to meet the future 21% standard for Leeds in 2005/06 (DETR, 2001a).

Pearson Product Moment Correlation's unsurprisingly shows a strong positive relationship between the potential diversion and diversion levels (r=0.89 significant at 0.01 confidence level). However, more interestingly, a negative relationship between total weight arisings and diversion (r= -0.81 significant at 0.01 confidence level) and total weight arisings and effective diversion is reported (r= -0.73 significant at 0.5 confidence level). This suggests that the more waste an area produces, less material is diverted and diverted effectively. However, the relationship between total weight and contamination is not evident (r=0.30 not significant confidence level) suggesting household mis-use of the SORT scheme is independent of the amount of waste they produce. A relatively high negative correlation between total weight arisings and potential diversion (r= 0.71 significant at 0.5 confidence level) confirms that households recycle less effectively in the SORT scheme the more waste they produce.

When specific material diversions are compared to the sample areas ACORN categories (figure 4.33), marginal differences are noticed between the overall diversions, although ACORN category F4 has the lowest level. More interestingly, differences in recoveries between targeted materials are similar in all areas; newspaper and magazines report the highest recoveries and cardboard and food/drink cans the lowest. However, low card recoveries are thought to be a result of poor communication by the authority, including materials to the scheme, without correctly informing households (Perrin, 1998).

Figure 4.33 Specific Material Diversions in Relation to ACORN Groupings



[Note 1] ACORN categories are based on a single/accumulation of sample(s) where the dominant ACORN group has been used to classify an area, although a small proportion of households may have been classified under a different category 2) TOTAL is based on diversion of all materials into the green bin and not just targeted materials]

Differences between ACORN categories and the recovery of different materials are reported, i.e. A1 households recovering the highest plastic bottles but are third for magazines. The data suggests that some ACORN categories perform well recovering some materials, but not others. However, the F4 group consistently under-performs in relation to the other ACORN categories. Such results should be viewed with caution as this test was not designed to investigate the influence of ACORN categories on recoveries and further analyses would be required to be conclusive.

Targeted material diversion ratios, in relation to the newspaper fraction are shown in table 4.39 Ratios have been normalised against the newspaper fraction to identify household's relative participation efficiency in relation to other materials. The different mean ratios suggest a variation between the recovery of materials. Excluding card (for reasons previously identified), drink / food cans report the lowest ratio (0.41) followed by plastic bottles (0.60) then magazines (0.86). Low standard deviations confirm differences in the recovery efficiency between materials. Sample area 6 (predominantly ACORN D9) reports relatively large ratios for both magazines and drink/food cans in relation to the other sample areas. Reasons for this are unknown other than to suggest sampling error or that these households are a unique sub-set of the population and less affected by issues associated with recovering different materials.

Unfortunately, as drink and food cans are grouped together it is difficult to identify if beverage containers achieve similar recoveries.

Table 4.39 SORT Diversion Ratios

Sample Area	Newspapers	Magazines	Card	Plastic Bottles	Drink/Food Cans
	Diversion	Ratios	Ratios	Ratios	Ratios
1	82.1 %	0.96	0.32	0.51	0.44
2	72.7 %	0.57	0.33	0.61	0.30
3	86.2 %	0.99	0.22	0.65	0.41
4	62.8 %	0.80	0.35	0.68	0.46
5	70.0 %	0.73	0.23	0.47	0.42
6	70.4 %	1.41	0.26	0.64	0.70
7	69.0 %	0.79	0.44	0.56	0.31
8	74.1 %	0.73	0.25	0.87	0.47
9	73.1 %	0.88	0.40	0.58	0.32
10	48.4 %	0.69	0.41	0.46	0.27
Mean	70.9 %	0.86	0.32	0.60	0.41
S.D	0.10 %	0.22	0.08	0.11	0.12

4.4.2 Compositional Analysis

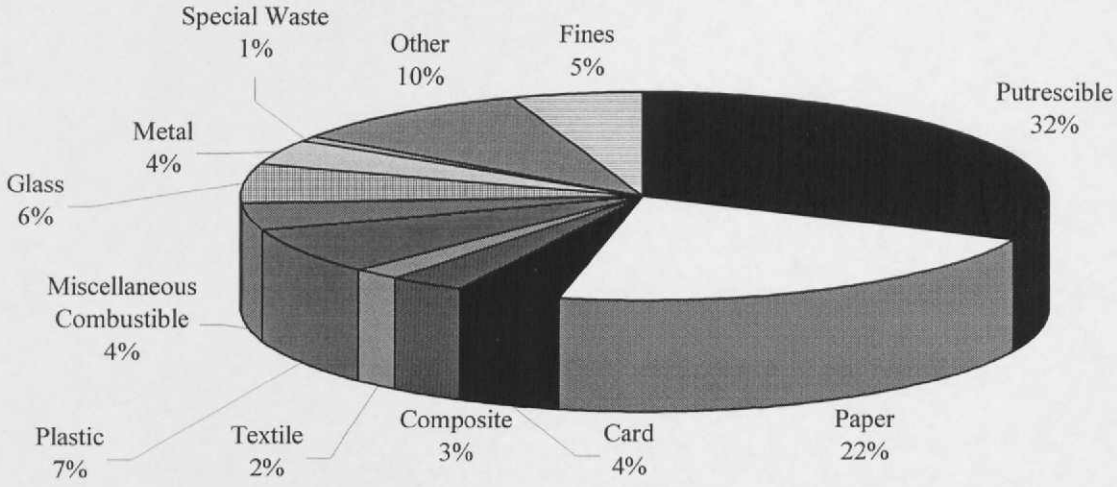
Table 4.40 shows the waste composition for each of the sample areas. Although all areas report a similar proportion of their waste arising in each category, the most important point to note is the variability in the quantity of total waste produced and specific materials between areas. For example, area 10 generates over ten times the amount of textiles than area 1, which may be the difference between introducing a viable collection scheme for a specific material. The other fraction represents a high proportion of the waste due to the small number of material categories shown.

Figure 4.34 presents the mean waste composition for all 10 sample areas. The putrescible content in relation to the Millennium scheme data and nationally reported data is relatively high. Similarly, the packaging fractions, i.e. glass, metal and plastic are proportionally lower, which may reflect the proportion of materials recycled at bring sites (especially the glass fraction). However, when considering weight arising in kg/hh/wk, they are similar. This may be a result of all SORT areas having a wheeled bin, whilst the Millennium sample area was served by a sack collection, and nationally, only c.40% of households are served by this waste collection method. The largest dry recyclable fraction is paper accounting for 22% of the total which equates to c.3.9kg/hh/wk; it is also the most successfully recovered fraction.

Table 4.40 Waste Composition in Relation to Sample Areas in kg/hh/wk (% of total waste arisings in brackets)

Material	Sample Area										
	1	2	3	4	5	6	7	8	9	10	ALL
	D9	A1	A1	B5	D9	D9	A1	A1	E11	F14	
Food Waste	1.88 (15.7)	3.21 (13.4)	2.49 (15.9)	2.17 (20.3)	6.15 (27.4)	1.93 (14.2)	3.78 (15.6)	3.01 (15.8)	3.23 (22.3	4.61 (21.3)	3.25 (18.3)
Garden Waste	0.76 (6.3)	3.78 (15.9)	3.50 (22.3)	0.56 (5.3)	1.44 (6.4)	3.28 (24.2)	5.19 (21.4)	1.21 (6.3)	2.57 (17.7)	1.39 (6.5)	2.37 (13.3)
Newspaper	2.48 (20.7)	2.36 (9.9)	2.05 (13.1)	1.35 (12.6)	2.61 (11.6)	2.64 (19.4)	2.05 (8.5)	1.83 (9.6)	1.67 (11.5)	2.00 (9.3)	2.10 (11.8)
Magazines	1.13 (9.5)	1.86 (7.8)	1.25 (8.0)	1.06 (9.9)	1.01 (4.5)	0.87 (6.4)	1.06 (4.4)	0.86 (4.5)	1.04 (7.2)	0.69 (3.2)	1.08 (6.1)
Card	0.45 (3.8)	0.76 (3.2)	0.64 (4.1)	0.63 (5.9)	0.97 (4.3)	0.30 (2.2)	1.07 (4.4)	0.79 (4.2)	0.57 (3.9)	0.96 (4.4)	0.71 (4.0)
Plastic Bottles	0.25 (2.1)	0.36 (1.5)	0.32 (2.0)	0.37 (3.4)	0.55 (2.4)	0.20 (1.5)	0.32 (1.3)	0.33 (1.8)	0.23 (1.6)	0.47 (2.2)	0.34 (1.9)
Plastic Containers	0.14 (1.2)	0.27 (1.1)	0.23 (1.4)	0.16 (1.5)	0.28 (1.2)	0.11 (0.8)	0.27 (1.1)	0.27 (1.4)	0.17 (1.2)	0.21 (1.0)	0.21 (1.2)
Plastic Carrier Bags	0.34 (2.8)	1.26 (5.3)	0.40 (2.5)	0.58 (5.4)	0.69 (3.1)	0.31 (2.3)	0.57 (2.4)	0.53 (2.8)	0.34 (2.4)	0.80 (3.7)	0.58 (3.3)
Glass Bottles and Jars	0.74 (6.2)	0.74 (3.1)	0.85 (5.44)	0.72 (6.7)	1.88 (8.4)	0.49 (3.6)	0.78 (3.2)	1.54 (8.1)	0.94 (6.5)	1.38 (6.4)	1.0 (5.7)
Drink and Food Cans	0.31 (4.8)	0.49 (2.1)	0.43 (2.7)	0.65 (6.1)	0.66 (2.9)	0.42 (3.1)	0.56 (2.3)	0.73 (3.9)	0.47 (3.2)	1.15 (5.3)	0.59 (3.3)
Textiles	0.12 (1.8)	0.46 (1.9)	0.21 (1.3)	0.11 (1.0)	0.25 (1.1)	0.27 (2.0)	0.38 (1.5)	0.31 (1.6)	0.27 (1.9)	1.23 (5.7)	0.36 (2.0)
Other	3.38 (12.6)	8.31 (34.8)	3.31 (21.3)	2.31 (21.7)	5.95 (26.6)	2.75 (20.3)	8.23 (33.9)	7.59 (40.0)	3.51 (20.7)	6.6 (31.0)	5.17 (29.1)
TOTAL	**11.98**	**23.86**	**15.67**	**10.66**	**22.45**	**13.57**	**24.26**	**19.00**	**14.50**	**21.61**	**17.76**

Figure 4.34 Mean Waste Composition for ALL sample areas



Although plastics are the second largest dry recyclable fraction with 7% of total arisings, only bottle plastics are targeted to minimise logistical and market issues. More interestingly, the 6% of glass generated but which is excluded from the scheme is coincidentally desired by residents to be included. If glass were to be included in this scheme and recovered as effectively as in the Millennium scheme (c.70%) an additional 0.84kg/hh/wk of material would be diverted, increasing the effective diversion to c.24%, which would meet future targets. This would assume that the scheme would be rolled out and achieve similar recoveries. However, what is clear, is that the exclusion of glass can significantly affect recoveries and that if the technical difficulties associated with both the glass and plastic fractions can be addressed, both materials have a significant role to play in achieving high diversions.

Table 4.41 illustrates the variation in waste composition between sample areas when assigned to their appropriate ACORN category. Although results should be interpreted with caution for reasons previously identified, some logical relationships can be identified. For example, category F14 (typified as young families with young children in often cramped conditions) report a significantly higher proportion of textiles, possibly a result of the continual need to replenish young children's clothes. Also a high proportion of drink and food cans associated with tinned children's food and fizzy drink cans. The 'working class' background typically suggest a higher proportion of alcoholic beverage cans. As an ACORN category that has the most difficult social conditions, the proportion of 'luxury' items, e.g. magazines is relatively low.

A high proportion of drink/food cans are also found in the B5 category (represented by well off family areas). The children within this area are older and include teenagers which would explain, in association with affluence, the high proportion of magazines. By applying this logic relationship between households, characteristics and waste composition allows differences between groups to be more clearly understood.

Table 4.41 Waste Composition in Relation to ACORN Category in kg/hh/wk (% of total waste arisings in brackets)

	A1	B5	D9	E11	F14
Food Waste	3.12 (15.1)	2.17 (20.4)	3.32 (20.8)	3.23 (22.3)	4.61 (21.3)
Garden Waste	3.42 (16.5)	0.56 (5.3)	1.82 (11.4)	2.57 (17.7)	1.39 (6.4)
Newspaper	2.07 (10.0)	1.35 (12.7)	2.57 (16.1)	1.67 (11.5)	2.00 (9.3)
Magazines	1.26 (6.1)	1.06 (15.0)	1.00 (6.3)	1.04 (7.2)	0.69 (3.2)
Card	0.82 (4.0)	0.63 (5.9)	0.57 (3.6)	0.57 (3.93)	0.96 (4.4)
Plastic Bottles	0.33 (1.6)	0.37 (3.5)	0.33 (2.1)	0.23 (1.6)	0.47 (2.2)
Plastic Containers	0.26 (1.3)	0.16 (1.5)	0.18 (1.1)	0.17 (1.2)	0.21 (1.0)
Plastic Carrier Bags	0.69 (3.3)	0.12 (1.1)	0.45 (2.8)	0.34 (2.3)	0.81 (3.7)
Glass Bottles and Jars	0.97 (4.7)	0.72 (6.8)	1.04 (6.5)	0.94 (6.5)	1.38 (6.4)
Drink and Food Cans	0.55 (2.7)	0.65 (6.1)	0.46 (2.9)	0.47 (3.2)	1.15 (5.3)
Textiles	0.34 (1.6)	0.11 (1.0)	0.22 (1.4)	0.27 (1.9)	1.23 (5.7)
Other	6.87 (33.2)	2.76 (25.9)	4.04 (25.3)	3.00 (20.7)	6.71 (31.1)
TOTAL	20.70	10.66	16.00	14.50	21.61

[Note] ACORN categories are based on a single/accumulation of sample(s) where the dominant ACORN group has been used to classify an area, although a small proportion of households may have been classified under a different category.

4.4.3 Questionnaire Analysis

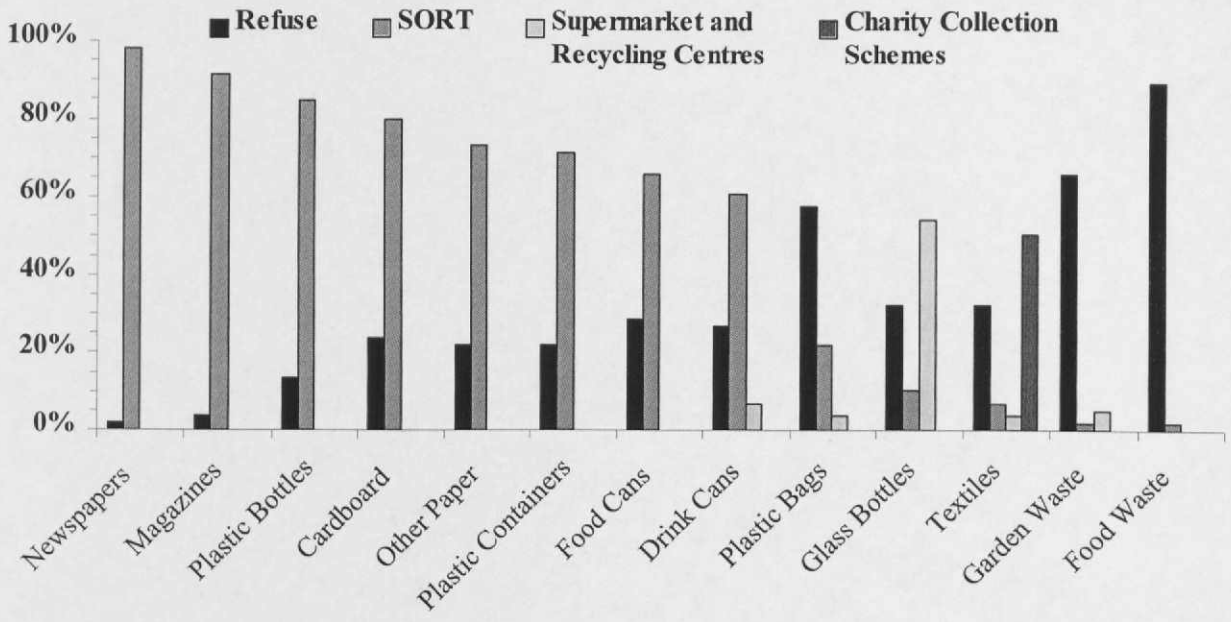
4.4.3.1 Claimed Recycling Behaviour

Of the 64 households asked, 93.8% claimed to recycle; of these 92% of respondents claimed to use the SORT recycling scheme. Three respondents indicated that they have never used the

SORT scheme and two respondents have 'opted-out' as they felt they were confused. They thought the scheme was inconvenient, and they regularly forgot to set their bin out on a regular basis. The remaining analysis will therefore focus only on SORT participants.

Figure 4.35 shows household claimed disposal and recycling behaviour. Households were encouraged to indicate as many applicable disposal options for each material. Therefore, results should (although unlikely) provide a rough estimation of participants efficiency. The less than 100% value reported for food waste in the refuse is thought to reflect household composting activity, an issue raised when collecting the questionnaires. There is a strong support for diverting textiles through charity collection schemes by 51% of the respondents. Equally a high percentage of respondents (54%) indicated recycling glass bottles, despite their exclusion from the scheme, at supermarkets and recycling centres (bring sites).

Figure 4.35 SORT Participants Claimed Disposal and Recycling Behaviour



[Note] Respondents were encouraged to tick as many boxes as applied for each material

Undoubtedly, nearly all households use the SORT scheme for newspaper (98%) and magazines (92%), although a comparably high proportion of households claim to recycle other materials targeted by the scheme, e.g. plastic bottles (85%), cardboard (80%), other paper (73%), food cans (66%) and drink cans (61%).

While a high proportion of households claim to place plastic containers in their green bin (71%), they are not targeted and may be a result of confusion on behalf of the household in the terminology used. For example, they may be interpreting plastic bottles as coke bottles and plastic containers as 4-litre milk bottles. Other reasons could be postulated, but waste analyses suggest otherwise. The lower claimed diversion levels of materials such as food / drink cans suggests some households are quite content to use the scheme for certain materials and not others; or this may reflect lack of awareness that these materials are requested. There is however evident variation in the claimed level of recycling for different materials. Overall, a declining pattern of claimed recoveries is noticed in relation to the level of inconvenience a material presents to the householder in order to recycle. This issue will be addressed later in the thesis.

Table 4.42 shows the high number of households who claim to rinse different material types prior to recycling them. The most dirty material, food cans, are claimed to be rinsed most in relation to other materials. Only a small percentage of households claim to rinse pet food cans despite their similar soiled nature. The extra time required to rinse materials may lead to some households choosing not to recycle these items. However, when respondents were asked if they would recycle more if they could place materials directly into the green bin without rinsing them, 28% agreed or strongly agreed and 49.1% disagreed or disagreed strongly. This suggests many households are either recycling at their perceived maximum level or they do not desire dirty materials being placed in their recycling bin. Some 35.6% of households agreed or strongly agreed that they need to clean their green bin on a regular basis to prevent odours; this compares to 40.7% disagreeing or strongly disagreeing, suggesting the latter is a greater issue.

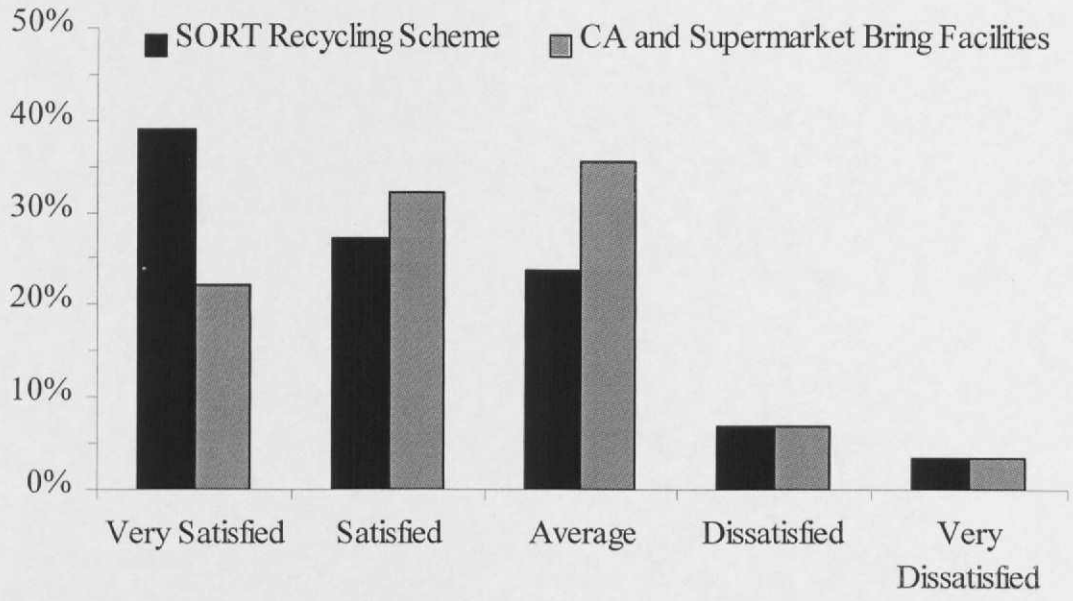
Table 4.42 Percentage of SORT Participants Rinsing Materials

Material	Percentage of Respondents
Food Cans	57.6%
Plastic Bottles	45.8%
Drink Cans	28.8%
None	27.1%
Pet Food Cans	25.4%

*Respondents could indicate more than one response

Although paper is the major component recovered by the scheme, 74.6% of households disagreed or disagreed strongly to the suggestion of replacing the SORT scheme with a paper only collection and only 3.4% agreed or strongly agreed, suggesting households are not necessarily dissatisfied with their current recycling provision. When households were directly asked about their level of satisfaction with the SORT scheme (and bring facilities), no great level of enthusiasm was claimed and satisfaction between the two recycling methods is similar (figure 4.36). There were few people totally dissatisfied with either method.

Figure 4.36 SORT Households Response to Scheme Provision



As with the Millennium scheme data, when actual recoveries are compared to the number of people claiming to recycle each material, differences are noted (table 4.43). Small differences are noted for the paper fractions (c.15% relative difference) and larger differences for the more difficult fractions with relative differences between 44 to 67%. This suggests those who are claiming to recycle these materials are not very efficient at recovering them. A large proportion of food and drink cans, plastic bottles and card end up in the residual bin. The high relative difference of 67% for card is thought to reflect the lack of publicity by the local authority to correctly inform residents of its addition into the recycling scheme. Similarly, the high relative difference of plastic bottles is thought to be a communication error, previously identified. What is clear is that the more convenient materials are being recovered more effectively.

Table 4.43 Recovery Rates and Claimed Recycling Behaviour

	Respondents Claiming to Recycle each Material	Average Recovery Rate of Questionnaire Sample Area 1*	Difference (%)	Relative Difference (%)
Newspaper	98%	82 %	- 16 %	- 16 %
Magazines	92%	79 %	- 13 %	- 14 %
Cardboard	80%	26 %	- 54 %	- 67 %
Plastic Bottles	85%	42 %	- 43 %	- 51 %
Plastic Containers**	71%	5 %	- 66 %	- 93 %
Food/Drink Cans	64%	36 %	- 28 %	- 44 %

*Recovery data is calculated from sample area 1 from 1998 REMECOM data.
** Not targeted by the scheme

4.4.3.2 Motivators and Barriers Towards Recycling

Consistent with questionnaire responses from the previous two pilot schemes and national findings, the greatest reasons for recycling was for 'future environment and generations' (table 4.44). 'Personal satisfaction / habit' and 'saves waste / landfill space' were also commonly cited by 59.3% and 57.6% of households respectively.

Table 4.44 Reasons for SORT Participants Recycling

Reason Stated	Percentage of Respondents
For the Future Environment / Generations	69.5
Personal Satisfaction / Habit	59.3
Saves Waste / Landfill Space	57.6
Good Facilities Nearby / Convenient	35.6
Save Dustbin Space	20.3
Peer Pressure / Duty	8.5

The questionnaire results suggest that participants are relatively satisfied and loyal to their SORT recycling scheme, although only 35.6% of households claimed to recycle as a result of good convenient nearby facilities. There is significant room for improvement for this scheme with only 10.2% of respondents agreed or strongly agreed that they would stop using SORT if a recycling centre was more convenient. Concerning the container of choice for recyclables some 78.0% of respondents disagreed or strongly disagreed that a box or bag would be easier to collect their recyclables where 65.3% agreed or strongly agreed that the wheeled bin acted as a visual reminder to recycle. This is supported by the small percentage of respondents requesting

any changes to the collection container in its size, type and quantity of bins for their recyclable material (table 4.45).

There is a strong desire to include other materials such as glass into the scheme, which is not surprising given that 54% of households currently claim to recycle glass at bring sites. Similarly other convenience issues such as an increase in collection frequency and providing an indoor container were the next most commonly cited changes. Although the wheeled bin provides an ideal storage point, it is located outside, usually beside the residual wheeled bin and households are accustomed to having an interim storage disposal point, i.e. 'the kitchen bin'. Issues such as poor weather / late evenings when the 'recyclable baked beans can' is generated means the householder has to provide / find an additional interim storage point within the household if they wish to recycle the material.

Table 4.45 Changes Residents Would Like to See Happen to the Scheme

Reason Stated	Percentage of Respondents
Collects more materials (e.g. glass)	59.3%
Have the Recycling Bin Collected More Frequently	45.8%
Provide an Additional Indoor Recycling Container	30.5%
Provide more Detailed Instructions about Exactly how to use the Green Bin Scheme	18.6%
Provide Households with Feedback About their performance	16.9%
Increase size of the Wheeled Bin	11.9%
Have Separate Containers for each Recyclable Material	11.9%
Change from Wheeled Bin to a Re-usable Bag/Box	3.4%
Reduce size of the Wheeled Bin	3.4%
Other	3.4%

Opinions on collection frequency are divided. 42.3% of respondents agreed or strongly agreed that they would recycle more if there bin was collected more frequently whilst 44.1% disagreed or disagreed strongly. However, an increase in collection frequency was cited as the second most popular change that residents would like to see happen to the scheme (table 4.45). Some 72.9% of respondents claim to 'never' forget to put their green bin out on collection day compared to 22.0% who 'occasionally' and 5.1% who 'frequently' forget. 69.4% of respondents

state their bin is often full or overflowing prior to the collection day (table 4.46), while a further 20.3% state their bin is ¾ full when they set out their recycling bin. Therefore, 90.3% of the respondents, if they missed the collection, would have insufficient capacity within their green bin until the next collection. This may be a concern considering that 18.6% of respondents could not indicate their next green bin collection date and a further 3.4% indicated the wrong date. This was not necessarily representative of a lack in memory, as residents had c. 1 week to complete the questionnaire, within which time they could have checked their information stickers supposedly placed on the lid of their bin.

Table 4.46 Period taken for households to fill their green bin who claimed to set out their green bin at the kerbside for collection 'full' or 'overflowing'

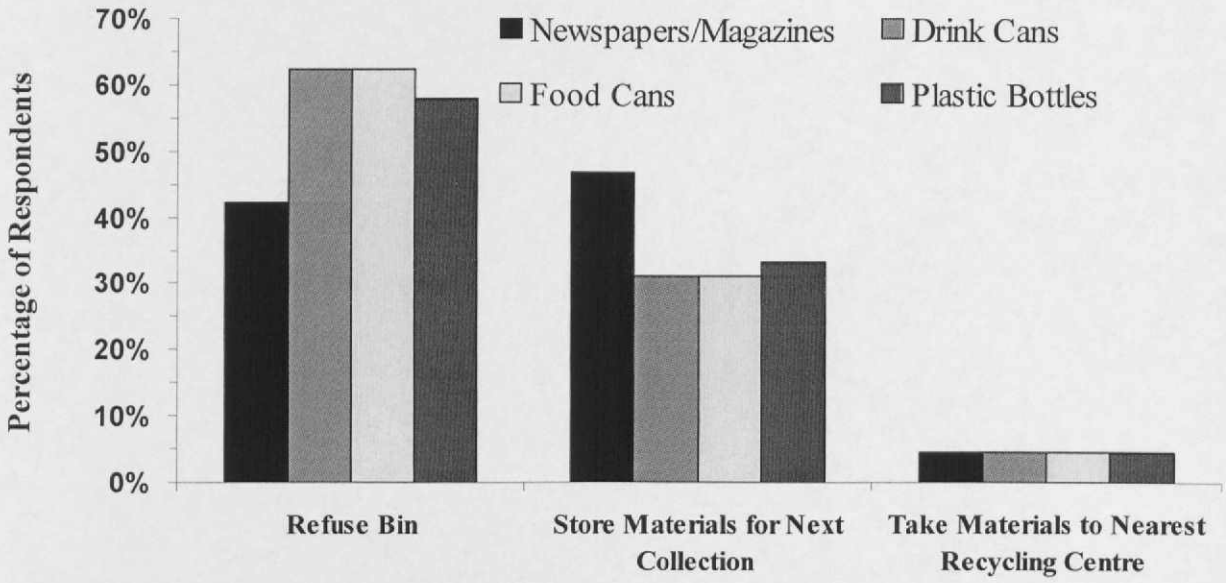
Period	Percentage of Respondents
1 week	0.0%
2 weeks	9.3%
3 weeks	23.3%
4 weeks	41.9%
Just before collection	25.6%

On comparison 93.2% of households put out their black wheeled bin for collection (which is collected weekly) predominantly on a weekly basis. The remaining households place their bin out fortnightly (3.4%) monthly (1.7%) or less often (1.7%). 54.3% of respondents claim their refuse bin is full or overflowing when set out, whilst the remainder put out their wheeled bin ¾ full (25.4%), ½ full (18.6%) or ¼ full (1.7%).

Households were asked to indicate where their 'would be SORT' recyclable material goes when the green bin gets full in order to identify the potential loss or storage of material (figure 4.37). The most common option is to place the materials in the refuse bin, followed by saving the materials for the next SORT collection. A significantly lower percentage of respondents (2%) indicated taking their materials to the nearest recycling centre. Differences between materials reflect ease of storage; a smaller percentage of respondents indicate placing newspapers in the refuse bin rather than storing them for the next collection. The marginal increase in the storage of plastic bottles for next collection compared to food and drink cans may again be a result of ease of storage.

The surprisingly high percentage of respondents who claim to store their drink and food cans for the next collection may be a result of the question asked. The reported result does not stipulate the acceptable period of storage. In relation to the time taken by the majority of respondents to fill their green bin (table 4.46), this storage may only be for a period of c.1 week which would cause no serious issues. If the collection were missed, it would be unlikely that household storage/disposal behaviour highlighted in figure 4.37 would remain the same.

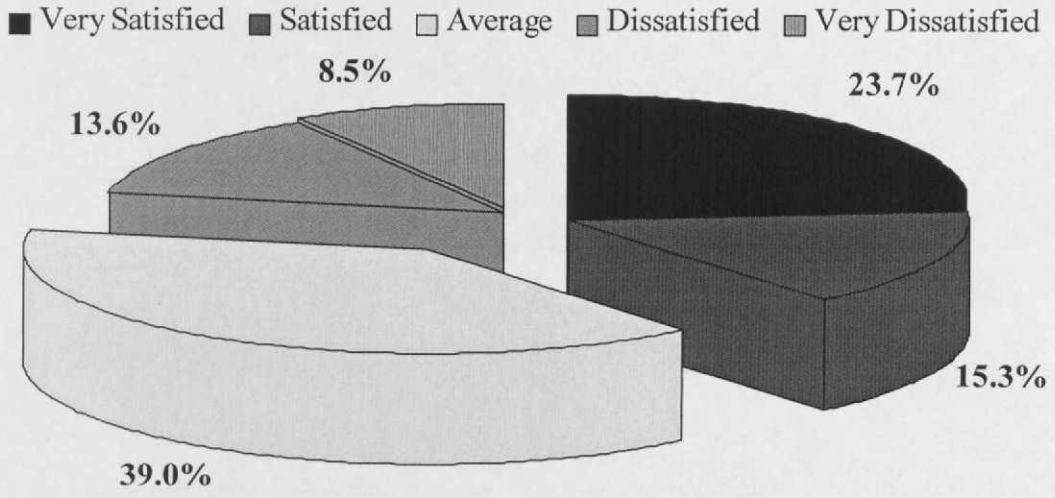
Figure 4.37 Households Storage/Disposal Behaviour for Different Materials when their Green Recycling Bin is Full



[Note] Respondents could indicate more than one response

Previous research on resident attitudes towards SORT (Perrin, 1998) suggested residents were confused about what materials could be placed into the green bin. Effective information, knowledge and understanding how to use a scheme is paramount in the success of any recycling scheme, and therefore a series of statements investigated household's perception of the amount and quality of the information provided. Respondents were asked to indicate on a scale of 1 (Very Satisfied) to 5 (Very dissatisfied) their level of satisfaction with the quality and quantity of information offered to them about SORT (figure 4.38).

Figure 4.38 Satisfaction with the Quality and Quantity of Information About SORT



More specific questions (table 4.47) suggest that although the majority of households are generally aware of to how to use the scheme correctly, there is a significant proportion who do not (22.0%). Over 49.2% of residents disagree or disagree strongly that the council provide enough regular information explaining how to use the scheme and forthcoming collection dates, although only 27.1% of residents feel as though they would recycle more as result of any performance feedback. Overall, the results suggest that there is perhaps a need for more sufficient and regular education / information / communication between the council and residents.

Table 4.47 Response to Information Provision

Statements	SA	A	N	D	SD
Regular information from the council about how well I used the Green Bin (SORT) recycling scheme would encourage me to recycle more	8.5%	18.6%	35.6%	27.1%	10.2%
I find the Green Bin (SORT) recycling scheme very confusing to use and unsure of exactly what materials to put into the recycling bin	0.0%	22.0%	15.3%	37.3%	25.4%
The council constantly remind me how to use the recycling scheme and when the collection dates are	10.2%	22.0%	18.6%	33.9%	15.3%

4.4.3.3 Legislative Drivers

Consistent with questions asked to residents served by the other two schemes, household views were canvassed in relation to potential future drivers, variable charging and separate charging to make people more aware and responsible for their waste disposal behaviours. As expected, both proposals were unpopular (table 4.48), where between 78.3% to 81.3% of respondents disagreed or strongly disagreed with the suggestions.

Table 4.48 Opinions on Waste Charging (SORT Respondents)

Statements	SA	A	N	D	SD
The cost of your waste / refuse collection should be charged separately from your council tax. For example, like electricity / gas	3.4%	0.0%	15.3%	20.3%	61.0%
Waste collection should be charged per bag or bin to encourage us to recycle more an put less out for refuse collection	5.1%	3.4%	15.3%	27.1%	49.2%

5.0 SUPPORTIVE SECONDARY DATA

The following results have been adapted from a series of reports (M-E-L, 1999, Miller associates, 1999, Thomas, 2000) and data provided by Daventry District Council for the purpose of this research. The views are not necessarily those presented within the reports, but those of the author in the context of this thesis. For the original views and more detailed information, readers should refer to the original references highlighted.

5.1 Project Integra

5.1.1 Participation, Set out and Performance Data

Table 5.1 highlights the significant variation of participation in and performance of recycling schemes between authorities. Table 5.2. illustrates the various scheme designs in operation within Hampshire. Eastleigh achieved the highest rates in all performance measures with a participation rate of 95% and diversion rate of 32%. A relatively high proportion of targeted materials were recovered (73%) and a high capture rate of 76% is not surprising. High participation rates above 90% were also achieved by Fareham, Hart, and Basingstoke and Dean, where all authorities provided wheeled bins to collect recyclables. Households with the lowest participation rates, in Gosport and Rushmoor, were provided with a sack or no container. Although no significant variation is evident and the relationship is not universal, the data would suggest that provision of a wheeled bin promotes higher participation rates. The exception to this is Winchester and New Forest where participation rates of 87-89% were achieved. Participation rates for authorities providing a box for recyclables were marginally lower than those providing a wheeled bin, although again, this relationship is not conclusive.

Within the context of mandatory targets set in the Waste Strategy 2000, if the schemes were representative of the authority as a whole (and not just the scheme), all would fail to meet the 2015 target. Only two would meet the 2005 and 2010 targets of 25% and 30% respectively, yet scheme participation levels are high for nearly all authorities. Increasing participation would have little effect, it is the increase in participation efficiency that needs to be addressed. For example, even if Gosport and Rushmoor doubled their current participation level, a maximum of c. 13% diversion level would be achieved. This is well short of the required mandatory levels, but in line with the interim targets of authorities with recycling rates between 5-15%, which need to be doubled by 2003/4. Effectively, the solution is not just an increase in the number of households participating, but also an improvement in how effectively they participate.

Table 5.1 Individual councils within the (Project Integra) Hampshire Scheme Performance Data

Council	Collection Container	Participation Rate (%)	Diversion Rate (%)	Recovery Rate (%)	Capture Rate (%)
Fareham	WB	94	16	49	52
Hart	WB	94	12	54	57
Eastleigh	WB	95	32	73	76
Portsmouth	B	79	11	37	47
East Hants	WB	67	24	50	74
Havant	B	88	17	46	52
Basingstoke and Deane	WB	91	9	33	36
Gosport	S	50	6	35	70
New Forest	S	89	23	65	73
Rushmoor	N/S	53	7	28	54
Winchester	N/S	87	11	33	38
Test Valley	WB	83	30	48	58

WB = Wheeled Bin, S = Sack, B = Box, N = None **(Source: Thomas, 2000)**

[Note – Performance indicators referred to by Thomas, 2000 were calculated in accordance with DETR (1999c) guidelines.]

Table 5.2 A Summary of Hampshire's Scheme Design

Council	Container		Collection Frequency		Materials Collected
	Recycling	Residual	Recycling	Residual	
Fareham	WB	WB	Fortnightly	Weekly	NP, M, MP, C, PB, FC, DC,
Hart	WB	WB	Weekly	Weekly	NP, M, PB, FC, DC,
Eastleigh	WB	WB	Fortnightly	Fortnightly	NP, M, MP, C, PB, FC, DC,
Portsmouth	Box	None	Fortnightly	Weekly	NP, M, MP, C, PB, FC, DC,
East Hants	WB	WB	Weekly	Weekly	NP, M, MP, C, PB, FC, DC,
Havant	Box	None	Fortnightly	Weekly	NP, M, MP, C, PB, FC, DC,
Basingstoke and Deane	WB	Sack/small bins	Weekly	Weekly	NP, M, PB, FC, DC,
Gosport	Sack	None	Fortnightly	Weekly	NP, M, MP, C, PB, FC, DC,
New Forest	Sack	Sack	Weekly	Weekly	NP, M, MP, C, PB, FC, DC,
Rushmoor	None (sack)	WB	Weekly	Weekly	NP, M, PB, FC, DC,
Winchester	None (sack)	WB	Weekly	Weekly	NP, M, MP, C, PB, FC, DC,
Southampton	Trial only	WB	-	Weekly	NP, M
Test Valley	WB	WB	Alternate Weekly	Weekly	NP, M, MPR, C, PB, FC, DC, Com

NP = Newspaper, M= Magazines, MP= Mixed Paper, C = Card, PB = Plastic Bottles, FC = Food Cans (Ferrous/non-ferrous), DC, Drink Cans (ferrous/non-ferrous), Com = Compostables, WB= Wheeled Bin

Source: M-E-L (1999)

Test Valley authority targets the most materials in relation to other Hampshire authorities as it collects compostible kitchen and garden waste. Despite having a relative high diversion rate,

presumably due to the heavy weight of compostibles, its recovery rate and capture rate are relatively low, thought to reflect the lack of understanding of residents (Miller Associates, 1999). Test Valleys 'alternate weekly' collection uses the same wheeled bin container for dry recyclables and compostible waste. Households have to either choose to recycle only one of the fractions or find their own alternative storage point, if they wish to recycle both. Alternatively residents can request a third wheeled bin. c.25% of residents have done this (Thomas, 2000). This requires a further 'inconvenience' on the householder to contact the authority and it is likely only the committed recyclers who have done this.

The 'capture rate', which effectively measures how efficiently households who choose to participate in the scheme recycle, varies significantly between authorities. Such variation could be a result of a scheme design, intrinsic factors within the home, the level of understanding of households about how to use the scheme and what materials are requested. Other reasons could be postulated, but this highlights the problem with the current situation and understanding the mechanisms of a good recycling scheme and what makes an individual recycle efficiently.

Two of the best performing authorities provide a wheeled bin, although the next best, New Forest, provides a sack. Consistently New Forest demonstrates impressive participation, recovery and capture rates, despite its 'inconvenient' scheme design. This is thought to be related to the intensity and variety of publicity campaigns within the authority, implying that maintenance of a scheme is relatively more important than the design itself. Although the Test Valley scheme design, in principle is effective, catering for all the households needs, it is one of the worst performing authorities in providing information and education to residents. This is reflected in resident's attitudinal responses, where households within the authority were found to be the most confused (Miller Associates, 1999).

The participation rate in Gosport is relatively low, yet households who are participating are recycling efficiently, demonstrated by a relatively high capture rate of 70%. Similarly, East Hants also has a relatively low participation rate but those participating are recycling efficiently with the second highest capture rate of 74%. From a global overview of the data, three general observations in relation to participation and scheme performance are suggested,

1) That scheme design appears to affect the level of participation and quantity of materials recycled,
2) The effective use of information, communication education etc. (scheme maintenance) is related to the capture rate, i.e. how efficiently households recycle,
3) Recyclers can be divided into the committed and non-committed; the committed will not be as easily influenced by the schemes design, communication efforts etc. as long as they

understand the basics of what is required of them to participate and will find out if necessary.

5.1.2 Compositional Analysis and Recovery Data

Waste composition data from M-E-L (1999) has been adapted to provide an overview of the average waste composition (table 5.3) and material diversions (table 5.4) for 12 of the Hampshire authorities. The mean values have been taken for each authority based on all waste analyses undertaken within that authority regardless of the ACORN category. Therefore, the mean value for each authority is based on either 2 or 3 waste analyses from different ACORN groups. The sampling matrix reported in M-E-L (1999) for each authority reports the diverse range of ACORN categories monitored. Detailed category compositions, reported by M-E-L have been aggregated to provide broader based material categories to facilitate comparisons. However, it should be noted that the materials included within these new categories are not necessarily targeted by the various recycling schemes and therefore some material recoveries, i.e. paper, may appear lower than expected. Diversions of newspapers and magazines will be reported separately later in the chapter. For exact material diversion data, readers should refer to the original data source.

Table 5.3 Mean Composition of All 12 Hampshire Authorities (kg/hh/wk)

Council	Paper	Card	Plastic Film	Plastic Bottles	Other Plastics	Textiles	Drink Cans	Food Cans	Glass Jars & Bottles	Garden Waste	Other Putrescible	Other	Total
1	3.82	0.90	0.55	1.50	0.44	0.61	0.05	0.23	0.37	6.72	2.12	1.63	18.92
2	6.14	0.92	0.56	0.20	0.57	0.72	0.10	0.30	0.64	5.47	2.11	2.26	19.97
3	5.07	1.06	1.03	0.18	0.76	0.44	0.08	0.40	0.51	0.31	2.27	1.99	14.06
4	3.42	1.42	0.81	0.28	0.75	1.37	0.09	0.39	0.85	1.58	3.22	2.33	16.51
5	7.08	1.67	0.89	0.27	0.69	0.36	0.11	0.46	0.80	1.22	2.96	1.71	18.19
6	3.83	0.91	0.78	0.20	0.48	0.55	0.06	0.41	0.69	0.74	2.42	1.77	12.82
7	6.10	1.33	1.15	0.23	0.76	1.09	0.21	0.56	0.57	1.63	3.16	3.33	20.09
8	3.07	0.91	0.69	0.23	0.50	0.76	0.07	0.37	0.59	1.06	2.58	1.62	12.45
9	2.92	0.72	1.36	0.12	0.71	0.37	0.06	0.28	0.36	1.13	1.91	1.14	11.05
10	4.17	1.22	1.45	0.22	0.58	0.57	0.19	0.37	0.56	2.58	2.26	1.34	15.48
11	4.35	1.30	0.99	0.17	0.78	1.11	0.07	0.45	0.76	1.78	2.81	1.72	16.26
12	3.94	1.16	1.40	0.22	0.89	0.70	0.07	0.31	0.73	5.93	2.88	2.16	20.36

1= Fareham, 2= Hart, 3= Eastleigh, 4=Portsmouth, 5= East Hants, 6= Havant, 7= Basingstoke and Deane, 8= Gosport, 9= New Forest, 10= Rushmoor , 11= Winchester, 12= Test Valley.

Paper = Newspaper, Magazines, Recyclable Paper (Non-packaging), Non-recyclable Paper. Card = Card & paper packaging, Cardboard, Card non-packaging, Liquid Cartons. Plastic Film = Refuse sacks, Film (packaging), Film (non-packaging). Plastic Bottles = All colours PET, HDPE and PVC. Other Plastics = Food and non-food packaging, Other. Textiles = Natural and man made fibres, Shoes. Glass jars and bottles = All colours. Drink/food cans = ferrous and non ferrous

Table 5.4 Diversions of all 12 Hampshire Authorities (%)

Council	Paper	Card	Plastic Film	Plastic Bottles	Other Plastics	Textiles	Drink Cans	Food Cans	Glass Jars & Bottles	Garden Waste	Other Putrescible	Other	Total
1	65.0	51.1	9.1	5.0	11.5	5.0	50.0	26.7	1.4	0.0	0.0	3.4	17.4
2	36.8	4.3	2.7	43.6	3.5	0.7	21.1	11.7	0.8	0.0	0.0	0.9	12.5
3	72.4	51.4	4.4	63.9	12.6	5.7	53.3	36.7	3.0	0.0	0.9	3.8	34.0
4	43.1	15.5	2.1	39.3	5.3	0.2	22.2	16.1	3.9	0.0	0.0	0.6	12.1
5	53.8	33.3	2.3	40.7	7.3	0.0	47.6	22.8	4.4	0.0	0.0	0.6	26.1
6	48.4	22.0	3.2	37.5	11.5	0.0	41.7	23.2	0.7	0.0	0.0	0.3	18.3
7	25.5	0.0	3.0	46.7	3.3	0.0	24.4	14.3	0.0	0.0	0.0	0.3	9.3
8	25.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3
9	69.0	43.8	3.3	62.5	9.9	4.1	54.5	49.1	1.4	0.0	0.0	1.8	24.6
10	25.8	1.6	0.9	20.0	1.7	0.0	5.4	6.4	0.0	0.0	0.0	0.0	7.7
11	35.7	18.1	2.5	27.3	4.5	1.4	30.8	13.3	0.0	0.0	0.0	1.2	12.4
12	41.2	25.1	2.1	27.3	7.9	0.0	28.6	13.1	2.1	71.3	5.0	2.6	32.3

1= Fareham, 2= Hart, 3= Eastleigh, 4=Portsmouth, 5= East Hants, 6= Havant, 7= Basingstoke and Deane, 8= Gosport, 9= New Forest, 10= Rushmoor , 11= Winchester, 12= Test Valley.

Paper = Newspaper, Magazines, Recyclable Paper (Non-packaging), Non-recyclable Paper. Card = Card & paper packaging, Cardboard, Card non-packaging, Liquid Cartons. Plastic Film = Refuse sacks, Film (packaging), Film (non-packaging). Plastic Bottles = All colours PET, HDPE and PVC. Other Plastics = Food and non-food packaging, Other. Textiles = Natural and man made fibres, Shoes. Glass jars and bottles = All colours. Drink/food cans = ferrous and non ferrous.

To assess whether socio-demographic factors had a significant effect on waste composition and scheme performance, a sub-set of authorities with ACORN category D9 was also selected for analysis (table 5.5 and 5.6). Comparisons using the same criteria used for calculating the mean for all authorities were completed. However, it should be noted that the composition and diversions for this subset are based on single samples, which would amplify any outliers or mis-sorting.

Both the composition and generation rates of waste between authorities is significantly different (table 5.5 and 5.6), with mean generation rates within the expected range of between 11.05 and 20.36 kg/hh/wk. The observed variations may be influenced by socio-demographic variations between authorities, although trends associated with the residual container used are also consistent with those reported in the literature. For example, mean generation rates of 17.61 kg/hh/wk for authorities using a wheeled bin for residuals compared to 14.58 kg/hh/wk for those using a traditional sack rear of property collection. Local authorities using a wheeled bin have a higher proportion of garden waste present, on average 3.43 kg/hh/wk compared to 1.23 kg/hh/wk.

The difference between the maximum and minimum ranges for each material is shown in tables 5.7 and 5.8. Mean values are lower than national reported data, although the relative proportions are similar with a large difference in the range of waste composition seen between all authorities. Reducing the analyses to a single ACORN group, D9 does not reduce this variability.

Table 5.5 Composition, D9 Households Only within Hampshire (kg/hh/wk)

Council	Paper	Card	Plastic Film	Plastic Bottles	Other Plastics	Textiles	Drink Cans	Food Cans	Glass Jars & Bottles	Garden Waste	Other Putrescible	Other	Total
1	3.11	0.96	0.51	0.07	0.36	0.77	0.05	0.18	0.34	6.66	2.53	1.35	16.89
2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	5.07	1.19	1.12	0.21	0.73	0.5	0.07	0.39	0.62	0.33	2.26	2.05	14.54
4	3.84	1.54	0.82	0.3	0.73	0.96	0.1	0.42	0.67	2.39	4.15	2.63	18.55
5	6.5	1.2	0.56	0.24	0.65	0.24	0.1	0.45	0.99	0.92	2.27	1.7	15.82
6	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-
11	5.07	1.05	0.8	0.13	0.63	0.76	0.07	0.38	0.76	1.41	2.5	1.18	14.74
12	4.44	0.98	1.19	0.22	0.59	0.65	0.06	0.29	0.37	5.66	2.2	1.68	18.33

1= Fareham, 2= Hart, 3= Eastleigh, 4=Portsmouth, 5= East Hants, 6= Havant, 7= Basingstoke and Deane, 8= Gosport, 9= New Forest, 10= Rushmoor , 11= Winchester, 12= Test Valley. - = No D9 Households monitored within the authority

Paper = Newspaper, Magazines, Recyclable Paper (Non-packaging), Non-recyclable Paper. Card = Card & paper packaging, Cardboard, Card non-packaging, Liquid Cartons. Plastic Film = Refuse sacks, Film (packaging), Film (non-packaging). Plastic Bottles = All colours PET, HDPE and PVC. Other Plastics = Food and non-food packaging, Other. Textiles = Natural and man made fibres, Shoes. Glass jars and bottles = All colours. Drink/food cans = ferrous and non ferrous

Table 5.6 Diversions, D9 Households Only within Hampshire (Not all material categories and sub-categories targeted by the recycling schemes)

Council	Paper	Card	Plastic Film	Plastic Bottles	Other Plastics	Textiles	Drink Cans	Food Cans	Glass Jars & Bottles	Garden Waste	Other Putrescible	Other	Total
1	77.5%	53.1%	11.8%	85.7%	13.9%	1.3%	60.0%	38.9%	2.9%	0.0%	0.0%	6.7%	19.5%
2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	65.9%	47.9%	5.4%	52.4%	15.1%	6.0%	42.9%	30.8%	3.2%	0.0%	1.8%	2.4%	30.8%
4	48.7%	16.9%	2.4%	53.3%	6.8%	0.0%	40.0%	21.4%	6.0%	0.0%	0.0%	0.0%	13.6%
5	57.1%	28.3%	5.4%	50.0%	6.2%	0.0%	60.0%	31.1%	7.1%	0.0%	0.0%	0.0%	28.5%
6	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-
11	32.9%	28.6%	2.5%	38.5%	3.2%	1.3%	28.6%	15.8%	0.0%	0.0%	0.0%	0.0%	14.6%
12	53.6%	40.8%	3.4%	31.8%	13.6%	0.0%	33.3%	17.2%	0.0%	61.7%	5.9%	4.2%	36.7%

1= Fareham, 2= Hart, 3= Eastleigh, 4=Portsmouth, 5= East Hants, 6= Havant, 7= Basingstoke and Deane, 8= Gosport, 9= New Forest, 10= Rushmoor , 11= Winchester, 12= Test Valley. - = No D9 Households monitored within the authority

Paper = Newspaper, Magazines, Recyclable Paper (Non-packaging), Non-recyclable Paper. Card = Card & paper packaging, Cardboard, Card non-packaging, Liquid Cartons. Plastic Film = Refuse sacks, Film (packaging), Film (non-packaging). Plastic Bottles = All colours PET, HDPE and PVC. Other Plastics = Food and non-food packaging, Other. Textiles = Natural and man made fibres, Shoes. Glass jars and bottles = All colours. Drink/food cans = ferrous and non ferrous.

Although differences between the maximum and minimum material values shows the range or variation that exists between materials, the relative differences between these values highlights more interesting points. In both the 'all authorities' sample and the 'D9 sample', the quantity of garden waste can be around 20 times as much between authorities. Plastic bottles in the 'all authorities' sample shows equally high levels of variability, with differences of c.12.5 times the amounts of waste generated between the lowest and highest reported values. Within the D9 sample areas, the relative difference between the lowest and highest reports for the quantity of individual materials in waste composition, show that all materials can have at least twice the amount between authorities. The largest differences are between garden waste, plastic bottles, glass and food cans. Materials reporting the least variability are card and textiles.

Mean material diversion levels based on the 12 authorities (table 5.4) show significant variations. Overall diversions from 6.3% to 34.0% are reported. The amount of available material for recycling is limited in some authorities and abundant in others. A Pearsons Product Moment correlation statistical test was undertaken to establish if authorities with limited material available reported lower recoveries. No statistical relationship was identified, showing that unlike results found from the SORT scheme, recoveries were independent of waste composition.

High variability can be noted for individual material diversions, particularly those present in small amounts. This may reflect a relatively small sample size number used to assess categories at such a detailed level, rounding data values and the associated limitations of doing so. Such uncertainty highlights some of the problems on relying on secondary data to derive at new conclusions.

Table 5.7 Mean Material Composition Ranges Between ALL Authorities (kg/hh/wk)

	Paper	Card	Plastic Film	Plastic Bottles	Other Plastics	Textiles	Drink Cans	Food Cans	Glass Jars & Bottles	Garden Waste
Max	7.08	1.67	1.45	1.50	0.89	1.37	0.21	0.56	0.85	6.72
Min	2.92	0.90	0.55	0.12	0.44	0.36	0.05	0.23	0.36	0.31
Diff.	4.16	0.77	0.9	1.38	0.45	1.01	0.16	0.33	0.49	6.48
Mean	4.5	1.1	1.0	0.3	0.7	0.7	0.1	0.4	0.6	2.5
S.D	1.3	0.3	0.3	0.4	0.1	0.3	0.1	0.1	0.2	2.2

Table 5.8 Mean Material Composition Ranges Between D9 Authorities (kg/hh/wk)

	Paper	Card	Plastic Film	Plastic Bottles	Other Plastics	Textiles	Drink Cans	Food Cans	Glass Jars & Bottles	Garden Waste
Max	6.50	1.54	1.12	0.30	0.73	0.96	0.10	0.45	0.99	6.66
Min	3.11	0.96	0.51	0.07	0.36	0.5	0.05	0.18	0.34	0.33
Diff.	3.39	0.58	0.61	0.23	0.37	0.46	0.05	0.27	0.65	6.33
Mean	4.7	1.2	0.8	0.2	0.6	0.7	0.1	0.4	0.6	2.9
S.D	1.2	0.2	0.3	0.1	0.1	0.3	0.0	0.1	0.2	2.6

None of the recycling schemes collect plastic film, other plastics or glass. However, contamination levels of c.20% are noticed in authorities such as Eastliegh. All authorities report some non-requested materials in their recycling container. This may reflect a series of issues such as mis-sorting, lack of knowledge or confusion about requested materials on behalf of the householder. Relatively high diversion levels of 'other plastics' would suggest that households are confusing bottle plastics with plastic containers. This issue has already been raised from data collected on the three kerbside schemes monitored within this thesis.

No glass categories are requested in any of the schemes. Glass diversion levels are significantly lower than the non-requested plastic categories. Confusion over the product type is not an issue, but the reported levels of glass in the recyclables fraction may reflect the desire of households to recycle glass or their assumption that a recycling bin is for recyclables, ignoring the materials requested in promotional and information leaflets.

Eastleigh high diversion level is not only reflective of the successful recovery of targeted materials but also a result of the high level of contaminants in the recycling container. What is interesting to note is that although Test Valley has a similar high diversion level to Eastliegh (the best performing authority), a large majority of the material diverted is garden waste. Diversions of other 'dry recyclables' are comparable to the 'poorer performing' authorities. Similar patterns are noticed when only D9 households are considered (table 5.6). Although the diversion rate is comparable to Eastleigh, participation, recovery and capture rates, which reflect an individual household's performance are significantly lower. The greater number of materials targeted by Test Valley ensure comparable diversion levels although participation efficiency is significantly lower. Overall, the waste composition is comparable to national reported data.

Recoveries of the more 'inconvenient' packaging materials, e.g. plastic bottles, drink cans and food cans are severely compromised. In some instances, the recoveries of some materials are

almost half that of other authorities collecting the same dry recyclable materials. The paper and card fraction are not as affected, although these materials are acceptable compost material. Resident feedback in Miller Associates (1999) showed that Test Valley households were more likely to be confused about their requirements to participate, reflected in the recovery data.

Limiting comparisons to D9 households to identify if any relationship between container type and material recoveries exists was inconclusive. Portsmouth and Winchester report lower food can diversions where a box or sack is used to store the recyclables. These containers, unlike wheeled bins, are likely to be stored within the home and therefore hygiene would become a more serious issue. Lower recoveries of heavier requested materials, i.e. paper and card are also reported. Heavy boxes filled with paper can present a serious barrier to households (especially the elderly) in taking the box to the kerbside. Similar relationships can not be identified for the lighter materials.

Winchester, (which provides a sack or no container to collect recyclables) reports lower recoveries for all materials, especially for the packaging fraction. This may be a result of limited storage capacity for recyclables where households have to provide either their own containers or find storage for their bag inside the home or garage. However, Winchester consistently reports a lower level of contaminants than the other authorities. Limited storage space may prevent households recycling frivolously and being *more* careful about using their limited space effectively.

Questionnaire responses showed that a higher proportion of Havant and Portsmouth residents thought their recycling container was not big enough. Both authorities use a box to collect their recyclables and both report relatively lower recoveries of paper and card in comparison to authorities using a wheeled bin.

Unfortunately, there were not enough separate waste analyses with different scheme designs from D9 households to conclude if specific elements of a scheme design i.e. the container used and collection frequency do effect specific material recoveries. Although the results suggest a relationship, further research is required to be conclusive.

The previous waste compositional analyses and diversions have grouped together a series of paper fractions, which may explain why some authorities report lower levels than expected. Newspaper and magazine only recoveries are presented in tables 5.9 and 5.10 alongside diversion ratios of the other targeted materials, card, plastic bottles, drink and food cans. Ratios

have been normalised against the newspaper fraction as done in the Millennium and SORT schemes.

Table 5.9 Diversion Ratios (ALL Hampshire Authorities)

Council	Newspapers	Magazines	Card	Plastic Bottles	Drink Cans	Food Cans
	Diversion/Ratios	Diversion/Ratios	Ratios	Ratios	Ratios	Ratios
1	85.6 (1.0)	71.4% (0.83)	0.60	*[0.00]*	0.58	0.31
2	65.6 (1.0)	27.8% (0.42)	NT	0.66	0.32	0.18
3	84.6 (1.0)	84.0% (0.99)	0.61	0.76	0.63	0.43
4	63.6 (1.0)	45.5% (0.72)	0.24	0.62	0.35	0.25
5	63.7 (1.0)	69.0% (1.08)	0.52	0.64	0.75	0.36
6	67.0 (1.0)	51.8% (0.77)	0.33	0.56	0.62	0.35
7	57.0 (1.0)	18.4% (0.32)	NT	0.82	0.43	0.25
8	46.5 (1.0)	22.4% (0.48)	NT	*[0.00]*	*[0.00]*	*[0.00]*
9	83.2 (1.0)	74.8% (0.90)	0.53	0.75	0.66	0.59
10	38.8 (1.0)	25.4% (0.65)	NT	0.52	0.14	0.16
11	56.8 (1.0)	47.3% (0.83)	0.32	0.48	0.54	0.23
12	58.2% (1.0)	42.1% (0.72)	0.43	0.47	0.49	0.23
Mean Ratio	64.2 % (1.0)	48.3% (0.73)	0.45	0.63	0.50	0.30
SD	Not Calculated	0.11	0.11	0.13	0.22	0.19

1= Fareham, 2= Hart, 3= Eastleigh, 4=Portsmouth, 5= East Hants, 6= Havant, 7= Basingstoke and Deane, 8= Gosport, 9= New Forest, 10= Rushmoor , 11= Winchester, 12= Test Valley.

NT = Not Targeted.

***[0.00]* = Bracketed data is excluded from the mean and standard deviations as it is thought not be accurate.**

Newspapers =, Newspaper only, Card = Card & paper packaging, Cardboard, Card non-packaging, Liquid Cartons. Plastic Bottles = All colours PET, HDPE and PVC. Drink/food cans = ferrous and non ferrous.

Table 5.10 Diversion Ratios (Hampshire D9 Households)

Council	Newspapers	Magazines	Card	Plastic Bottles	Drink Cans	Food Cans
	Diversion/Ratios	Diversion/Ratios	Ratios	Ratios	Ratios	Ratios
1	90.8 % (1.0)	86.9% (0.96)	0.58	0.94	0.66	0.43
2	-		-	-	-	-
3	78.5 % (1.0)	80.5% (1.03)	0.61	0.67	0.55	0.39
4	66.7 % (1.0)	59.8% (0.90)	0.25	0.80	0.60	0.32
5	66.1 % (1.0)	65.9% (1.00)	0.42	0.76	0.91	0.47
6	-		-	-	-	-
7	-		-	-	-	-
8	-		-	-	-	-
9	-		-	-	-	-
10	-		-	-	-	-
11	58.6 % (1.0)	39.4% (0.67)	0.49	0.66	0.49	0.27
12	74.1 % (1.0)	56.8% (0.77)	0.55	0.43	0.45	0.23
Mean Ratio	1.0	0.89	0.48	0.71	0.61	0.35
SD	Not calculated	0.07	0.04	0.16	0.03	0.03

1= Fareham, 2= Hart, 3= Eastleigh, 4=Portsmouth, 5= East Hants, 6= Havant, 7= Basingstoke and Deane, 8= Gosport, 9= New Forest, 10= Rushmoor , 11= Winchester, 12= Test Valley.

NT = Not Targeted.

- = No D9 households monitored within the authority

Newspapers =, Newspaper only, Card = Card & paper packaging, Cardboard, Card non-packaging, Liquid Cartons. Plastic Bottles = All colours PET, HDPE and PVC. Drink/food cans = ferrous and non ferrous.

An important point to notice is that authorities not targeting card and mixed paper have poorer recoveries of magazines than authorities requesting mixed paper and card. The materials collected are ultimately determined by the requirement of the materials recycling facility (MRF). However, it would appear that by not requesting these materials households may be confused about the message communicated and the distinction between the two categories, thus the recovery of magazines is suffering.

The mean ratios in the 'all authorities' sample and the 'D9 sample' show similar ratio patterns in relation to the material. Food cans are the worst recovered material with ratios to newspapers of 0.30 and 0.35. Card is the second worst recovered material with ratios of 0.45 and 0.48 followed by beverage containers, with the plastic bottle ratio of 0.63 and 0.71 being slightly higher than the drink cans ratio of 0.50 and 0.61. The best performing material following newspapers is magazines with a ratio of 0.73 and 0.89. Although the ratio levels vary, it is clear that there is a significant difference in the recovery efficiency of different materials regardless of the scheme design.

5.1.3 Attitude Data

A selection of relevant attitude data extracted from Miller Associates (1999) is referred to support the primary findings within the thesis; the analysis is not that of Miller Associates. For the primary analysis and further results, readers should refer to the original reference.

When households were asked what would encourage them to recycle, a convenient kerbside recycling system was the most popular response (table 5.11). Justifying the scheme and making households aware of there systems through effective communication were also high. Yet forcing households to recycle raised mixed views, with compulsory recycling systems being more favourable than a variable charging system.

Table 5.11 What (Hampshire) households feel would encourage people to recycle their waste

Measure	Total = 1563 %
Providing people with a convenient and easy to follow household collection system	70
Giving people a good reason to do more	31
Make recycling compulsory	31
Using a high profile media campaign to shock people	30
Support local businesses which can repair, re-use or recycle household items	18
Levy a charge based on the amount of rubbish put out	13

Household reasons for participating and not participating in a recycling scheme within Hampshire are shown in table 5.12 and 5.13. Views are from households from a variety of authorities served by different residual and recycling scheme designs as previously shown. The main reason households participate in recycling scheme is because the facilities are there and it

makes sense to do so. This is not reflective of positive environmental or recycling attitude of an individual, but a simple logistical service provision issue. All households served may not use the service efficiently, but they will use it if it is there. Environmental reasons do play a part, highlighted by the other responses. People want to make a contribution and do their bit. The least popular responses are those relating to effectively peer pressure. Similar results are comparable to the primary data collected and previous literature findings.

Table 5.12 Reasons for Participating in the recycling Scheme (Hampshire)

Reason	Weighted Total = 931(%)
Because the facilities are provided so I do it	41
It makes sense	37
Its good for the environment	37
It means I can do my bit/make my contribution	21
I hate to see things wasted	12
It means I can get more waste in my other bin	8
Other	4
Other people in the household encourage me o do it	3
My neighbours do it	2
Don't know	1

Table 5.13 Reasons for Not Participating in the Recycling Scheme (Hampshire)

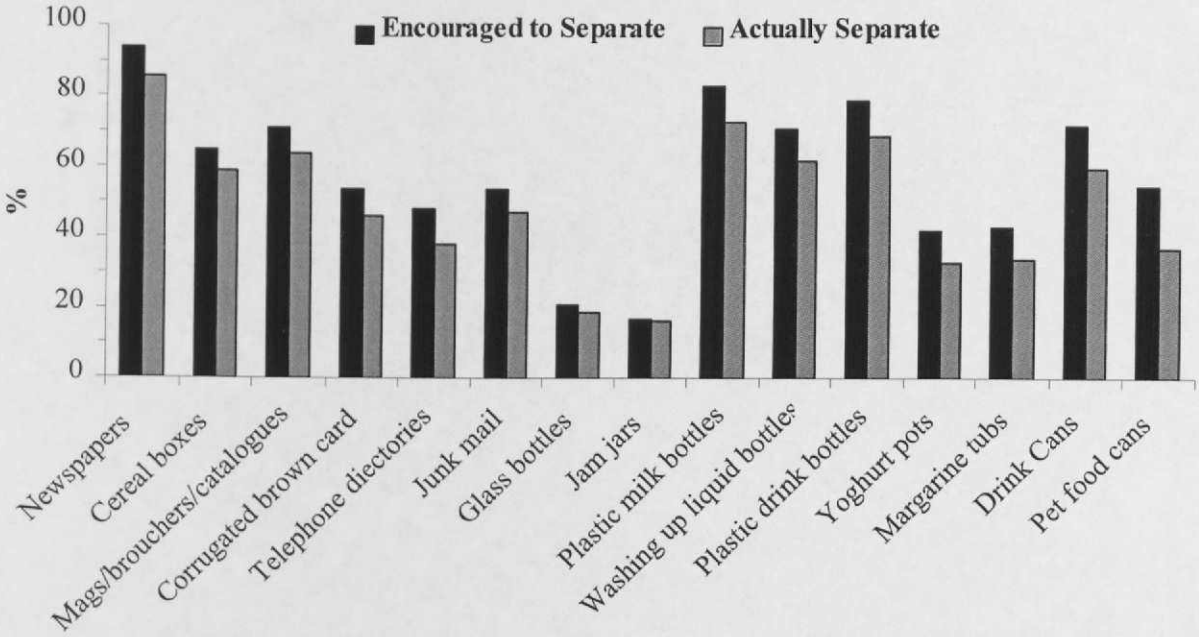
Reason	Weighted Total = 91(%)
Haven't been supplied with the bag/bin/box	24
Haven't been told enough about the scheme / don't know what to do	14
Other	14
There's nowhere to store plastics/cans/papers etc.	13
Don't see the point	11
Don't produce enough waste to make it worthwhile	11
Not interested / Can't be bothered	8
No longer have bin/box/sack	7
Live in a flat or other accommodation not included in the scheme	4
Don't Know	4

Household's main reasons for not participating in one of the recycling schemes are related to not being made aware of the scheme, or, not being provided with the facilities to participate. Other reasons including storage issues within the home, which may arise from some of the

schemes 'inconvenient' designs are also popular reasons for not using a scheme. The apathetic reasons such as 'not interested', 'don't see the point' are not as popular, although still evident.

Understanding how to use a scheme and what materials are requested is fundamental to a scheme's success. Readers should refer to Thomas (2000) for a detailed analysis of household understanding of schemes on 'Project Integra'. Figure 5.1 shows, by material, household perception as to what is recyclable by comparing actual separation against requested separation. Clearly, for all materials, householders are aware they recycle less material than is requested.

Figure 5.1 **Households perception of what they are requested to separate and what they actually claim to separate for doorstep collection (Hampshire). Adapted from (Miller Associates, 1999)**



However, c.18% of households claim to place this material in the kerbside schemes and c.40% of households claim to place other non-requested materials such as plastic into the scheme. This suggests there may be a communication failure, despite the intensive campaigns undertaken within the district. Although evident within the waste analyses, material diversions do not support these inaccuracies to such a level and questionnaire responses may reflect household desire to be seen to be doing the right thing, even if this not reflective of their actual behaviour.

5.2 Daventy – Waste Trial

The Daventry waste trial ran from August 1998 to August 1999. The main aim of the project was to maximise participation in the trial, monitor the effect of continual communication and identify as to whether this was the route to achieving and maintaining higher diversion rates. A red and blue box dry recyclable kerbside collection system had been in operation in the area for a period of over 2 years, collected on a weekly basis. The red box collected paper fractions, the blue box, cans, aerosols, plastic bottles, glass jars and bottles. Textile items, i.e. clothes, shoes, blankets etc. were collected via bags placed at the side. Approximately 70% of trial area households had boxes and households were provided with an additional 240 litre wheeled bin for organic waste. The normal grey refuse bins and organic bins were collected on an alternating weekly collection service. For more details refer to Waste Watch (1999b).

5.2.1 Compositional Analysis and Recovery Data

Tables 5.14 and 5.15 show the waste composition of the sample area for two waste audits and the varying diversion levels of materials into the appropriate collections containers. Data has been adapted from information forwarded by Sue Reed (Daventry Recycling Officer) and the analysis and opinions are those solely of the author. Only selected material categories relevant to supporting the thesis have been presented.

An important point to notice is the increase in the waste arisings between the two sorts. In May 1998, 12.44 kg/hh/wk was generated compared to 20.52 kg/hh/wk in October 1999. The weights, excluding the amount of material diverted into the compost bin, has increased from 10.78 kg/hh/wk (May 1998) to 12.41 kg/hh/wk (October 1999). During both collections households were served by wheeled bins and differences are thought to be reflective of seasonal variations affecting the sorting process.

Table 5.14 Daventry Waste Analyses May 1998.

Fraction		Residue kg/hh/wk	Recyclables Red/blue box kg/hh/wk	Compost Brown Bin kg/hh/wk	Total Waste Incldung compost	Total waste excluding compost kg/hh/wk	Recyclables Diversion (%)	Recyclables Diversion including Compost (%)
Paper & Card	Newspapers	1.33	1.23	0.09	2.64	2.55	46.5%	49.8%
	Magazines/ads/glossy							
	Cardboard & Paper packaging +	0.69	0.00	0.00	0.69	0.69	0.0%	0.0%
Glass	Clear glass jars & bottles	0.27	0.16	0.00	0.42	0.42	36.9%	36.9%
	Green glass jars & bottles	0.06	0.12	0.00	0.19	0.19	66.9%	66.9%
	Brown glass jars and bottles	0.07	0.04	0.00	0.11	0.11	36.7%	36.7%
	Total Glass Bottles & Jars	0.40	0.32	0.00	0.72	0.72	44.6%	44.6%
	Other glass	0.10	0.00	0.00	0.10	0.10	0.0%	0.0%
Metals	Ferrous drink cans	0.01	0.01	0.00	0.02	0.02	61.0%	61.0%
	Aluminium drink cans	0.01	0.01	0.00	0.03	0.03	55.4%	55.4%
	sub-total drink cans	0.02	0.03	0.00	0.05	0.05	58.1%	58.1%
	Ferrous food cans	0.21	0.05	0.00	0.27	0.27	19.8%	19.8%
Textiles	Textiles	0.18	0.00	0.00	0.18	0.18	0.0%	0.0%
Plastic	PET Bottles	0.03	0.04	0.00	0.07	0.07	52.5%	56.5%
	HDPE Bottles	0.09	0.06	0.00	0.15	0.15	40.3%	40.3%
	PVC Bottles	0.01	0.00	0.00	0.02	0.02	21.4%	21.4%
	Sub-total plastic bottles	0.14	0.10	0.00	0.24	0.24	43.1%	43.1%
	Plastic Film +	0.56	0.00	0.00	0.56	0.56	0.0%	0.0%
	Other plastic food and non-food packaging +	0.17	0.00	0.00	0.17	0.17	0.0%	0.0%
Total Targeted Recyclables		2.60	1.73	0.09	4.42	4.33	39.2%	41.2%
Total Targeted Compostables		2.97	0	1.50	4.47	2.97	0.0%	33.6%
Total Residue		3.40	0.08	0.07	3.55	3.48	2.1%	4.0%
Total Waste		8.97	1.81	1.66	12.44	10.78	14.5%	27.9%

+ Not Requested by the scheme

Table 5.15 Daventry Waste Analyses October 1999.

Fraction		Residue kg/hh/wk	Recyclables Red/blue box kg/hh/wk	Compost Brown Bin kg/hh/wk	Total waste Including Compost kg/hh/wk	Total waste excluding compost kg/hh/wk	Recyclables Diversion (%)	Recyclables Diversion including Compost (%)
Paper & Card	Newspapers Magazines/ads/glossy	1.16	1.56	0.03	2.74	2.71	56.8%	57.8%
	Cardboard & Paper packaging+	0.63	0.03	0.00	0.66	0.66	4.0%	4.0%
Glass	Clear glass jars & bottles	0.27	0.30	0.00	0.57	0.57	53.0%	53.0%
	Green glass jars & bottles	0.15	0.23	0.00	0.38	0.38	61.1%	61.1%
	Brown glass jars and bottles	0.05	0.07	0.00	0.11	0.11	58.8%	58.8%
	Total Glass Bottles & Jars	0.46	0.60	0.00	1.06	1.06	56.5%	56.5%
	Other glass	0.11	0.00	0.00	0.11	0.11	0.0%	0.0%
Metals	Ferrous drink cans	0.01	0.02	0.00	0.04	0.04	62.7%	62.7%
	Aluminium drink cans	0.01	0.02	0.00	0.03	0.03	55.5%	55.5%
	sub-total drink cans	0.03	0.04	0.00	0.06	0.06	59.4%	59.4%
	Ferrous food cans	0.20	0.08	0.00	0.29	0.29	29.0%	29.0%
Textiles	Textiles	0.28	0.01	0.00	0.29	0.29	2.06%	2.1%
Plastic	PET Bottles	0.05	0.06	0.00	0.11	0.11	55.7%	55.7%
	HDPE Bottles	0.10	0.09	0.00	0.19	0.19	47.6%	47.6%
	PVC Bottles	0.00	0.00	0.00	0.01	0.01	35.3%	35.3%
	Sub-total plastic bottles	0.15	0.15	0.00	0.31	0.31	50.1%	50.1%
	Plastic Film +	0.52	0.01	0.00	0.53	0.53	1.5%	1.5%
	Other plastic food and non-food packaging +	0.24	0.02	0.00	0.26	0.26	6.8%	6.8%
Total Targeted Recyclables		2.74	2.50	0.03	5.27	5.24	47.46%	48.02%
Total Targeted Compostables		2.10	0.00	7.97	10.07	2.10	0.00%	79.12%
Total Residue		4.72	0.12	0.11	4.94	4.83	2.36%	4.51%
Total Waste		9.79	2.62	8.10	20.52	12.41	12.76%	52.27%

+ Not Requested by the scheme

The level of targeted material diverted has increased significantly in the second waste analyses, particularly for the compostables. This has resulted in overall waste diversions more than doubling from 28% to 52%. Targeted dry recyclables have increased from 1.73kg/hh/wk to 2.50kg/hh.wk. Total residue waste has also increased marginally, as has the contamination levels in the recyclable boxes and compost bin. A relatively low amount of newspaper, magazines and other paper are diverted into the recyclables box. This may be a common phenomena with schemes targeting both the dry recyclables and organic fraction as a similar pattern was noticed on the Test Valley scheme in Hampshire. Alternatively, the inclusion of mixed paper in the category may be causing unrepresentative diversions of the newspaper fraction. Unfortunately, this can not be tested, as the two categories were not separated.

The amount of textiles diverted is insignificant, despite being targeted by the scheme. Reasons for this are unknown and it is assumed that households may recycle textiles through other methods, i.e. charity collections or there are inaccuracies in the data set. Food can diversions as expected are low, unlike drink cans, where levels are comparable to other beverage containers, e.g. PET bottles. What is interesting to note is that more PET bottles (primarily fizzy drink bottles) are diverted in both analyses than HDPE bottles, and include for example primarily milk bottles. These and other 'containers' are typically generated at less 'inconvenient times', and include for example cleaning liquids and cosmetics.

Overall, the intensive public communication and feedback campaigns appear to have been successful in increasing the amount of material diverted. The communication efforts were primarily focused on recovering the organic fraction, where the most significant increases were noticed. Contamination levels were low and the waste analyses grouped the dry recyclables contaminants into one material category, so the nature of contamination could not be identified.

Table 5.16 summarises the diversions of the main material categories of concern within this thesis. Following the feedback and media campaign, all materials with the exception of glass jars increased; paper recoveries are lower than expected.

Table 5.16 Basic Category Material Diversions (Daventry)

	Newspapers magazines, adds and glossy	Glass Bottles	Glass Jars	Textiles	Plastic Bottles	Drink Cans	Food Cans
Oct 98	49.8%	41.9%	56.9%	0%	43.1%	58.1%	19.8%
May 99	57.8%	60.7%	44.6%	2.1%	50.1%	59.4%	29.0%

6.0 ANALYSIS AND DISCUSSION

This chapter will integrate results from the previous chapters along with further tests and analysis to identify the relative importance of four factors; the material, the individual, scheme design and scheme maintenance on determining participation and recovery levels. Although the final model will not be calibrated, this chapter will discuss the potential of calibration and the relative benefits of doing so. Results will be discussed within the context of the UK waste management system and the implications / benefits to waste managers, local authorities and scheme managers.

6.1 The Material

Within the UK there are substantial variations in recovery and diversion rates, thought to be influenced by a scheme design / maintenance, individuals attitudes, demographics and socio-economic status, to name a few. One factor remains consistent throughout many schemes when monitoring reported individual material recoveries; some materials, e.g. food cans consistently report low recoveries and others, i.e. newspapers show consistently high recoveries. Although overall scheme diversion of c.40% on the Millennium scheme was impressive, significant differences between the recoveries of individual material categories were found. While the effectiveness of households recovering different materials was reported on all schemes, comparisons of material recoveries between the Millennium and SORT scheme showed that households recycled with different efficiencies for different materials. Including 'Project Integra' data, it can be shown that irrespective of the scheme design, recovery ratios between schemes, when normalised against the newspaper fraction, are similar for different materials (table 6.1).

6.1.1 The Product and Material Effect

Materials that are perceived to be more inconvenient to recycle report lower efficiencies / recovery ratios. This would suggest that 'other' factors not traditionally quoted as affecting material recoveries are having an effect, i.e. the 'material itself'. Given this, a hypothesis was tested 'regardless of a scheme design, household attitudes and demographics, there will be different diversion ranges for each material'.

To fully test the hypotheses, primary data from the PhD research and secondary data from Project Integra is used. The Project Integra data set is unique as it presents waste composition and recovery data for both the residual and recyclable fraction, not only between scheme designs, (e.g. different collection containers and collection frequencies) but also according to ACORN groupings for each scheme. For obvious reasons, not all ACORN areas were measured

for all authorities and their associated scheme designs. To control socio-demographics, diversion levels of 6 commonly referenced recyclable materials were calculated from waste analyses, considering only D9 households (the most representative ACORN subset in the UK) for each of the 6 authorities.

Table 6.1 Mean Material Recovery Ratios in Relation to Normalised Newspaper Recoveries

	Material Recovery Ratios						
Scheme	**Millennium**		**SORT**		**Project Integra**		**All Sample Ares**
Sample Size	**4**		**10**		**12**		**26**
	Mean	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**
Newspaper	81%	0.0	71%	0.1	64%	14.6	72%
Magazines	1.0	0.1	0.9	0.1	0.7	0.1	0.9
Card	0.7	0.2	0.3	0.2	0.5	0.1	0.5
Plastic Bottles	0.6	0.2	0.6	0.1	0.6	0.1	0.6
Plastic Containers	0.3	0.1	-	-	-	-	0.3
Drink Cans	0.8	0.1	0.4	0.1	0.5	0.2	0.7 *
Food Cans	0.4	0.2			0.3	0.2	0.4 *
Textiles	0.7	0.2	-	-	-	-	0.7
Glass Bottles	0.9	0.0	-	-	-	-	0.9
Glass Jars	0.7	0.2	-	-	-	-	0.7

*** Excluding SORT Data**

Figure 6.1 presents the diversion levels (y axis) for the six selected materials, against the order of their average (arithmetic) diversion efficiency. At this stage, no attempt has been made to 'calibrate' the x-axis and a linear scale (1 to 6) has been selected for presentation purposes. Although individual authority schemes show a degree of variability in ranking the "inconvenience" level for materials, overall this crude analysis exhibits a relatively high correlation of (r^2 =0.594). This observed correlation is consistent with factors that would be expected to influence diversion, with lower recoveries for materials that are inherently less convenient to recover due to product / material type and / or waste generation characteristics.

For example, newspapers and magazines are well-recognised recyclable material and easily stored, illustrated by the previous analysis of residence times in the scheme performance chapter. They are more likely to be recycled in bulk, than materials such as food cans, which require immediate disposal into either a residual or recycling container after use. 'Convenient'

materials are generated during times of leisure and relaxation and not necessity, e.g. Sunday morning newspapers on a day off or evening after work, unlike baked bean tins generated during children's meal times.

Figure 6.1 Material diversions for D9 households served by 6 different recycling schemes in Hampshire

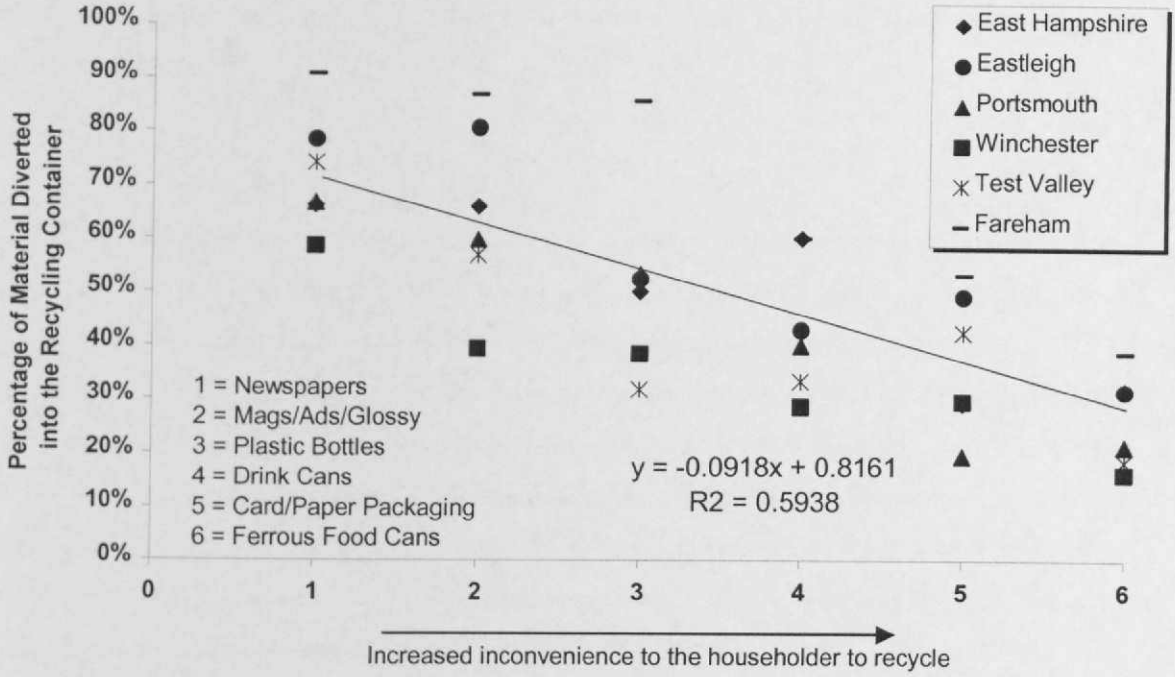
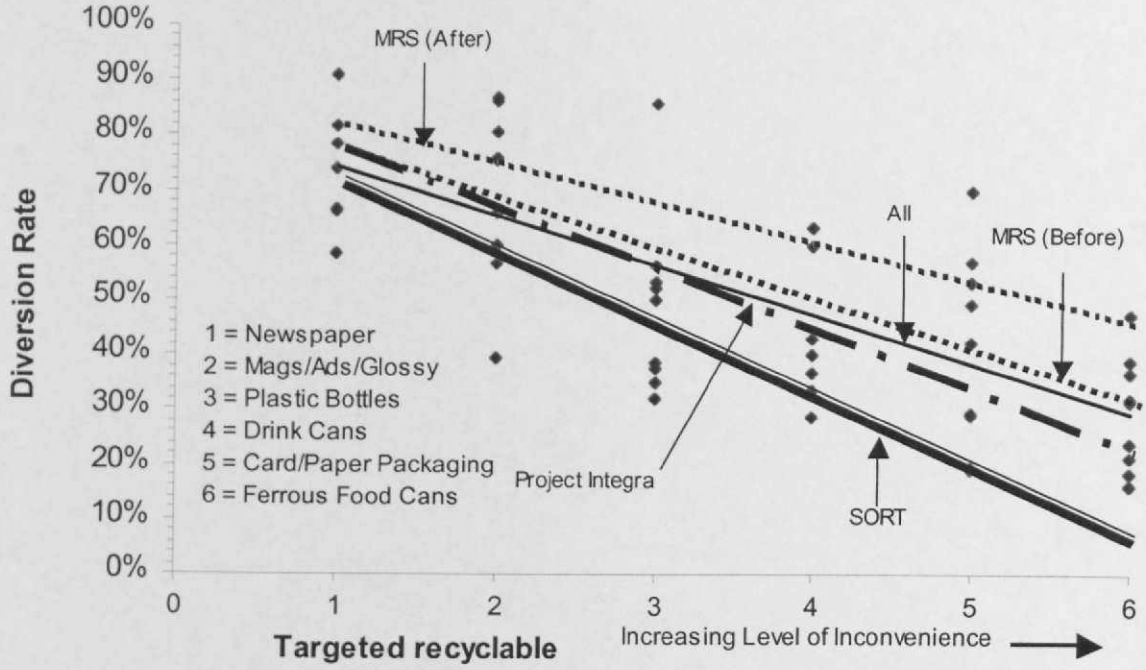


Figure 6.2 also includes the average recoveries for these 6 materials over the 6-month period of the Millennium scheme and SORT scheme along with the best-fit lines. Again, some variations in ranking are evident, but overall a fair degree of consistency is shown. The consistency between the Project Integra and Millennium data allows these categories to be investigated in more detail from the Millennium waste analysis data with a high degree of accuracy.

The various scheme designs within Hampshire may have affected diversions influencing this 'material effect'. Although a general pattern is noticeable and supported at the level of detail for each of the 6 materials shown by SORT and Millennium scheme data, it is difficult to disentangle the two factors.

Figure 6.2 **Material diversions for D9 households served by 3 different recycling schemes**

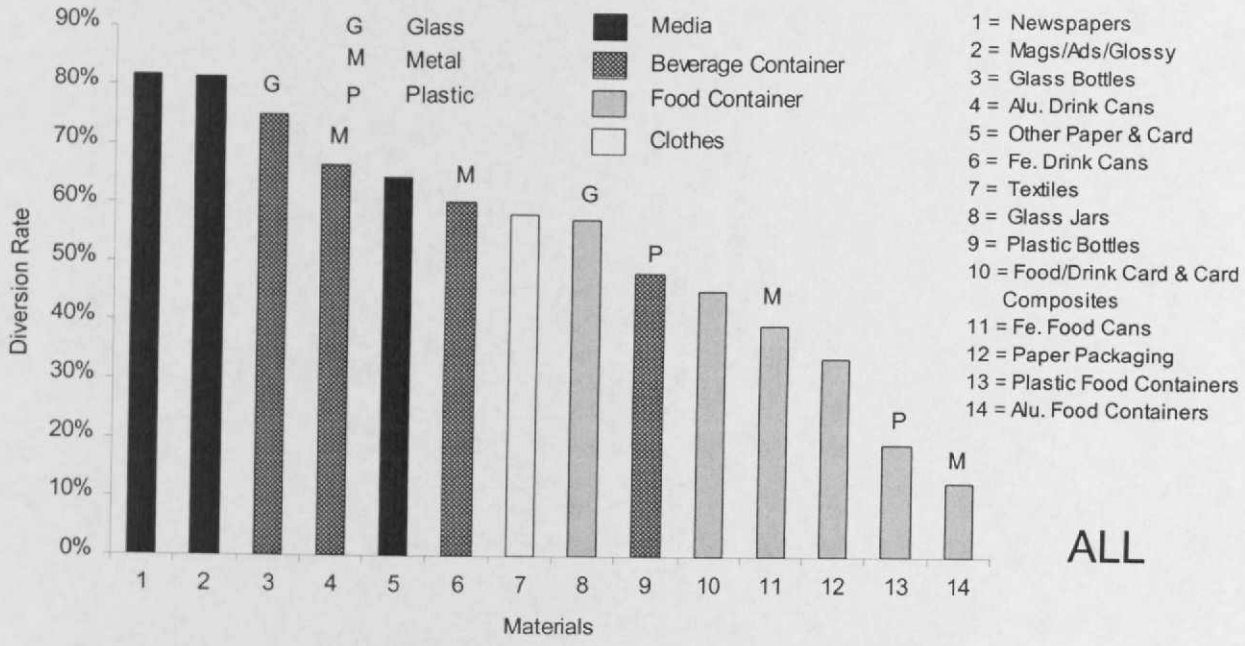


All	$y = -0.0893x + 0.8318$
	$R^2 = 0.5437$
Project Integra	$y = -0.0918x + 0.8161$
	$R^2 = 0.5938$
Millennium Recycling Scheme (Before Feedback)	$y = -0.0905x + 0.8779$
	$R^2 = 0.5571$
Millennium Recycling Scheme (After Feedback)	$y = -0.0613x + 0.889$
	$R^2 = 0.5953$
SORT *	$y = -0.1016x + 0.8222$
	$R^2 = 0.6907$

* Food and drink can recoveries could not be separated, therefore the same value of 36.9% reported for each category.

Figure 6.3 presents mean material diversion levels from the Millennium scheme, where previously identified other 'influential' factors e.g. scheme design or spatial / temporal conditions, were controlled. Diversions are presented in order from highest to lowest. The Millennium scheme aimed to ensure a convenient design to ACORN category D9 households. Differences between materials would therefore be a result of this 'material effect' and not other factors.

Figure 6.3 Material Categorisations Based on All Millennium Waste Analyses Throughout the 6 Month Sampling Period



Material diversions can be classified into three main product categories, media, beverage containers, food containers and a fourth, clothes. A large difference within material categories e.g. metals or plastics are noticed. The difference between drink and food containers certainly highlights this. However, when materials are placed into these 'product categories' a clear distribution is evident. Similarly, the 'convenience factor' of these product categories is reflected in their recovery levels. For example, food cans are more inconvenient than drink cans to recycle and thus lower recoveries are achieved. Within the beverage containers and food containers product categories a pattern can also be noticed between the material types and recoveries.

For example, glass beverage containers achieve higher recoveries than metal beverage containers. In turn, metal beverage containers achieve higher recoveries than plastic beverage containers. Although the traditionally perceived differentiation between material types and recoveries is well recognised, the materials initial product category appears to be having a more significant influence. This phenomenon may explain why material recoveries reported at a broad category level within the literature e.g. metals and plastic, in some instances show similar recoveries. When assessed initially according to their product category, differences are noted.

The clothes product category is independent to these relationships, and warrants a category of its own. Clothes are not commonly generated as a waste material. They are often re-used and

passed on to younger children or taken to charities to be re-sold. Clothes are usually generated in bulk as a result of a clear out and can be easily stored for long periods of time if required. Such inconvenience/behaviour relationships would therefore seem inapplicable to this analysis. Recoveries of textiles would also seem unrepresentative of an average household's performance, as the actions of a few individuals can severely distort the results if clothes are not a commonly disposed of material into the refuse.

Figures 6.4 and 6.5 show the variation in materials in relation to this 'material / product effect' both before and after feedback. Material recoveries following feedback of the more difficult packaging categories increased. However, the same material effect both before and after feedback is noticeable. What is interesting to note is that materials traditionally associated with recycling which we can assume the household recognise as recyclable i.e. newspapers, glass bottles and drink cans did not increase following the feedback whilst materials assumed to be less commonly known i.e. plastic bottles, packaging materials etc. did.

Comments from the Millennium scheme focus groups suggested that households did not fully understand firstly what materials were initially targeted by the scheme, and secondly that they were not aware certain materials could be recycled. Along with the recovery data, this would suggest that household's knowledge of the recyclability of certain materials is affecting specific materials recovery efficiency. However, given that the same 'material / product effect' is evident both before and after feedback would suggest that household's knowledge may be limited regarding the recovery efficiency of specific materials as once addressed is still noticeable; suggesting that, the 'material / product effect' may be a more significant factor.

Figure 6.4 **Material Categorisations Based on Millennium Waste Analyses Before Feedback**

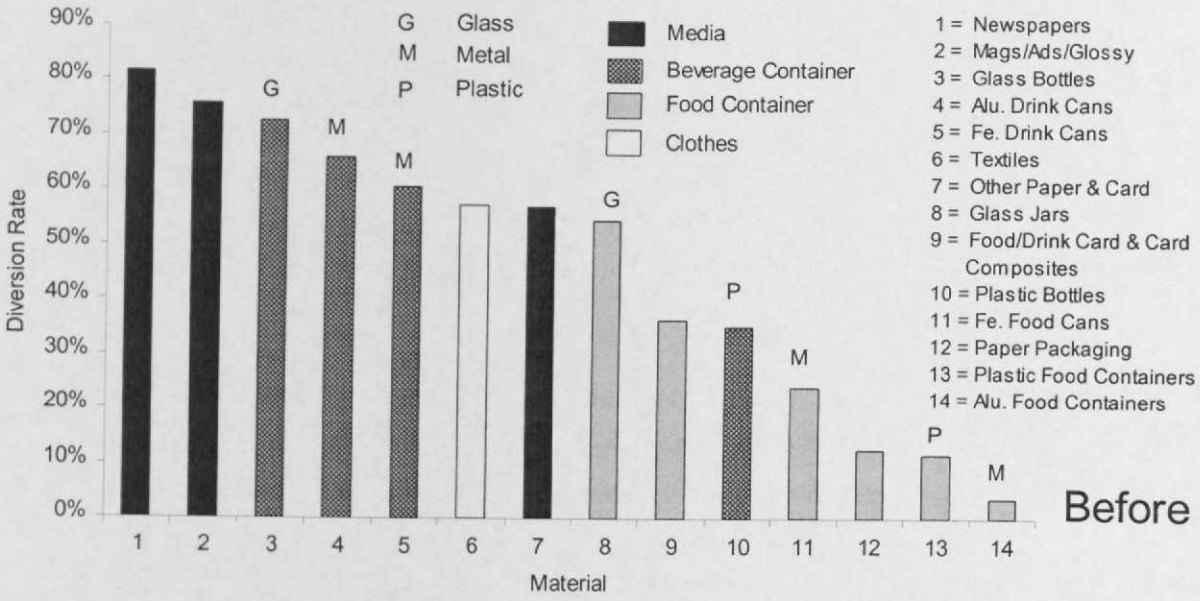
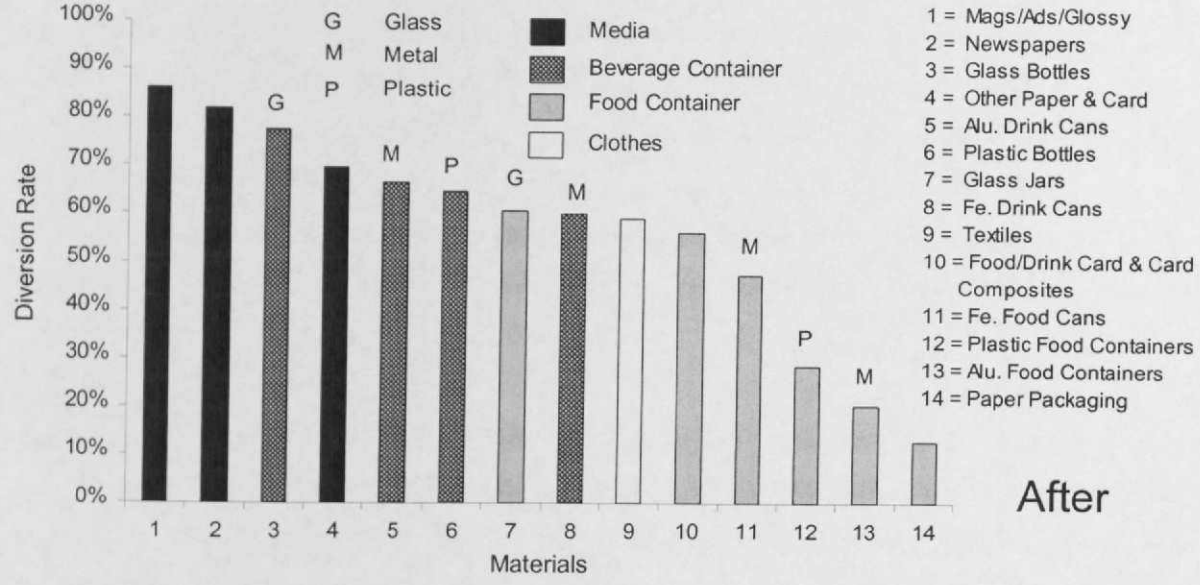


Figure 6.5 **Material Categorisations Based on Millennium Waste Analyses After Feedback**



6.1.2 Conditions of Disposal Within the Home

A series of issues and considerations arise when the materials are viewed in this light. How much 'inconvenience' the material causes the individual to change their behaviour into thinking about recycling a particular material and them actually following this intention through, is thought to be focused around five questions regarding conditions.

1) ***Where and when is the waste material generated ?***

If the material is generated in the kitchen during meal times, it is likely to be quickly disposed of in the interim residual bin located in the same room. Contrary to this, if the material is generated in the living room on a Sunday morning, there is more time to think about where the material will be disposed of. If materials are gathered together as part of a 'spring clean' clear out, the occasional drink can is unlikely to be separated from the other materials when disposing of them.

The provision of indoor collection containers to place beside the normal kitchen bin would help to address this issue; although, if provided by the scheme provider, would be a significant capital cost. This cost may be offset by the increase in material recovered. Read (1999) showed how the costs of an initial capital outlay to increase household recycling levels can be recovered through the resulting increased material's recovery. A relatively high proportion of residents in both the Millennium and SORT scheme requested such an additional indoor container.

2) ***Are the materials generated in bulk, together or individually?***

When materials are generated in bulk, there is a greater pressure on the individual to recycle those materials. For example, an accumulation of the week's newspapers, or glass bottles and drinks cans after a party. Disposing of large quantities of materials at the same time enables the individual to recognise the volume of waste they are generating; throwing these away and not recycling causing a greater sense of guilt, triggering intrinsic motivators than disposing of a single food can or cereal packet. Obviously, attitudes have to be positive and social norms high for this to be activated.

3) ***Can the material be easily stored or does it require cleaning, present hygiene problems, or danger to other members of the household (especially children)?***

Lack of storage was quoted in pre-scheme questionnaire surveys as a major barrier to recycling, supported by reports within the literature. Once the pilot schemes were in operation, Paper Chain residents who choose not to recycle identified storage as the main barrier. When Millennium residents were directly asked about their storage behaviour in relation to product type, differences between product categories were noticed. Relationships between where the material was generated and where it was stored for recycling were noted. In light of these and other results, it would appear that the issue of storage contributes to differential recovery rates between product and material types.

Newspapers, (media category) are a cleaner, safer material than a food can (food category), and therefore are easier to store for longer periods of times without any effort. Newspapers can be

stored for collection anywhere within the household and is a safe material with minimal concern if they come into contact with young children if placed in the wrong place. On the other end of the scale, food containers cannot be stored for any period of time without rinsing or cleaning to avoid causing hygiene problems. A dirty food can, would not be stored in the lounge or bedroom or even its point of generation, the kitchen, for a long period of time. If cleaning is required (which is often dictated by many kerbside recycling programmes), then there is an additional effort on behalf of the householder to recycle this material.

In an attempt to test this hypothesis, the feedback letter used in the Millennium scheme (see appendices) stated two bold statements to households,

1) Please empty your containers but you don't need to clean them !
2) A logo of a metal can saying "I don't have to be clean to be in the recycling scheme"

Following the feedback letter, the recovery of 'dirty' materials, e.g. food cans significantly increased. However, it is difficult to disentangle the causative factor of this increase as recovery improved for all categories, albeit much less so for the majority of materials. The increase may be a result of a series of factors already identified such as communication, increased knowledge and awareness etc. However, comments from the focus group suggested that by removing the perceived requirement to clean materials made the task easier and thus households claimed to recycle more of these fractions. A proportion of households will rinse or are prepared to rinse materials, as shown in the previous chapters, yet for those who do not wish to, this message may be preventing higher recoveries of e.g. food containers being achieved. Only a small percentage of households claimed to rinse their pet food cans. This is a result of the perceived contamination of pet food in the same sink where food is cleaned and prepared. The perceived hygiene risk is higher for pet food cans than food cans. Although the waste analyses does not differentiate between the two products, observations and informal conversations with residents would support this view.

Even if food containers are cleaned, they still present a risk (e.g. sharp edges) to other members of the household, especially children, limiting the storage opportunities for this material / product as a secure, enclosed space is required. An open kerbside recycling box may be safe for adults, but not young children who may wish to rummage and play with the contents inside. Open food cans could cause cuts and serious injuries if not handled correctly. There is therefore a huge incentive to dispose of this material immediately in the refuse bin, which is usually located next to the point of generation.

Beverage containers fall between these two extremes and both the positive and negative issues in relation to cleaning, hygiene and danger are relevant, but neither with the same severity as the

other material / product categories. A plastic bottle or drink can is not as easy to store as newspapers but do not present the same hygiene and danger issues as food cans. Thus, in conjunction with the other six issues, medium recoveries are achieved.

4) Are households actually aware that the material is recyclable and are some materials more commonly known than others?

Feedback from residents during the Millennium focus group indicated that they were unaware that some materials were recyclable. If unsure, they would not place them into the recycling bin in fear of contaminating the other materials. Combinations of non-uniform service provision and targeted material campaigns have potentially caused confusion amongst residents regarding, which materials are recyclable and which are not. 'Bottle banks' are a recognisable phrase and commonplace in supermarket car parks. Although a recognisable phrase, the name itself insinuates that only glass bottles and not jars are collected. 'Plastic banks' are not such a common phrase. Materials such as glass and paper have a long 'history' of recyclability, certainly amongst the older generations. Glass bottle deposit refund systems and scout clubs collecting newspapers are often quoted as examples.

Previous single material campaigns and collection systems can influence individuals' perception of whether a material is recyclable. This may subsequently influence the recovery level of these materials as a result of not providing enough global knowledge about materials recyclability. A good example of this was quoted within the Millennium focus group and informal comments with residents within sample areas. Drink cans are correctly perceived to be recyclable, although the distinction between aluminium and steel drink cans is not so clear.

The 'Blue Peter' campaign is often quoted as only requesting aluminium drink cans for recycling and explaining to viewers how a magnet can be used to separate the two materials. Along with aluminium drink can crushing machines located in public places, and ALUCAN site visits at major shopping outlets, the image that steel cans might not be as important for recycling as aluminium cans may be presented. Questions by the public have certainly been raised about the acceptability of steel cans for recycling. Indeed some members of the public are so consensus towards recycling, that they would rather not recycle certain materials than risk recycling materials they do not recognise as recyclable. Fortunately, the recovery data does not overwhelmingly support this, although a marginal difference is noted between the two material fractions. However, such actions should be implemented with caution and recognise the potential damage of conflicting messages provided to the general public and their effect on recycling as a whole and not a specific project, scheme or campaign. This is perhaps now even

more relevant given the recent development of communication campaigns within the UK such as NWAI and 'Are you doing your bit' etc.

5) Is the material generated on its own e.g. a coke can, or a mixture of several materials, e.g. a cereal box, containing a mixture of materials within the same product?

If only one material, it is easily identifiable in accordance with instructions and requested materials listed on any communications efforts. An aluminium drink can easily be associated with a message requesting 'drink cans'. However, does a message requesting cardboard and plastic bottles render a cereal box with a plastic inner bag as unacceptable without separation? The material is correct, but the product is not. Would the cereal product without material separation cause serious problems to industry? And would these be offset if the recovery of packaging card were seriously increased?

From a household's perspective, this may cause confusion. If in doubt, or thought is required, it is more likely that the material will be disposed of in preference to recycling it. Separating materials for recycling requires additional effort. If there are a greater number of different materials in the same product, i.e. Easter egg boxes (cardboard, rigid and film plastic, foil, paper) there may be a greater chance of the material not being recycled.

When such issues are considered for each material and an imaginary scale of 'very convenient' to 'very inconvenient' is derived, it starts to become clear why some materials are recycled more efficiently than others. Attitudes and socio-demographics have been related to recycling behaviour in the literature. However, the efficiency in which different materials are recycled may be more related to factors directly associated with the material itself. Recycling any material, is in itself, an inconvenience to the householder and overall perceived barriers, attitudes, norms etc. must be overcome to undertake the task of recycling at all. The recycling of additional 'inconvenient' materials is perhaps reflective of households' ability to make this task interesting or convenient for each material and how far they are willing to go.

Parallel comparisons with economic theory e.g. 'marginal utility' could be made. Households recycle for reasons previously identified derived from a level of 'utility' or 'satisfaction' from participating in that activity. This can be partially achieved by recycling only a single material (usually the easiest material newspapers). As more materials are recycled, the additional barriers caused by the materials themselves, requires an additional effort on behalf of the householder to recycle. The extra level of satisfaction (utility) gained from recycling that additional material or quantity of that material gradually becomes less and not reflective of the extra effort required. In essence, the 'law of diminishing returns' is applicable to the recycling efficiency of a

households' recyclable material. It also suggests due to the universal nature of this phenomenon, that as long as a scheme targets the material, its design is relatively not as important as these factors within the home itself. As socio-demographics were controlled, this may also suggest that individual profiles may not be relatively as important.

Different material diversion levels reported on kerbside schemes regardless of the other conventional factors may suggest that a 'ceiling effect' for individual materials could exist. Regardless of the scheme design/maintenance or individuals attitudes, food cans and plastic containers may never reach the same levels as newspapers and magazines.

Table 6.1 showed similar newspaper recovery ratios between schemes. Newspaper is believed to be the easiest material to recover. Food contaminated containers i.e. plastic containers and food cans with ratios of c.0.3 compared to plastic bottles which is consistent at 0.6 and magazines reporting between 0.7 and 1. Identifying these ratios may allow other material recoveries to be identified from calculating for example, only newspaper recovery. However, more importantly this may confirm that a ceiling effect does exist. If this is the case, then is it fair to expect the recovery of all materials to be equal?

Reflecting on the current targets in place for industry and local authorities an uneven playing field would appear to be in place. Industry has specific material recycling targets whilst local authorities only have overall weight targets. Local authorities can substitute the more difficult fractions with the heavier easier materials. Such different targets could prove to be difficult for those aiming to provide an integrated waste management system.

Local authorities best approach could be to target the three heavy fractions, organics, paper and glass. Given appropriate and well-maintained scheme design, high diversions could be achieved. Although this narrow approach may meet EU Landfill Directive targets and UK recovery and recycling targets, it would fail to address the need to recover packaging from the domestic waste stream. Although technically metals could be extracted from the normal residual waste at a dirty MRF, the plastic fraction would pose serious problems.

If local authority targets were similar to the packaging regulations where a minimum material specific recycling level were in place alongside an overall recovery and recycling level, then both industry and local authorities would be aiming to meet the same objectives. However, incentives are needed to ensure co-operation between these sectors. Although an obvious initial co-operation on either logistical or financial grounds would be logical, this could later extend to

the design of the products itself, and influences on kitchen design etc. as it would now be to the benefit of the industry to do so.

Given that a high proportion of the packaging required by industry is in the domestic waste stream, there is a potential (given the current targets and situation) for separate systems to be put in place to collect from the same waste stream as seen in other European countries. If material specific targets were to be set for local authorities, they would perhaps need to recognise the potential 'ceiling effect' between materials and levels set accordingly as with the packaging regulations. However, given that some materials could only ever be recovered at low levels, this would require the 'easier' fractions to be recovered at maximum efficiency, requiring maximum participation initiated by a convenient collection system.

This research has shown that a substantial difference in the recovery of different materials exists. Reasons for these variations have been postulated and it has been suggested that they are more important and potentially independent of traditionally perceived causative factors although further research is required to quantify these questions surrounding the materials perceived level of inconvenience. By understanding the actual level of effect of each question on material recoveries will help identify what measures are needed to increase recoveries and reduce the inconvenience to the householder. For example, this will establish if changing a kitchen design to include dual bins will be beneficial or a single material campaign is more effective.

6.2 The Individual

6.2.1 Demographics

Previous research findings show a positive relationship between recycling behaviour and demographics. When respondent's demographic profile was separated according to household's pre-scheme recycling behaviour (i.e. bring sites), a similar positive relationship can be identified (table 6.2).

Overall, recyclers were found to be older than non-recyclers; 65.8% of recyclers were over 45 compared to 43.0% of non- recyclers. A chi-square of 18.94 showed this result as statistically significant with a confidence level of 0.01. Wetherby recyclers were also found to be older than non-recyclers; 60.0% of recyclers were over 45 compared to 32.6% of non- recyclers. A chi-square of 13.00 showed this result as statistically significant with a confidence level of 0.05. Differences in Garforth and Bradford samples area were not statistically significant, however a higher percentage of recyclers were over 45 in Garforth (63.9%) and Bradford (79.2%), compared to non-recyclers in Garforth (48.5%) and Bradford (64.3). Recyclers in all sample

areas had fewer children under 18 per household than non-recyclers, suggesting young children within the home are influencing recycling behaviour.

Table 6.2 Demographics of respondents on pre-scheme questionnaire in relation to their recycling behaviour

		Age of Respondent (%)						% of males	Average number of Children <18 per household
		<26	26 – 34	35 – 44	45 – 54	55 – 59	60+		
Wetherby	Recycler (n= 75)	5.3	18.7	16.0	10.7	13.3	36.0	41.3	0.7
	Non-recycler (n= 46)	15.2	23.9	28.3	13.0	8.7	10.9	30.4	0.8
	Total (n= 121)	**9.1**	**20.7**	**20.7**	**11.6**	**11.6**	**26.4**	**37.1**	**0.8**
Garforth	Recycler (n= 108)	3.7	16.7	15.7	30.6	8.3	25.0	37.0	0.5
	Non-recycler (n= 33)	6.1	21.2	24.2	18.2	18.2	12.1	48.5	0.7
	Total (n= 141)	**4.3**	**17.7**	**17.7**	**27.7**	**10.6**	**22.0**	**39.7**	**0.6**
Bradford*	Recycler (n= 48)	2.1	8.3	10.4	35.4	12.5	31.3	37.5	0.5
	Non-recycler (n= 14)	7.1	14.3	14.3	28.6	7.1	28.6	50.0	0.8
	Total (n= 62)	**3.2**	**9.7**	**11.3**	**33.9**	**11.3**	**30.6**	**40.3**	**0.5**
Total	Recycler (n= 231)	3.9	15.6	14.7	25.1	10.8	29.9	38.5	0.6
	Non-recycler (n= 93)	10.8	21.5	24.7	17.2	11.8	14.0	39.8	0.8
	Total (n= 324)	**5.9**	**17.3**	**17.6**	**22.8**	**11.1**	**25.3**	**38.9**	**0.6**

* Chi-square test could not be carried out due to insufficient sample number.

Demographic comparisons in relation to recycling behaviour on the Paper Chain scheme are shown in table 6.3. The difference between recyclers and non-recyclers is more definitive. A difference between all recyclers and non-recyclers and participants and non-recyclers was statistically significant with chi-square values of 40.98 (significant at 0.001) and 42.55 (significant at 0.001) respectively. 67.4% of recyclers are over 45 compared to only 28.9% of non-recyclers.

Table 6.3 Demographics of respondents on Paper Chain in relation to their recycling behaviour

		Age of Respondent (%)						% of males	Average number of Children <18 per household
		<26	26 – 34	35 – 44	45 – 54	55 – 59	60+		
Recycler	All Recyclers n= 307	3.3	12.1	17.3	19.2	12.7	35.5	34.5	0.42
	Participants Only n= 255	2.7	11.4	18.0	19.6	11.8	36.5	32.2	0.42
Non-recycler n= 45		17.8	33.3	20.0	17.8	4.4	6.7	33.3	0.78
Total n= 352		5.1	14.8	17.6	19.0	11.6	31.8	34.4	0.47

6.2.2 ACORN Relationships

Throughout the results, reference has been made to classifying areas or individuals in relation to their ACORN grouping, primarily to identify its benefits in using this socio-demographic tool as a predictor of behaviour. The results are not definitive as not all groups were monitored during this thesis. A further assessment and more detailed monitoring would be required to be conclusive. However, there is a suggestion that various weak relationships to participation and waste composition exist.

For example, the results have shown the following general observations. E11 households were found to participate significantly less in comparison to A1, B5 and D9 households, and were less likely to sustain their participation in the Paper Chain scheme. D9 households were found to marginally participate more than the other three groups and were more likely to join the scheme once operational than during the initial introductory weeks. Some generic observations regarding waste composition and recovery showed that A1 and F14 households generated the most waste at c.20kg/hh/wk and B5 the least at c.11kg/hh/wk. The main differences noted in the compositional analyses, were that B5 and F14 households produced significantly more drink and food cans than other groups. B5 households also had proportionally more plastic bottles and magazines, F14 households more textiles. A1 households had significantly less glass bottles and jars. In relation to material recoveries, the more successful areas were B5 and D9 households and the worst F14 in the proportion of waste diverted. Similarly, F14 households reported the highest contamination levels and D9 households the lowest. D9 households generally recovered magazines and plastic bottles better than the other groups whilst F14 households were relatively poor at recovering these materials.

Although linking recycling behaviour to particular ACORN groups is an attractive option, understanding why a particular group consistently under/over performs is of greater importance. For example, understanding why a significantly higher proportion of E11 households failed to put their intended participation in practice on the Paper Chain scheme. This group was dominated by type '33', represented by council rented (or bought council) properties, occupied by either retired elderly couples or young single parent families. These individuals may have had a positive attitude but their practical circumstances in conjunction with poor scheme design may have prevented then from doing so when the scheme was offered. For the elderly population, lifting the heavy bag of newspapers to the kerbside would have been unattractive, whilst for single parent families storage of a plastic bag around children may have been a barrier. When the typical ACORN descriptions of these households are understood it starts to become clear why these behavioural patterns are occurring.

6.2.3 Attitudes - Motives and Barriers

Prior to both the Paper Chain and Millennium scheme, motives for recycling were similar (table 6.4). Environmental reasons and saving dustbin space were the main drivers and peer pressure had the least effect. Non-recycler's reasons for not recycling were similar between areas (table 6.5) where inconvenience, poor facility provision and the associated storage and handling problems were identified as the main barriers. The results suggest that the attitudes of both recyclers and non-recyclers are similar between sample areas (and typical of national reported data).

Table 6.4 Reasons for households recycling prior to the kerbside schemes introduction (Effectively bring site behaviour)

	Wetherby (Paper Chain)	Garforth (Paper Chain)	Total Paper Chain	Millennium
	N = 75	N = 108	N = 183	N = 48
Good facilities nearby / Convenient	45.3% (4)	53.7% (3)	50.3% (4)	58.3% (2)
For the future environment / Generations	73.3% (1)	73.1% (1)	73.2% (1)	81.3% (1)
Saves waste / Landfill space	58.7% (3)	60.2% (2)	59.6% (2)	52.1% (3.5)
Personal satisfaction / Habit	62.7% (2)	43.5% (5)	51.4% (3)	52.1% (3.5)
Save dustbin space	34.7% (5)	47.2% (4)	42.1% (5)	33.3% (5)
Peer pressure / Duty	9.3% (6)	6.5% (6)	7.7% (6)	6.3%(6)

(3) = Ranking in relation to the popularity of other responses.

Table 6.5 Reasons for households not recycling prior to the schemes introduction

	Wetherby (Paper Chain) N = 46	Garforth (Paper Chain) N = 33	Total Paper Chain N = 79	Millennium N = 14
Inconvenient/Not time	50.0% (2)	51.5% (1)	50.6% (1)	64.3% (1)
Facilities too far away/Inadequate	52.2% (1)	45.5% (2)	49.4% (2)	42.9% (3)
Not enough materials to recycle	21.7% (4.5)	21.2% (6)	21.5% (6)	14.3% (5)
Too much effort	21.7% (4.5)	9.1% (8)	16.5% (7)	7.1% (6.5)
Storage/handling problems	34.8% (3)	36.4% (4)	35.4% (3)	50.0% (2)
Lack of Information	19.6% (6)	42.4% (3)	29.1% (4)	28.6% (4)
Never really thought about it	17.4% (7)	30.3% (5)	22.8% (5)	7.1% (6.5)
Other	6.5% (8)	12.1% (7)	8.9% (8)	0.0% (8)

(3) = Ranking in relation to the popularity of other responses.

Following the scheme introduction, recycler's attitudes are similar between schemes despite their different design and demands on the householder to participate. Although the scheme design has been shown to affect participation and recovery levels, individual motives for recycling remain intrinsic, remaining independent of the scheme design (table 6.6). Environmental reasons remain the primary motive for recycling; saving dustbin space / peer pressure, are still reported as having little effect on recycling behaviour following the scheme introduction.

Unlike the pre-scheme questionnaires, responses had to be ranked according to their popularity due to differences in the question asked. Paper Chain households were asked to indicate 'three' reasons why they recycled whilst Millennium and SORT households were asked to indicate 'up to three'.

The main difference is the higher ranking of personal satisfaction / habit than facility provision by SORT households. This may reflect the more permanent nature of the SORT scheme compared to the other two pilot schemes. Households may have assessed the recent kerbside scheme in relation to bring sites and had not been served by the scheme long enough to recognise establishing a 'habit'. This may also explain the higher proportion of SORT households indicating 'peer pressure / duty' as a motive; long establishment and habit increases feelings of unease, should the household stop using the scheme.

Table 6.6 Reasons for households recycling WHO PARTICIPATED in the three separate kerbside schemes

	Wetherby (Paper Chain)	Garforth (Paper Chain)	Total Paper Chain	Millennium	SORT
	N = 99	N = 156	N = 255	N = 84	N = 59
Good facilities nearby / Convenient	50.5 % **(3)**	55.7 % **(3)**	53.7 % **(3)**	58.3 % **(3)**	35.6 % **(4)**
For the future environment / Generations	68.7 % **(1)**	65.4 % **(1.5)**	66.7 % **(1)**	69.0 % **(1)**	69.5 % **(1)**
Saves waste / Landfill space	61.6 % **(2)**	65.4 % **(1.5)**	63.9 % **(2)**	64.3% **(2)**	57.6 % **(2)**
Personal satisfaction / Habit	48.5 % **(4)**	47.4 % **(4)**	47.8 % **(4)**	48.8 % **(4)**	59.3 % **(3)**
Save dustbin space	37.4 % **(5)**	41.0 % **(5)**	39.6 % **(5)**	27.4 % **(5)**	20.3 % **(5)**
Peer pressure / Duty	2.0 % **(6)**	3.8 % **(6)**	3.1 % **(6)**	2.4 % **(6)**	8.5 % **(6)**

(3) = Ranking in relation to the popularity of other responses.

Perhaps more interesting is the difference in the level of response between Millennium and SORT households where wording on the questionnaire was the same. The main reason 'for the future environment / generations' is almost identical in the level of response, whilst the others are more reflective of the recycling and residual collection design in the sample areas. For example, a lower proportion of SORT households indicated saving waste as a motive, yet they were served by a 240 litre wheeled bin for their residue; compared to the Millennium households, who were served by a traditional sack collection. A higher percentage of households indicate 'personal satisfaction/habit' for reasons already identified. What is perhaps more of a concern is that c.23% fewer SORT households indicate 'good facilities nearby / convenient' which may reflect households long-term acceptance of the system or poor scheme maintenance on behalf of the authority. Households' frustration with the absence of glass from the system, missed collections, confusion over the schemes operations was all reasons previously discussed with its poor scheme maintenance. Other reasons could be postulated but it is clear facility provision would appear to be an issue with SORT households where a convenient scheme design is relatively not a significant motivational factor.

6.2.4 Generic Environmental Attitudes

Following the scheme introduction there was little change in specific attitudes. Attitudes in relation to legislative / fiscal drivers and environmental purchasing were similar between schemes. Minor shifts in the level of agreement following the scheme introduction were also

similar between schemes. This suggests that although the presence of a kerbside scheme may make households consider issues and their implications more carefully, the operational design of a scheme does not necessarily affect attitudes towards e.g. the purchasing of environmentally friendly products. There was a marginal increase in the proportion of households regarding themselves as environmentally conscious as would be expected given the increase in the number of households recycling. However, this is not reflected in their claimed purchasing behaviour before or after the introduction of a scheme. The main change noted on both schemes was the shift in household attitude towards the 'no opinion' category. Ultimately, scheme design may marginally change attitudes, but this does not translate into a change in actual behaviour.

Some global issues that did not require the individual to change their behaviour also reported no change following the introduction of either scheme. For example, if we should still recycle even if it costs more than landfill. Although households are prepared for the higher costs of recycling, they do not believe it should be born by the householder, as support for variable charging is very low, before and after scheme introduction. Households were more reluctant of variable charging following the introduction of both schemes. The greatest shifts were a decline in the 'agree' and increase in the 'strongly disagree' categories. They may have recognised the practical issues associated with high levels of recycling and realised that this would translate into increased personal financial costs. Alternatively, households may expect the council to provide a recycling service which they now recognise they are paying for already in their council tax and feel they should not be expected to pay more.

Discussions through the focus groups highlighted that there was a level of uncertainty regarding what such measures would involve. In principle, (although they feel they are not necessarily fair to families and large households), they can understand such proposals. However, they did not see how they could work and although a small increase in council tax was not an issue, they did not wish to pay separately for the waste service. SORT participants were also against such measures. Their opposition to the idea of variable charging was strong. c.80% of households disagreed or disagreed strongly with being charged for waste similar to other utilities.

It is often thought that if households have the means to reduce their waste, i.e. providing adequate recycling facilities, then they would be more amenable to such a change. This would not appear to be the case; households are more opposed to the idea once facilities are provided. The results demonstrate that by providing the recycling facilities (even the Millennium scheme collecting all recyclables), opposition is high and greater than when the scheme was introduced.

Variable charging has previously been raised as a potential fiscal measure to increase recycling levels. The government has dismissed the idea as unfair and unworkable. However, given the high statutory recycling and recovery targets in place, and that households are the only non-legislated element of the waste chain this could potentially change if households do not respond positively to voluntary measures. Given the unpopularity of the issue, it highlights the sensitive approach needed if such a measure was introduced. Making costs of waste disposal transparent (social and financial) could make households recognise the impact of their behaviour rather than immediately dismissing an issue they may not necessarily understand other than seeing an increase in personal cost. Households current perception of waste generation, costs, disposal / treatment options, markets etc. has been shown to be incorrect (Waste Watch, 1999).

Introducing a law to encourage households to recycle was a more acceptable change and slightly more popular following the introduction of the schemes. This is not surprising given that once households are served by any kerbside scheme they recognise that complying with mandatory recycling would not be difficult. It is however, not overwhelmingly popular on any of the schemes and would seem unnecessary given the high levels of participation and recovery which can be achieved by providing the correct scheme design on a voluntary basis.

Effectively attitudes are not necessarily controlled by scheme design. Attitudes (especially those related to environmental purchasing, fiscal and legislative divers) are unlikely to change without further measures. Such measures may include national awareness and education campaigns to highlight the need for environmental purchasing and understanding of the waste issues we are faced with.

Specific attitudes of recyclers and non-recyclers were reported separately within the thesis. Responses to specific attitude statements were not significantly different. A smaller percentage of non-recyclers claimed to be less environmentally conscious, reflected in their behaviour; purchasing less environmentally friendly products and not as influenced by the products recycled content in their purchases. Surprisingly, one of the main differences in attitudes between the two groups was that non-recyclers were more likely to accept variable charging and legislative measures; this may reflect their lack of awareness in the practical difficulties associated with recycling. Alternatively, they may be openly admitting they need such severe measures for them to change their behaviour.

6.2.5 Attitude Scores

It has been suggested that attitudes and opinions are the most difficult category of social survey data to collect and 'must be used with caution and not pushed too far' (Parfitt, 1997). Many

previous investigations have used a 5-point 'likert' scale for a series of statements, each representing an attitude (global or specific) where respondents indicate their level of agreement to each statement. Likert scales have been suggested to be a useful, reliable rough-ordering method with regards to people's attitudes. (Oppenheim, 1979). Some authors have aggregated these naturally distributed responses and undertaken factor analysis where a large number of questions have been asked and underlying attitudes can be identified from a series of questions which display inter-correlation. Other researchers have utilised less statistically complicated methods and report responses in their raw state, to avoid loosing the distributional information (Tucker 1999a).

Speirs and Tucker, (2001) and Tucker (2001) report using attitudinal scores constructed from the sum of an individuals attitude score, while Foster and Parker (1995) and Oppenhiem, (1979) describe the development of these scores. A point system, dependant on an individual's level of agreement with a statement (strongly dis-agree = 1 to strongly agree = 5), is aggregated to provide each individual with a score. Scores were reversed where necessary, dependent on the positive or negative nature of the statement.

This approach was used to develop an individuals attitude score using four of the same statements used in both schemes before and after the scheme to assess if attitudes varied between schemes, or changed following their introduction. The number of statements used was relatively limited compared to other reported studies, which is why an attitude score approach, in preference to factor analysis, was used. Such a collection of attitude statements is referred to as an 'attitude battery' (Parfitt 1997), where its main advantage is that respondents can be led fairly quickly through a range of statements which explore different aspects of the topic without overburdening the respondent. A higher score reflects a more positive attitude. Although subjective, it aims to provide a very basic identification of an individual's generic attitude towards recycling and the environment.

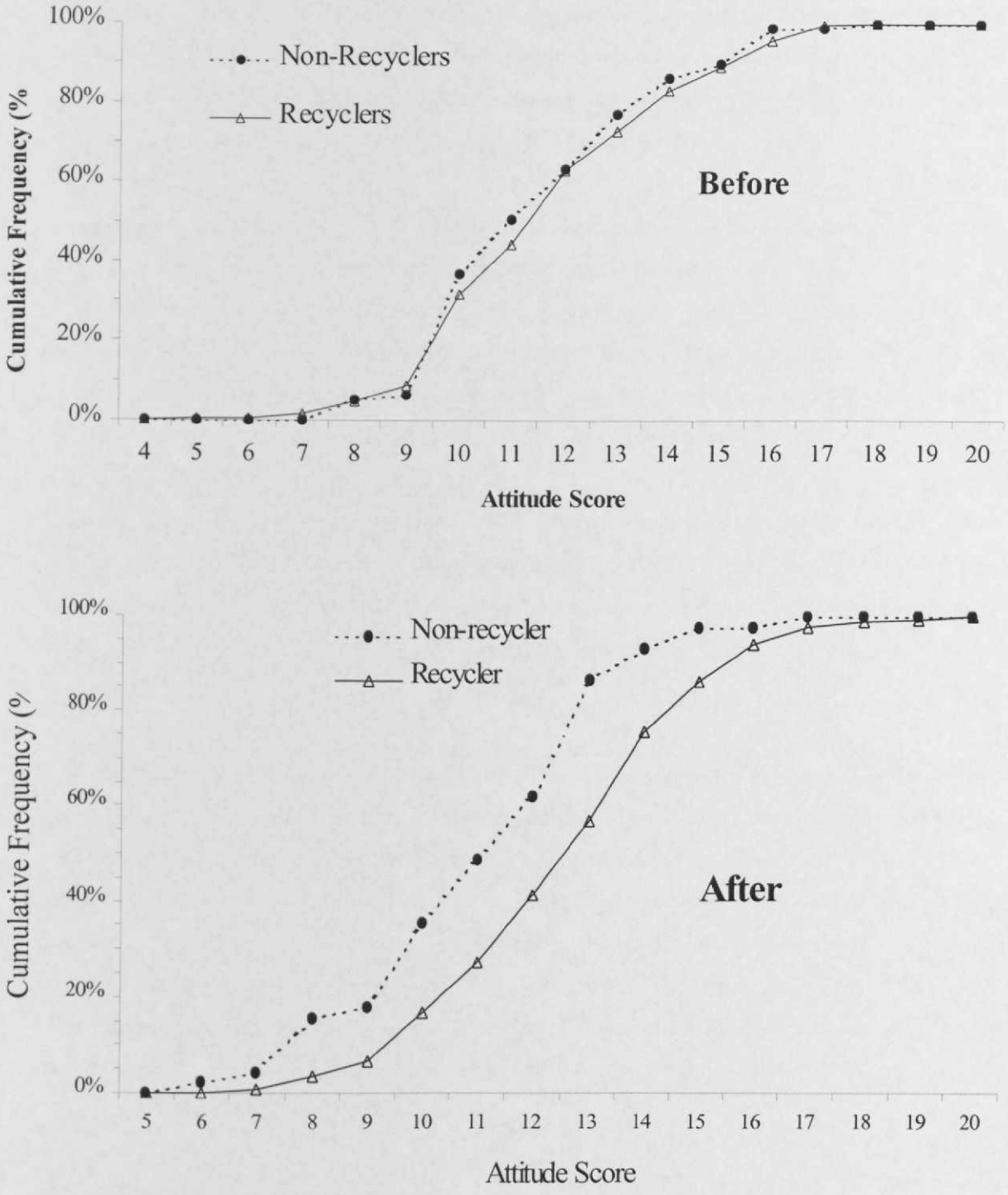
The statements used were as follows,

- We should still recycle even if it costs more than landfill (SA= 5),
- Recycling labels printed on the products packaging encourages me to recycle it (SA=5),
- The recycled content of a product/packaging encourages my purchasing decision (SA= 5),
- I always try to buy the most environmentally friendly products (SA=5).

Figure 6.6 shows household attitude scores before and after the Paper Chain recycling scheme was introduced. More detailed categorisations showing household attitude scores in relation to the two individual sample areas and households participatory behaviour are shown in tables 6.7

and 6.8. Data for the Millennium scheme is presented in table 6.9 where the sample size was insufficient to identify recyclers from non-recyclers separately.

Figure 6.6 Attitude Scores of Recyclers versus Non-Recyclers before and after the introduction of a kerbside scheme



Potential Min score = 4, Max Score = 20

Table 6.7 Households Attitude Score in relation to claimed bring recycling behaviour

	Sample Area	Sample Size	Mean Score	S.D	Mode
Recyclers	**Wetherby**	75	12.45	2.41	10
	Garforth	108	11.77	2.35	10
	Total	**183**	**12.05**	**2.40**	**10**
Non-Recyclers	**Wetherby**	46	11.83	2.33	10
	Garforth	33	11.94	2.15	10
	Total	**79**	**11.87**	**2.24**	**10**
GRAND TOTAL		**262**	**12.00**	**2.35**	**10**

Table 6.8 Households Attitude Score once served by the Paper Chain kerbside recycling scheme

		Sample Area	Sample Size	Mean Score	S.D	Mode
Recyclers	**Participant**	**Wetherby**	99	13.25	2.4	14
	Non-participant		18	13.44	2.6	14
	Participant	**Garforth**	156	12.67	2.28	13
	Non-participant		35	13.06	2.54	10
	Total participant		255	12.89	2.34	14
	Total Non-participant		53	13.19	2.56	14
	Total Recyclers		**308**	**12.94**	**2.38**	**14**
Non-Recyclers		**Wetherby**	27	11.85	2.20	13
		Garforth	18	10.67	2.38	10
		Total	**45**	**11.38**	**2.32**	**13**
GRAND TOTAL			**353**	**12.75**	**2.42**	**13**

Table 6.9 Households Attitude Score before and after the Millennium Recycling Scheme

	Sample Size	Mean Score	S.D	Mode
Before Scheme	62	12.44	2.57	12
After Scheme	84	13.00	2.46	14

The results suggest no significant differences between recyclers and non-recyclers general environmental / recycling attitude prior to the introduction of the recycling scheme. Although the recyclers' mean score is marginally higher at 12.05 compared to 11.87, high standard

deviations and the same mode score of 10 would confirm no real difference in attitudes. From a potential score of between 4 to 20, this would also suggest that both groups have an average attitude towards recycling and that attitudes are not necessarily a primary determinant of bring recycling behaviour.

Following the kerbside schemes' introduction, differences between recyclers and non-recyclers are slightly more pronounced (figure 6.6) although not significantly different. When service provision is inconvenient, i.e. bring sites, non-recyclers may have positive attitudes but other barriers prevent them from actually recycling. Therefore, attitudes between the two groups are similar and recycling behaviour is a function of perceived barriers. When convenient facilities are provided, i.e. a kerbside scheme, the barriers to recycling are removed and those who wish to recycle with positive attitudes to recycling and the environment do so. Households who have less interest in recycling and the environment do not, and a lower attitude score for non-recyclers would be expected. This would appear to be the case.

Results in the previous chapters have shown that a proportion of households within the Paper Chain sample area recycle, but do not use the kerbside recycling scheme and show differences in specific attitudes. Table 6.8 shows that although non-participating recyclers have a marginally higher mean attitude score of 13.19, compared to participants with a score of 12.89, the difference is not substantial and a more thorough investigation is required.

Household attitudes become more positive following the introduction of the Paper Chain scheme, with an increase from 12.00 (mode score 10) to 12.75 (mode score 13). A similar increase was noticed with residents served by the Millennium scheme (table 6.9) where the attitude score increased from 12.44 (mode score 12) to 13.00 (mode score 14). It can also be noted that household attitudes in the Millennium scheme sample area were marginally more positive both before and after the introduction of the kerbside scheme. Effectively, attitudes are positive for all groups and marginally increase following the introduction of a kerbside recycling scheme. However, overall, there is no real difference between recyclers and non-recyclers and attitudes would appear to play a relatively insignificant role in determining recycling behaviour.

6.2.6 Change in an Individual Attitude Following Scheme Introduction

Due to the restricted size of the Millennium scheme sample area, unlike the Paper Chain sample area, the same 145 households were approached with both the pre-scheme and during scheme questionnaire. Inevitably a proportion of the same households would answer both questionnaires, providing an invaluable opportunity to compare any change in attitudes at an

individual level. Eight of the same attitude / opinion question, used in both questionnaires were compared.

To ensure responses were from the same person, the address, sex and age appearing on the questionnaires were matched. Inconsistencies were eliminated from the analysis, i.e. same address but different sex. Such refining was necessary as two individuals in the same household, i.e. husband and wife may possess totally different attitudes. Such detail reduced the sample size to only 20 individuals, limiting sample reliability. The magnitude of an individuals change are shown in figure 6.7; table 6.10 reports where the change has occurred, and provide an insight into how individual attitudes may change as a result of the introduction of the recycling scheme. It is important to show the two, as a change in attitude of +1 may reflect the individual attitude becoming stronger, i.e. agree to strongly agree or positively taking a view, i.e. no opinion to agree.

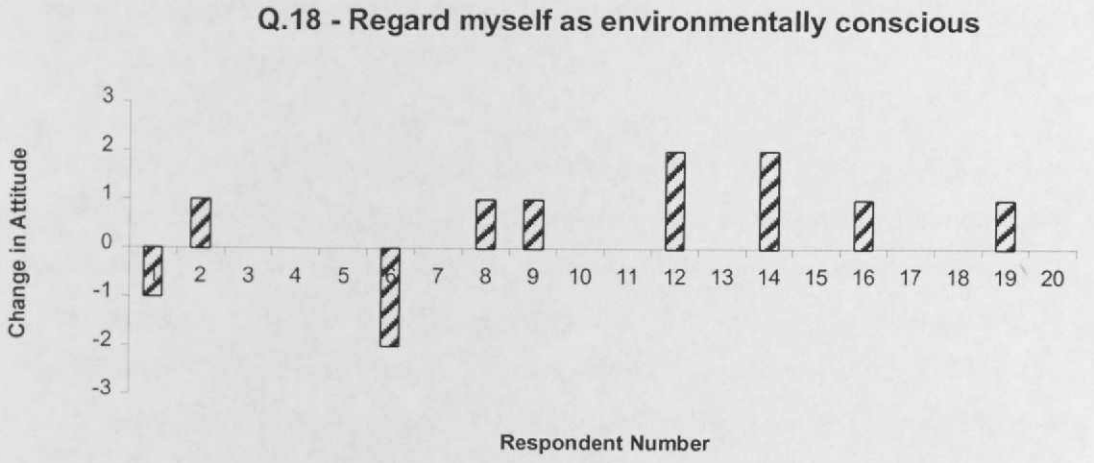
Table 6.10 Level of Agreement with the Statements Before and After the Scheme (%)

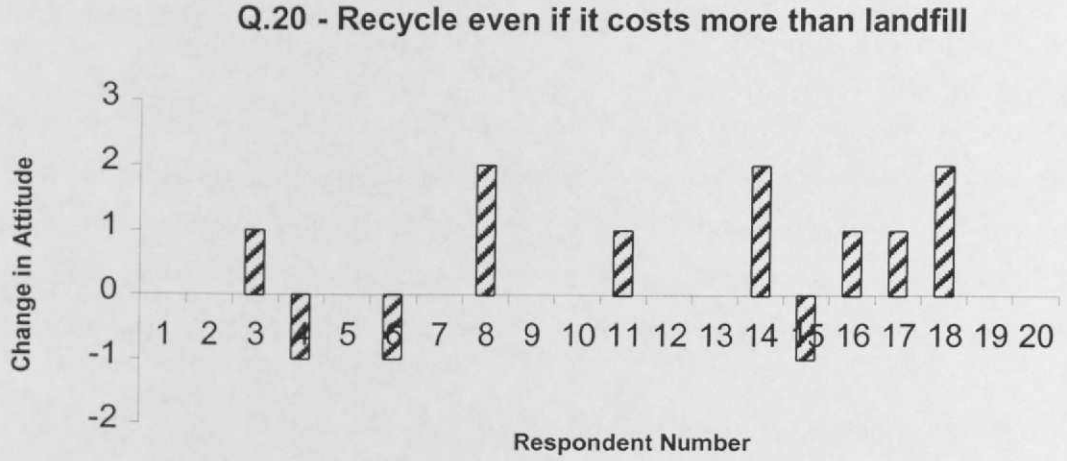
Question Numbers	18		20		21		22		23		24		25		26	
	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D
Strongly Agree	10	25	20	25	5	15	0	0	5	0	5	5	5	15	5	0
Agree	65	55	55	70	30	50	0	25	30	45	20	15	20	15	50	55
No Opinion	15	20	10	0	15	10	15	25	15	20	10	20	10	25	25	20
Disagree	10	0	15	5	45	15	80	35	45	25	45	30	55	30	15	20
Strongly Disagree	0	0	0	0	5	10	5	15	5	10	20	30	10	15	5	5

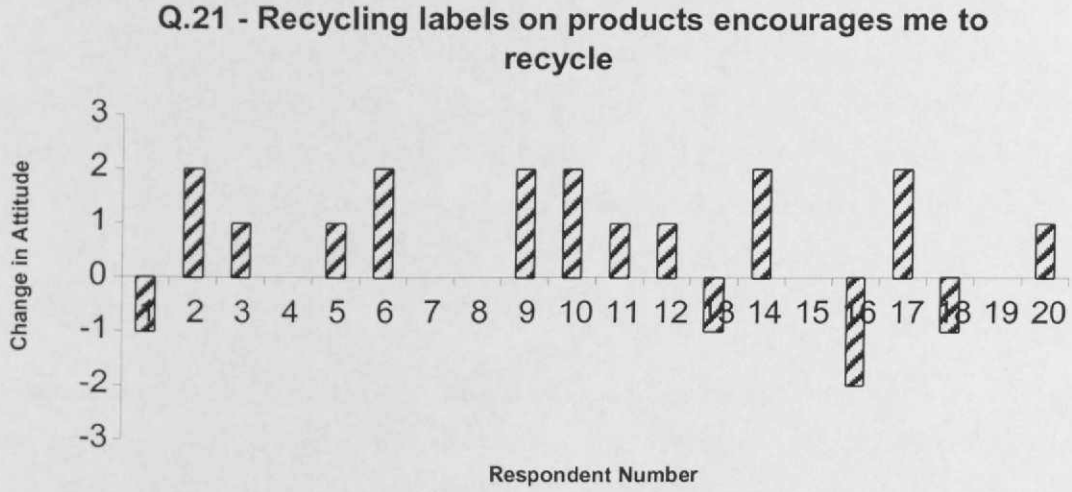
B = Before the scheme (Pre-scheme questionnaire) D = During the scheme (2nd questionnaire)

Overall, individuals attitude have marginally improved though differences are more marked in some statements than others. One of main changes is the view that recycling labels on products encourages them to recycle. Attitudes have shifted from a general disagreement to an agreement with this statement. This may reflect individuals recognising recycling labels to identify the recyclability of the product and thus its acceptance in the Millennium recycling bin. The Millennium scheme did not request specific materials, e.g. glass, paper etc. but specifically requested all recyclables. This required individuals to identify which materials were recyclables and which were not. Recognition of a product's recyclability can also be seen in the individuals purchasing behaviour, where there is a move away from disagreeing that the recycled content of a product influences the purchasing decision.

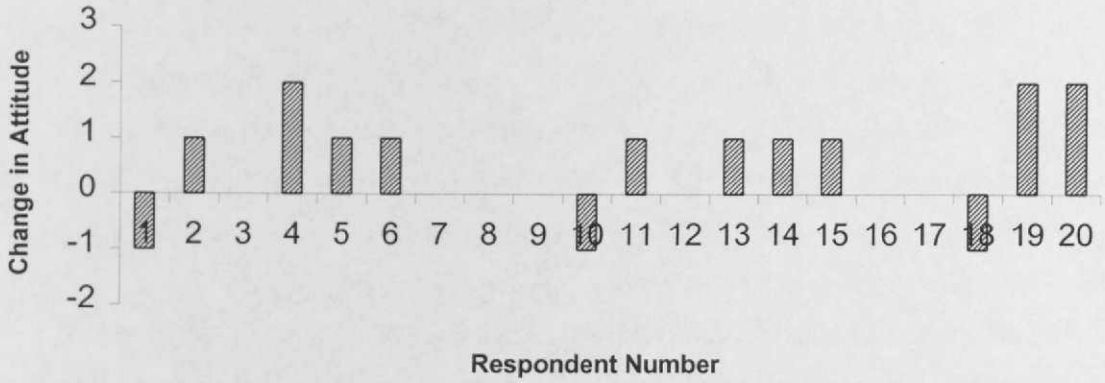
Figure 6.7 Changes in Individuals Attitude Following the Schemes Introduction



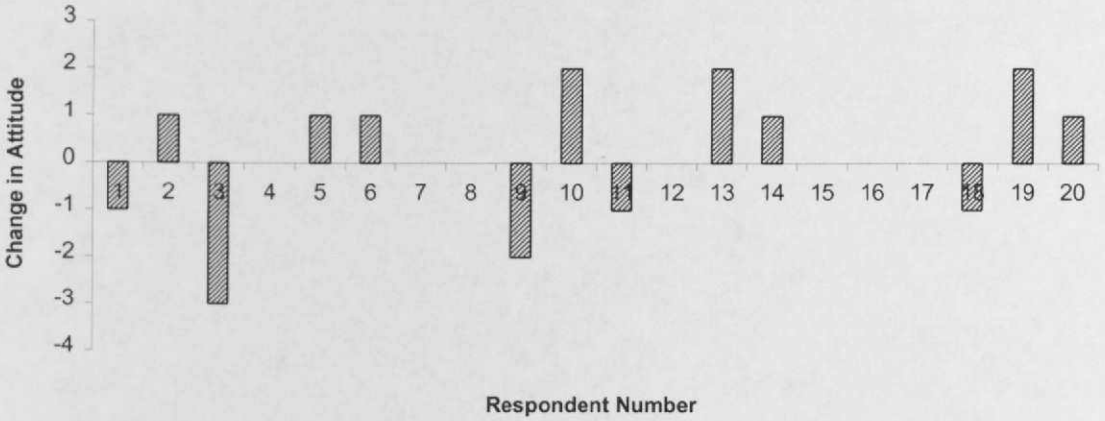




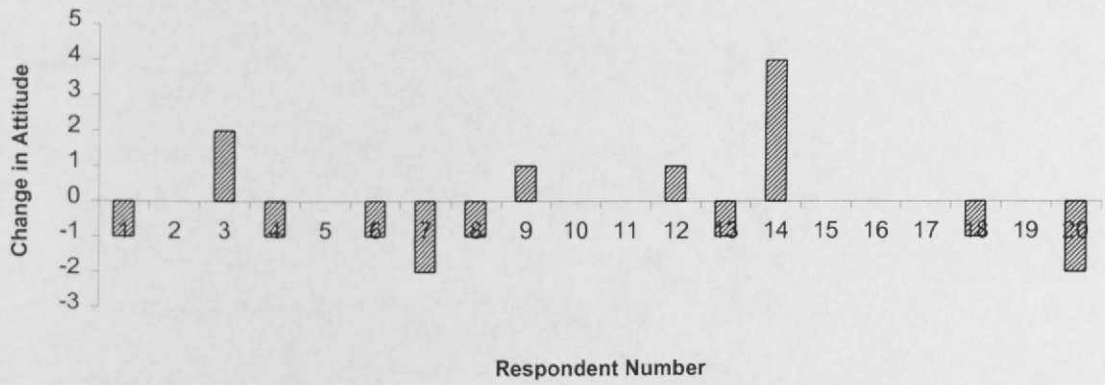
Q.22 - The recycled content infleunces my purchasng decision

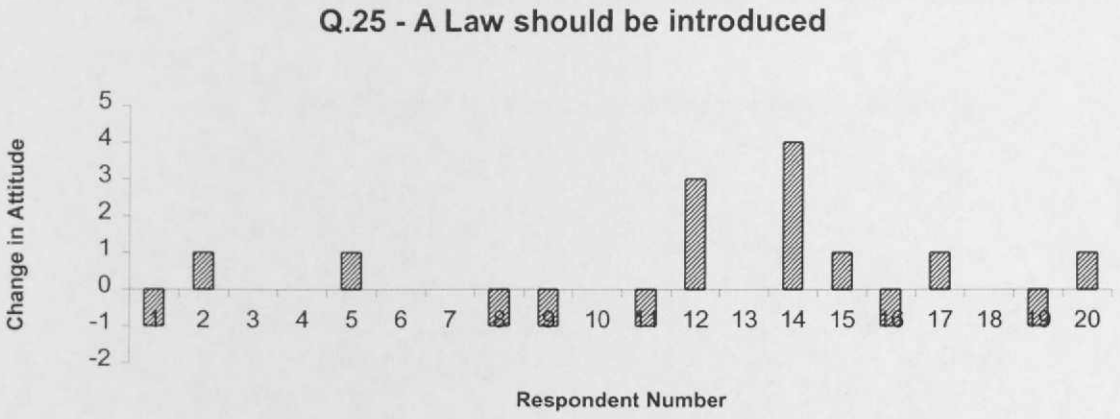


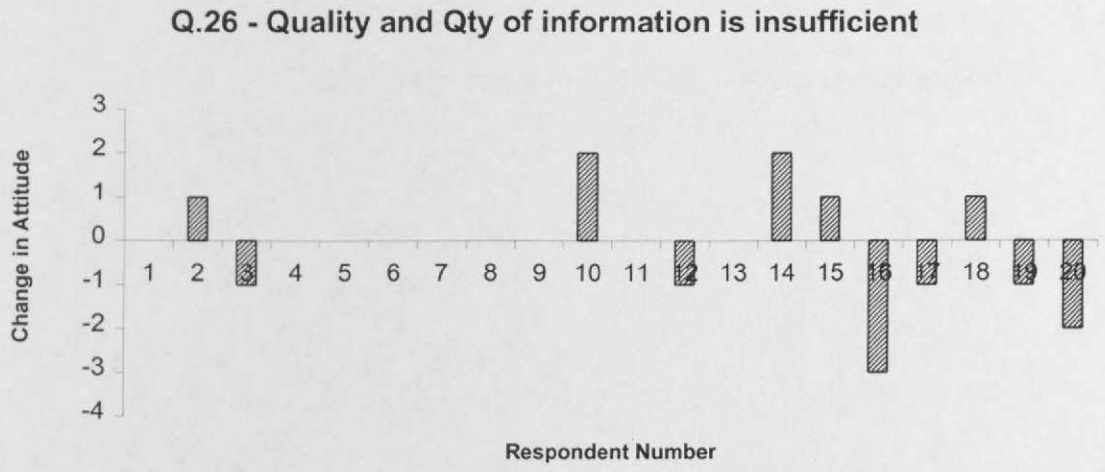
Q.23 - Always try to buy the most environmentally friendly products



Q.24 - Variable Charging





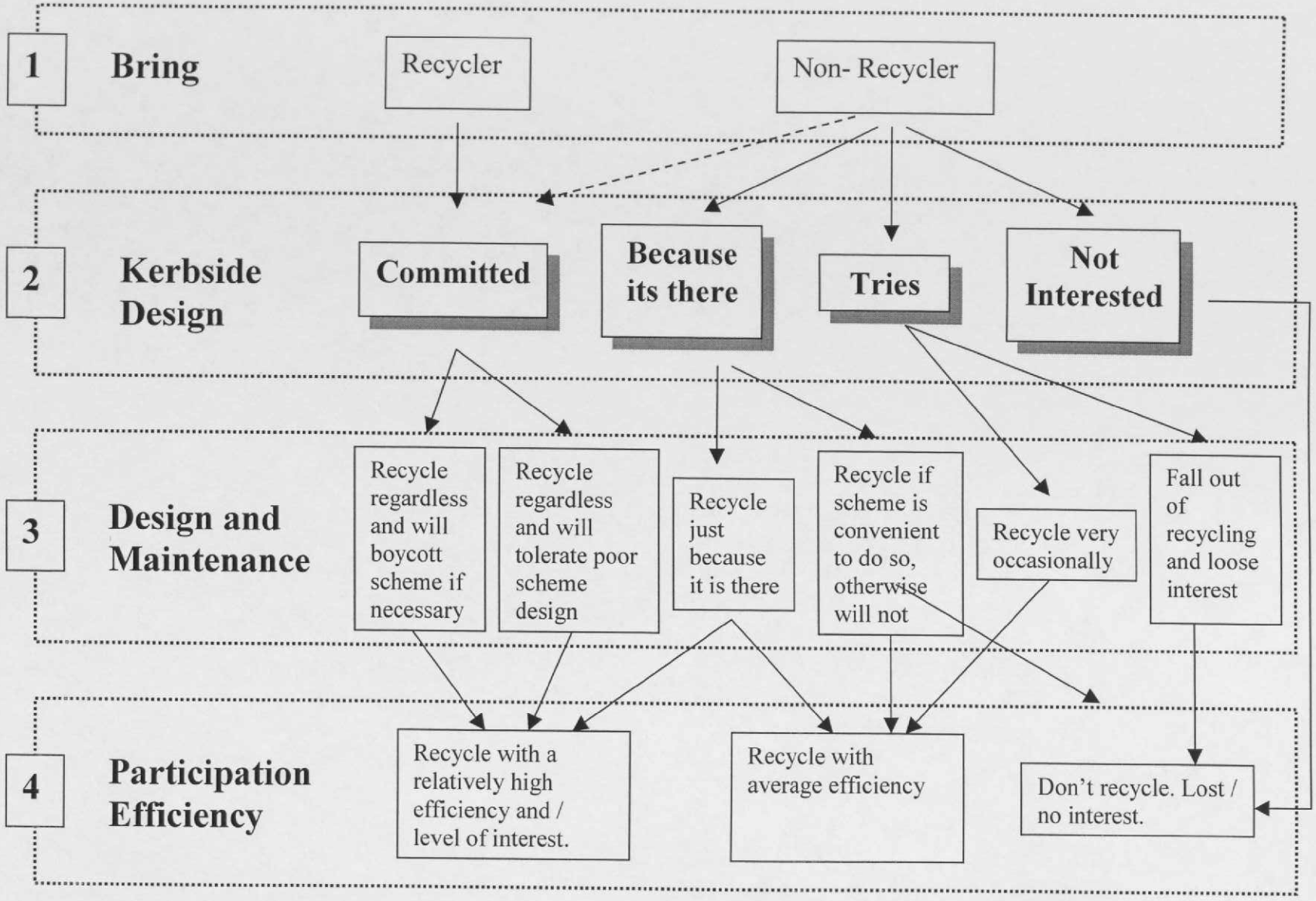


Many reasons could be postulated about the reported changes for each statement. The main point to note is that the schemes introduction does appear to have made individuals more aware about their purchasing behaviour and the issues associated with recycling although this may not be reflected directly into behaviour. These results support the attitudinal findings highlighted in the previous chapters based on a sample area basis.

6.2.7 Classifying Individual Recycling Behaviour

Figure 6.8 illustrates a proposed non-calibrated classification of recycling behaviour in relation to introducing and maintaining a scheme. However, it is aimed to highlight the potential groups of different recyclers and their distribution, which will ultimately be dependent on a scheme design and how it is maintained.

Figure 6.8 Classification of Recycling Behaviour in Relation to Scheme Design



Prior to the introduction of a kerbside scheme, bring recyclers are relatively committed to recycling as they have overcome enough of the perceived barriers to behave. Following the introduction of a kerbside scheme, household behaviour can be divided into four categories, dependent on the scheme offered. The committed recycler will consist primarily of bring recyclers who will accept or reject a scheme but 'attempt' to recycle as efficiently as possible. They are the group most likely to tolerate a poor scheme. A small percentage of previously non-recyclers may be contained within this group, as the presence of the scheme has made them aware of recycling and they wish to participate as effectively as possible, taking a genuine interest in ensuring that all their material is recycled.

A proportion of previous non-recyclers will use a kerbside scheme just because it is there. Their participation efficiency is thought to be less predictable and their behaviour more susceptible to a scheme design and how it is maintained. Such households will try a scheme, but many only participate on a sporadic basis and are very susceptible to design and maintenance issues. There is a proportion of this group that are likely to fall out of the scheme due to simple lack of interest and commitment. There will undoubtedly be a small group of households who will not participate at all, regardless of a scheme's convenient design or effective maintenance. Depending on how convenient the scheme is to use will determine the number of households assigned to each category. It has been suggested that irrespective of design, 20% of households are highly likely to participate in a kerbside scheme and 20% highly unlikely to participate (Waste Research Ltd, 2001). This leaves c.60% of households who will only participate and participate effectively when scheme design and maintenance encourages them to do so.

6.3 Scheme Design

The design of a scheme and the manner of introduction (opt in or opt out) is critical in determining participation levels and the amount of material recovered. When good practice becomes the 'norm', it will become relatively less important. Convenience, in its broadest meaning, is perhaps the most important characteristic of a scheme design on influencing behaviour.

6.3.1 From 'Bring' to 'Kerbside'

The introduction of a kerbside recycling scheme into areas previously served by bring facilities has been shown through the questionnaire analyses to increase both the proportion of households claiming to recycle and the quantity of materials claimed to be recycled. Introducing a kerbside scheme can overcome a wide selection of barriers previously identified by non-recyclers such as inconvenience, inadequate facilities, storage and handling problems. The

number of households claiming to recycle increased from 70% to 87% (Paper Chain) and from 77% to 99% (Millennium) respectively following scheme introduction.

The Millennium scheme waste arising data allowed an estimate of household bring recycling behaviour to be made where an increase of c.0.6 kg/hh/wk in waste arisings of the commonly recycled fractions i.e. paper, glass and metals were reported following scheme introduction. An actual increase was noted in both the weights diverted and household's claims to recycling more materials following the introduction of a kerbside scheme.

Around 98% of households interviewed in both the Paper Chain (98.4%) and Millennium (97.8%) sample area indicated they would use a kerbside scheme if introduced in their area. However following the scheme's introduction, participation rates of c.50% (Paper Chain) and c.90% (Millennium) were reported. While you would expect to see some difference between willingness-to–use the scheme and actual scheme usage (due to falsely claimed behaviour), the significant difference in uptake between the two schemes highlights that scheme design significantly affects participation. Whilst local authorities have no direct control over households attitudes, they can improve take up by offering a suitable service. Encouraging households to participate in a scheme (even if this is not very effectively) is within the control of a local authority and does not necessarily require an immense culture shift initiated at a national level.

6.3.2 Operational Characteristics

Specific scheme design features may appear at the outset beneficial. Although not specifically tested within the thesis, targeting both the organic and packaging fractions may increase the overall diversion levels, although individual material category capture rates may be compromised. For local authorities concerned with weight-based biodegradable targets, this is of minimal concern. For those concerned with recovering packaging from the domestic waste stream, this could potentially be a concern in terms of actual materials recovered and for monitoring and reporting "recycling " of paper / card packaging, if such materials factors are accepted in the bio-waste bin. Would it be classed as 'recovery' or 'recycling' and how would the amounts diverted be assessed (there would be no incentive for local authorities to sort such feedstock).

Data for Daventry reported newspaper diversions c.20-30% lower than expected. Although other material diversions were comparable to other schemes (and at an overall 52.3% diversion, the scheme is very successful), less than 50% of the available dry recyclables targeted for

collection were recovered. The scheme collected all main dry recycables and compostible fractions and undertook intense public communication exercises.

In Test Valley (Project Integra - Hampshire), where both compostibles and dry recyclables are collected, low diversions of packaging materials were also reported. Although relatively high, overall diversions of c.30% were achieved, the scheme's design was both confusing and inconvenient to the householder (Miller Associates, 1999), having to utilise the same wheeled bin for both fractions on an alternate weekly collection. In practice, households had to choose between fractions or make an additional effort of obtaining another wheeled bin. As the scheme design was 'inconvenient' to the recycler, it is hard to disentangle if the cause of low diversions of non-compostible fractions is a result of both fractions being collected, or the operational characteristics of the scheme. Previous literature findings also report lower recoveries of dry recyclables on schemes collecting both wet and dry fractions and further research on such schemes is needed.

Positive relationships have previously been identified between participation levels and scheme characteristics. It is generally recognised that the provision of a free container is essential to achieving high participation and recovery levels. The data collected reports marginal differences between the types of container used, i.e. bag, bin etc. and the quantity and type of materials recovered. It is suggested that a wheeled bin is the most effective, followed by a box then a bag with the least effective providing no container at all. Schemes not using wheeled bins showed marginally lower diversions of heavy and dirtier materials for reasons described in the previous chapters. This may be a consideration in initial scheme design if the heavier and dirty packaging fractions are to be specifically targeted; within the current climate, these materials are of primary importance.

The three containers provide different volumes, storage and handling requirements for households. Any decision on which container to use must be considered in conjunction with both the collection frequency and materials requested, given that an incorrect design may result in low participation and recovery levels. E.g. providing a bag to collect all recyclable materials on a monthly basis communicates the wrong message to households as well as practically providing them with not enough space to store their materials.

6.3.3 Participation Efficiency

The paper fraction was a common collected material on all three schemes. All schemes demonstrate impressive recoveries of this fraction comparable with other reported scheme recovery data reported within the literature (table 6.7). Households served by Paper Chain are

recycling very efficiently. Although the calculated figure of 100% is subject to sampling error, it is clear that households using the scheme divert the majority of material generated. However in comparison to the other two schemes, Paper Chain appears to have attracted the more 'committed recycler'. Both the Millennium and Paper Chain scheme present a simple message in relation to the materials targeted, yet more effort was required by households to participate in Paper Chain due to the scheme design and operational characteristics i.e. fortnightly on a different collection day than the residual collection, rather than weekly on the same day.

Similarly, it was easier to opt-out and not participate in Paper Chain as the bag could be thrown away and forgotten, unlike the wheeled bin that had to be set out on the first collection week empty if they did not wish to participate. The wheeled bin in the Millennium scheme acted as a visual reminder encouraging the 'non-committed' and 'non-recycler' to participate once in operation.

Although Millennium participants were recycling with c.15% less efficiency, overall they were diverting 83-84% of newspapers and magazines from the sample area. Similarly, SORT participants were recycling less inefficiently diverting only c.73% of newspapers and magazines (c.30% less efficient than Paper Chain). However, overall 66% of newspapers and magazines were recovered from the sample area, c.15% more than the Paper Chain sample area as a result of the high participation rate. Therefore, although a single material kerbside scheme was the most effectively used by its participants, it is the least effective in diverting overall a greater proportion of material from the sample area.

This highlights that effective participation by committed recyclers is not as effective as a lower participation efficiency of a more abundant number of committed and non-committed recyclers. Therefore, ensuring high participation rates through a convenient scheme design is of paramount importance. Local Authorities emphasis should therefore be on encouraging non-recyclers to recycle than "preaching to the converted".

Table 6.11 Participant [a] and Overall [b] Paper Recoveries

		Newspaper / Magazines
Paper Chain	**Overall (%)**	**51**
	Participant (Estimated %)	**c.100**
Millennium Before Feedback [c]	**Overall (%)**	**83**
	Participant (%)	**90**
Millennium After Feedback [d]	**Overall (%)**	**84**
	Participant (%)	**92**
SORT	**Overall [e] (%)**	**66**
	Participant [f] (Estimated %)	**c.73**
Project Integra [g] (Fareham)	*Overall (%)*	*79*
	Participant (Estimated %)	*c.84*
Project Integra [g] (Portsmouth)	*Overall (%)*	*55*
	Participant (Estimated %)	*c.70*
Project Integra [g] (New Forest)	*Overall (%)*	*79*
	Participant (Estimated %)	*c.89*

a Participant refers to recoveries of targeted material from households observed participating

b Overall refers to recoveries of targeted material from all households within the sample area

c Results taken from waste auditing 2 weeks after the scheme started

d Results taken from waste auditing 3 weeks after the feedback letter

e Although this figure represents all households within the sample area, sampling bias towards households who had set out their recycling bin suggest this figure is greater than the true value.

f This figure is based on assumed participation rate of 90% given a monthly collection and a set out rate of 70%

g Overall and participant recoveries estimated from Project Integra data (see chapter 5 results) and as secondary data subject to unknown uncertainties. Fareham – Wheeled bin (fortnightly collection), Portsmouth - box (fortnightly collection), New Forest – Sack (weekly collection). All collect the same materials fortnightly and residue weekly. Data mixed form two sources and therefore subject to sampling variability.

6.3.4 Service Satisfaction

6.3.4.1 Existing Service Maintenance Score

A service maintenance index was developed using the same method as the attitude score. The questionnaire was completed prior to households being informed of their kerbside recycling scheme. A higher score represented a higher level of satisfaction with the waste management

and recycling service provided. The questions related to existing service provision, i.e. bring sites, and were as follows,

- The current waste management system adequately suits my needs (SA=5)
- The local bring sites are regularly overflowing and untidy (SA=1)
- Bring facilities should be more adequately sign posted and better managed (SA=1)
- Recycling facilities are a long way from my place of residence (SA=1)
- The quality and amount of information on recycling in Leeds/Bradford is insufficient (SA=1).

Mean scores, in relation to households recycling behaviour, are shown in table 6.12. From a potential maximum score of 25, and minimum score of 5, the mean score was 13.56 (mode 14), suggesting that overall, households thought their service provision was average to dissatisfied. Recyclers appeared to be more satisfied with their service than non-recyclers. Again, this supports the view that household's failure to recycle is related to their dissatisfaction with the service provided.

Table 6.12 Mean ESM scores in relation to claimed recycling behaviour

	Sample Area	Sample Size	Mean Score	S.D	Mode
Recyclers	**Wetherby**	75	13.0	3.1	12
	Garforth	108	14.0	2.7	14
	Bradford	48	15.8	3.1	18
	Total	**231**	**14.1**	**3.1**	**14**
Non-Recyclers	**Wetherby**	46	12.0	2.9	11
	Garforth	33	12.3	2.4	14
	Bradford	14	13.2	2.1	14
	Total	**93**	**12.3**	**2.7**	**11**
Total		**324**	**13.56**	**3.06**	**14**

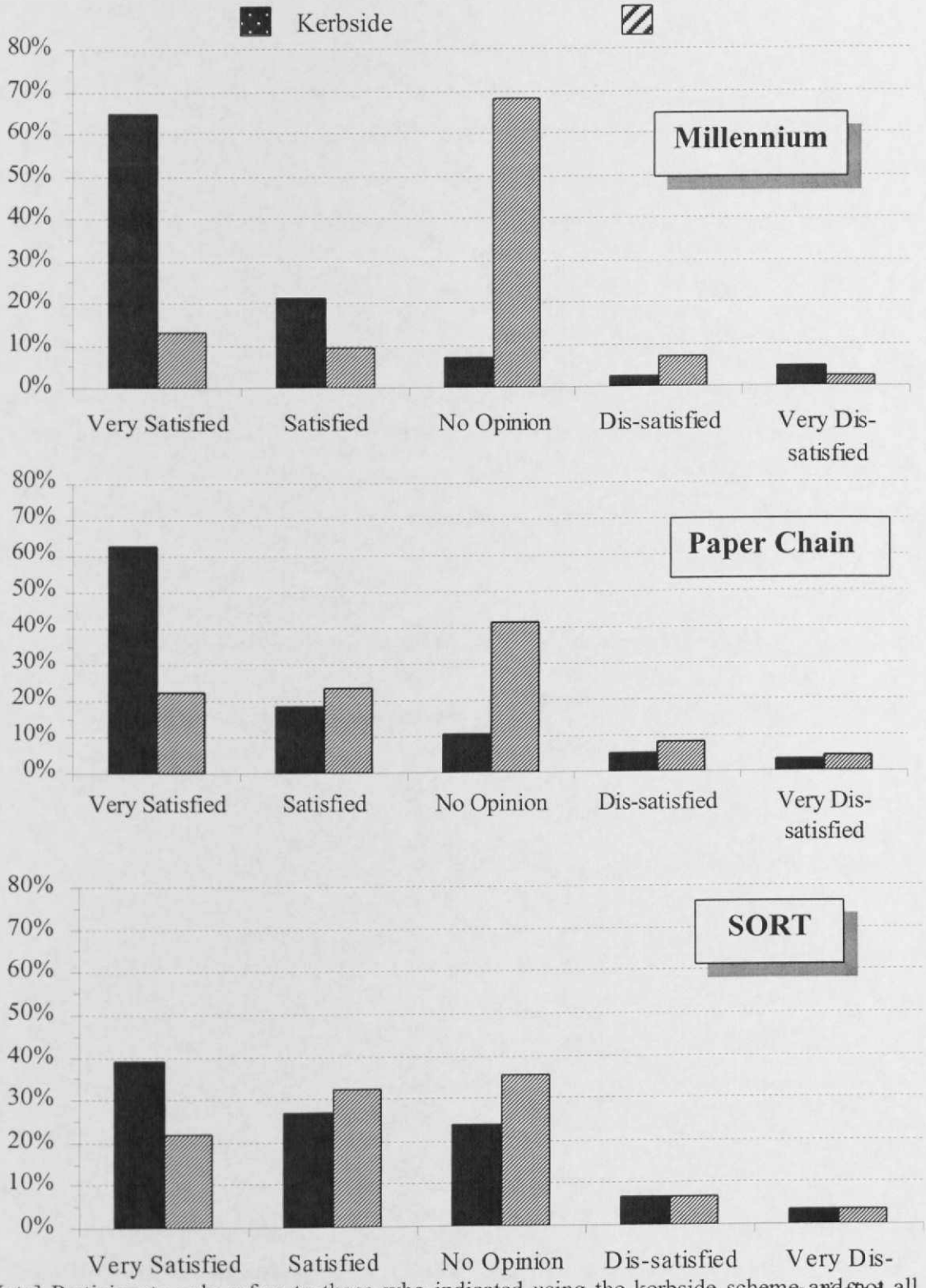
6.3.4.2 Kerbside Provision

Figure 6.9 shows the variation in participant's level of satisfaction between schemes. The same 'rating scale' (Foster and Parker, 1995) was used on all three schemes. Households served by the SORT scheme appear less satisfied, compared to the other two schemes, with satisfaction levels comparable to bring provision. Satisfaction towards bring facilities are not necessarily poor, but clearly there are many who have 'no opinion'. On the Millennium scheme, attitudes are very positive towards the scheme, especially in comparison to bring provision regarded as 'the norm'.

As a 'service', the satisfaction levels of the 'customer', is of paramount importance. Encouragingly, households overall are not strongly dissatisfied with any of the schemes. The provision of any kerbside scheme addresses at least some, if not all, of a households recycling needs, as recycling facilities are provided at the home given that inconvenience is the major barrier to recycling. Ideally, scheme providers would like to see distinct differences, as noted by Millennium residents, to pinpoint which design of scheme is most accepted by residents. Satisfaction levels are high and similarly so are participation and diversion levels. An interesting point to note is that a positive relationship can be identified when participation efficiency levels for paper recovery (table 6.11) are compared to satisfaction levels (figure 6.9). Admittedly this can be attributed to a series of factors, although if households are satisfied with a service, they are likely to use it more often.

To an extent, interpreting and comparing such responses implies that the participants have a reasonably strong desire to recycle – clearly one can express 'satisfaction' for a service you perceive to have little need for even if it is poor. Furthermore, caution should be exercised when comparing household satisfaction levels of bring provision between schemes. As the designs of the scheme differ in terms of the materials they collect, households will rely on bring sites for different materials and some will rely on them more than others. For example, households served by SORT will rely on bring sites for glass and possibly textiles and compostables, whilst Paper Chain households will rely on bring sites for all materials except paper. As the Millennium scheme collected all recyclables, households only relied on bring sites for compostables (although admittedly this fraction can be, and was more likely to be dealt with at home). As Millennium households have no use for bring facilities, it is not surprising that they have no strong opinion either way regarding them.

Figure 6.9 Participants satisfaction with kerbside and bring site provision



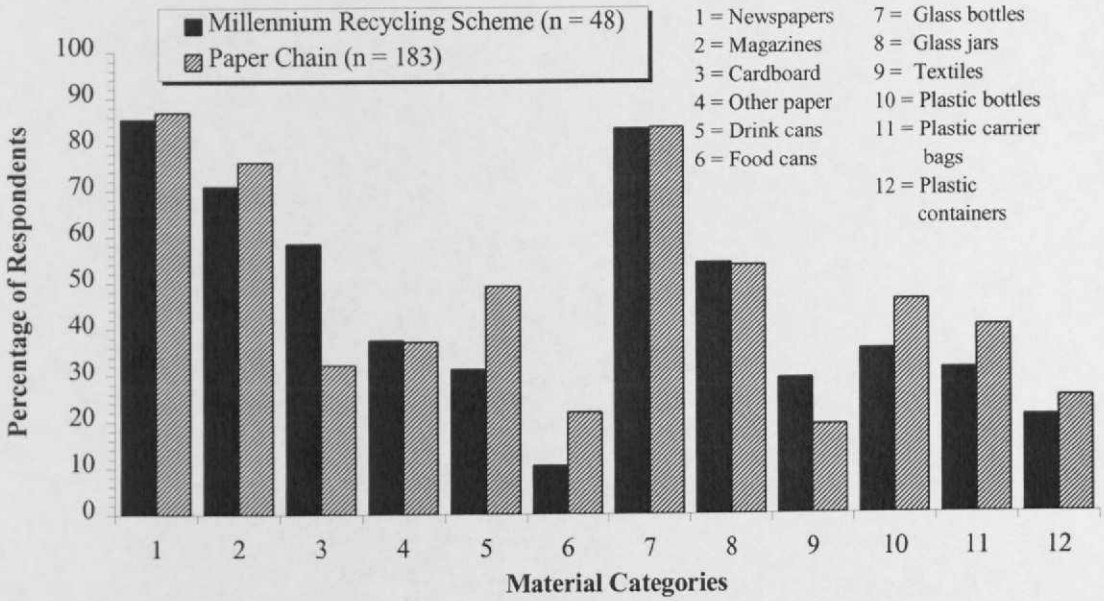
[Note] Participants only refers to those who indicated using the kerbside scheme, and not all respondents claiming to recycle

6.3.5 The Effect of a Schemes Design on Claimed Recycling Behaviour

Before the Paper Chain and Millennium scheme were introduced, materials recycled at bring sites by households were very similar for both areas (figure 6.10). The main difference was

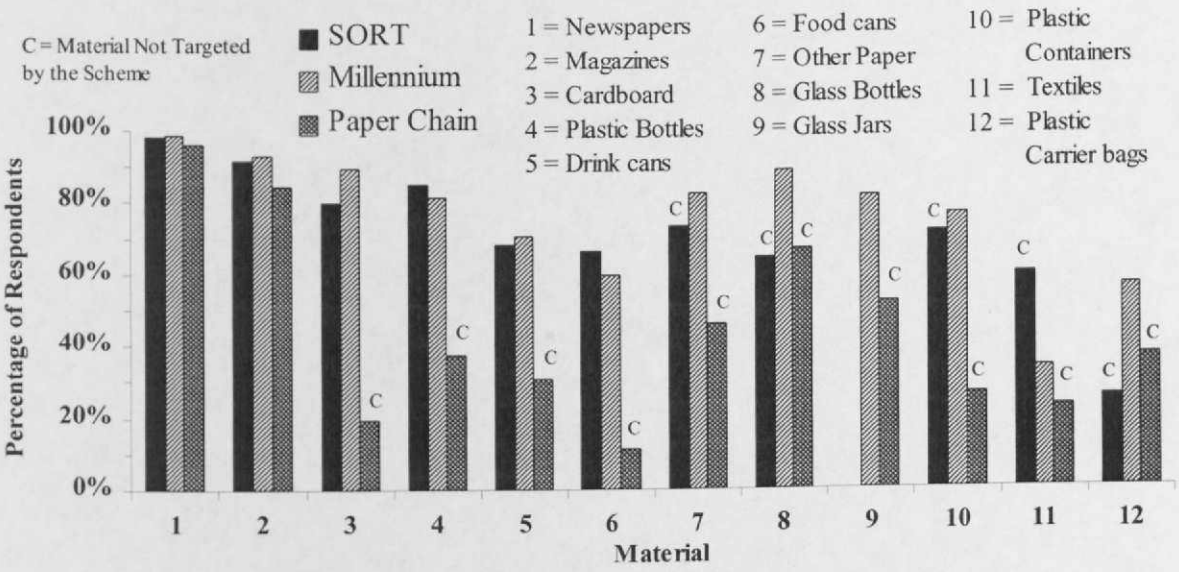
cardboard, although this may reflect the lack of cardboard recycling facilities available within the Paper Chain area. The main materials recycled are similar to both national reported material recycling levels, and the availability / densities of bring sites for each of the materials, i.e. paper banks are more common than plastic bottle banks.

Figure 6.10 Claimed 'Recyclers' Behaviour Before Kerbside Recycling Scheme Introduced



Once the kerbside scheme is in operation, the range of materials households claim to recycle broadly relate to the scheme design offered (figure 6.11). If the material is targeted by the scheme, households will claim to and hopefully recycle the material. A lower proportion of households claim to recycle a material if it is excluded (in comparison to schemes requesting the material). Households may focus only on the materials requested by the scheme. The claimed recycling of plastic containers is the exception, although as previously discussed, this is thought to be a mis-understanding of communication when questionnaires were completed. Paper Chain households appear to be recycling a significantly smaller proportion of materials in relation to the other two schemes. The most notable differences are in relation to materials inconvenient to recycle i.e. food cans, which would reinforce the effect of the material as previously discussed. Results have shown that although households claim to recycle these materials does not guarantee these claims are correct or materials are recycled efficiently.

Figure 6.11 Claimed Recycling Behaviour in Relation to Scheme Design



[Note] SORT waste analyses did not distinguish between glass jars and bottles

An interesting point to mention (although not conclusive) is that a number of materials previously recycled on paper chain i.e. glass and plastic bottles have decreased once the kerbside scheme has been introduced. This could suggest, households no longer recycling a range of materials, satisfied they are 'doing their bit' by participating in the Paper Chain scheme. It is more likely, that the 'new' recyclers are only encouraged to recycle the single material requested by the scheme, thus lowering the overall reported percentages of other materials given the number of recyclers has increased as result of the kerbsides introduction.

An analysis of paper bank weights in the sample area reported a dramatic decline following the paper schemes introduction. This suggested a large proportion of collected materials were merely transferred. As the scheme did not stimulate recycling of other materials, (if anything the range of materials recycled declined), the wisdom of introducing more costly kerbside systems for paper alone is questionable. Further research is required to identify the long-term effect of introducing a single material scheme on the recycling of other materials beyond the initial 6-month pilot period.

In comparison, levels have increased for all materials on the Millennium scheme and consistently high levels are reported. Given that the questionnaire was completed before the feedback letter, (and therefore claimed levels are likely to increase further with the increase in knowledge), this would suggest that the need for bring sites in an area with such intensive multi-materials kerbside recycling would be limited.

6.4 Scheme Maintenance

The level of service provided to facilitate household intention / desire to recycle has to be maintained once the scheme has been introduced. A convenient kerbside scheme is critical in ensuring high recycling levels. However, regardless of the quality of the scheme, if households are not told how to use it correctly at the outset, and continually reminded and encouraged, then they may loose interest. Although primarily a result of scheme design, households were observed dropping out of the Paper Chain scheme, thought to be a result of initially service provision not meeting their needs and subsequently poor maintenance.

Influential factors on recycling behaviour regarding scheme maintenance can be low resource intensive, e.g. quality control, to high resource intensive, e.g. education and feedback. The relative effect between these measures has not been quantified, although from the results gained we can assume the latter is more effective. However, it is clearly evident from the schemes monitored and assessment of the secondary data that both are crucial in determining overall participation and recovery levels.

Unlike refuse collection (which is an essential service), households can choose not to use a recycling service. It should therefore be provided as a service comparable to e.g. retailing, recognising that if the 'customers' are unsatisfied with the service provided, they would choose not to use it or go elsewhere. Practically, households cannot choose to boycott their refuse collection service and have little control over forcing change. Although quality control issues such as the number of missed refuse bins are within various local authority indicators, they are unlikely to influence household behaviour in the same way as failing to collect a recycling container, or returning it to the wrong place.

The literature certainly highlights this issue where failure to collect recyclables (Spaccarelli et al 1989) and issues relating to the collection container either being lost, stolen, never provided, or not collected being the primary reason for non-participation, or falling out of a kerbside recycling scheme (Miller Associates, 1999, Tucker 2001c). Feedback from the Millennium focus group reported how courtesy of the collection crew, reliability and punctuality all assisted in providing a level of confidence in individuals to participate in the scheme. Qualitative discussions with SORT participants and previous participants highlighted the residents frustration with the council in not providing a reliable service, and indicating this as their main reason for no longer participating.

Previous comparisons between diversions reported on the SORT scheme and the Millennium scheme, indicate differences, which were thought to be due to the scheme maintenance, rather than the design of the scheme itself or participant attitudes. Households were content with the SORT scheme, but were not enthusiastic to use the scheme to its full potential. A large proportion of households were unaware of targeted materials and collection dates. It is thought that through the delivery of feedback, material recoveries could increase in a similar manner as seen on the Millennium scheme.

One of the main factors of scheme maintenance is effective information and communication with households so that they understand why they need to recycle and how they can participate. Household satisfaction with the quality and quantity of information on recycling provided before knowledge of any scheme being introduced, were consistently poor in the sample areas questioned. Around 60-70% of households were dissatisfied or strongly dissatisfied. Views were not significantly different between recyclers and non-recyclers. Interestingly c.30% of households in both sample areas identified lack of information as a reason for not recycling prior to the introduction of a kerbside scheme. This may be a perceived barrier to recycling or an easy excuse for non-recyclers.

The introduction of a kerbside scheme, unsurprisingly, reduced the number of households dissatisfied with information on recycling, although around half of the respondents asked were still unhappy with the quality and quantity of information provided. Therefore, despite the initial information provision associated with introducing a pilot kerbside recycling scheme, a significant proportion of households felt this did not go far enough in meeting their needs. Unlike pre-scheme attitudes, non-recyclers felt more strongly about the lack of sufficient information than recyclers.

31% of non-recyclers still indicated lack of information as a reason for not recycling once served by the Paper Chain scheme. This again could be attributed to 'an easy excuse' for not recycling. However, households who choose not to use the kerbside scheme in favour of continuing to use bring facilities held similar views to non-recyclers regarding the quality and quantity of information provided, suggesting households may genuinely have not felt well informed about the scheme and thus did not use it.

c.40% of participants on all three monitored schemes thought the information provided was average. Requests to provide more detailed instructions on how to use the scheme and feedback were common all three schemes when households were asked about their preferred scheme changes, especially those served by the Millennium scheme. Feedback from residents on the

Millennium scheme highlighted their dissatisfaction and confusion with the initial information leaflet. Although the intention of requesting 'all recyclables' was to remove the onus of product/material identification from the householder, it was presumptuous and only a simple instruction message if households knew what materials were actually recyclable. This may have prevented some households recycling certain materials in fear of contaminating the recycling bin. However, the operational instructions were clear, weekly collection on the same day as refuse collection and knowledge of common recyclable materials were reflected in their recoveries i.e. paper and glass. However, the initial lower recoveries of the less commonly known packaging fractions, particularly the plastics, were thought to, in part, reflect household lack of knowledge.

'Project Interga' data and other national surveys reported in the thesis showed the variability of materials claimed to be recycled which are collected by a kerbside scheme, attributing this to poor communication on behalf of the scheme provider of materials targeted by a scheme; households may simply not know what materials are recyclable and thus do not claim to recycle them. Feedback from the Millennium focus group highlighted residents initial criticism of the first scheme information leaflet, indicating that, although the scheme collected all recyclables, they did not understand what materials were actually recyclable, suggesting the need for the implementation of two strategies. Firstly, needs to successfully communicate at a local level what materials are requested by a scheme, i.e. the knowledge factor. Secondly, at a national level, the need to universally 'educate' people not only on the generic issues of recycling and other disposal options, but the basics of what materials are recyclable.

Although households would appear frustrated at materials being excluded from kerbside recycling schemes, (indicated in both Paper Chain and SORT), suggesting they would prefer as many materials collected from the kerbside as possible, they still require some guidance on what materials are requested. Generally, it is thought households are concerned about contaminating a recycling bin and if unsure about a material will not recycle it. Only half of the SORT residents felt they were 'not confused about what materials to put in the recycling bin'. In addition, about half disagreed that the council constantly reminded them of how to use scheme. Clearly, there is a need for the scheme provider to communicate and educate its residents, if any progression is to be made.

Household opinions on information provision are relatively consistent, regardless of the scheme design offered. However, the delivery method is the same on all three schemes, blanket leaflet provision. Although an incorrect leaflet design can have its implications on the message communicated, (as seen in the Millennium scheme), there would appear to be a general need to

go further in informing and educating the public. Whether this is an issue regarding the level and quantity of information delivered, or the delivery message / medium used, is uncertain. If the latter, then a central uniform message provided through mass media campaigns using various mediums at a national level may be required in addition to those at a local scale.

One successful way of providing further information to households was shown on the Millennium scheme, by providing performance feedback. In the form of a leaflet, it firstly addressed the issue of households recognising which materials were recyclable. However, its main advantage was highlighting household good and bad performance on how to use the scheme. This was positively received by residents as 'a pat on the back' and a form of constructive criticism. The result was a significant increase in overall scheme diversions, particularly for the packaging fractions and set out rates. Providing feedback cannot be underestimated. It is thought, given similar initial material recoveries between the SORT and Millennium scheme (prior to feedback), that such an approach would be an effective way to increase SORT diversions. However, an important point to note, is that, although not tested, such feedback may need to be regularly repeated, i.e. every 6-12 months to ensure that household interest is retained, and they are aware that their performance is being measured.

Feedback from residents highlighted the importance of a clear, simple, colourful and pictorial leaflet design in order to be successful. Pictures of requested materials and operational features e.g. a clock, helped residents identify what was required of them. Although comical, and perhaps extreme, they successfully communicated what was required of the residents, which subsequently translated into behavioural change. Leaflets are the most common delivery method when informing the public about recycling and how to use a scheme. Therefore, scheme providers should ensure that such principles are adopted, so that they have maximum effect.

6.5 False Claims

In order to verify the accuracy of household self-reported behaviour, which has often been criticised of 'measuring a separate reality' (Corral-Verdugo et al, 1995; Corral-Verdugo, 1997), a series of direct comparisons were made between the self-reported and observed data sets on primarily the Paper Chain, Millennium scheme and to a lesser extent the SORT scheme. It was essential to identify and potentially quantify the level of difference between self-reports and observed behaviour, as the thesis relies on both data sets, and the perceived difference is integrated into the model. The research design provided an invaluable opportunity to compare claimed and observed behaviour, for a series of phenomena previously not investigated, particularly monitoring the failure of a household to put intention into practice. Three

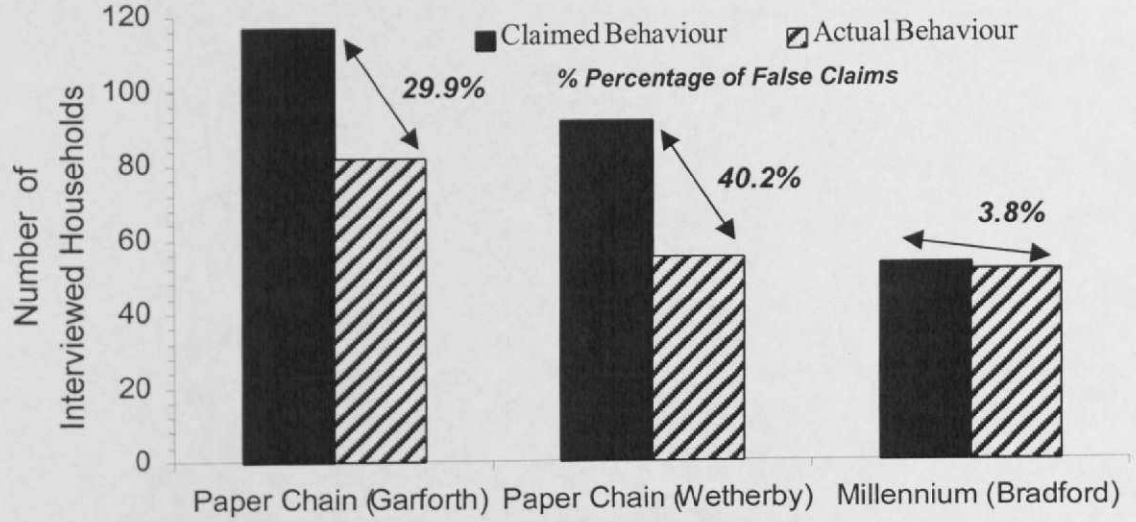
performance factors where differences had been noted in the literature were investigated; participation, set-out rate, and materials recycled.

6.5.1 Participation

Addresses of households who had indicated that they would use a "door-to-door collection system if introduced in their area" from the 'Paper Chain' and 'Millennium' pre-scheme questionnaires were recorded. Those indicating 'regularly' or 'all of the time' were compared with monitored set-out data collected during the first eight weeks operation of the scheme. Differences shown in figure 6.12 were regarded mainly as households who had failed to put their intention into practice, although undoubtedly a proportion will be a result of a direct false claim. A higher proportion of households in both Paper Chain sample areas, compared to the Millennium sample area, failed to put their intended participation into practice; this was significantly higher in the Wetherby area.

Differences between the schemes again support the view that the Paper Chain scheme failed to meet households recycling needs and may not have been entirely a result of households making false claims, or failing to follow through their intentions. The scheme was not sufficiently attractive to encourage households (particularly non-recyclers) to participate. Table 6.13, illustrating households intended and observed participatory behaviour in relation to existing recycling behaviour, reinforces this view. A higher proportion of non-recyclers failed to put their intended participation into practice in both Paper Chain sample areas; supported with a chi square value of 5.35 (0.05 confidence level).

Figure 6.12 Number of households who failed to put their intention to participate into practice following the introduction of the pilot kerbside schemes



Although non-recyclers may have had the desire to recycle, envisaging a convenient collection system, on introduction, it did not convince them to participate. Their initial reasons cited for not recycling prior to the scheme would support this view, where 'facilities too far / inadequate' (60%), 'inconvenient / no time (48%) and 'storage and handling problems' (48%) were still amongst the main barriers. Interestingly, all interviewed non-recyclers put their intended behaviour into practice when the Millennium recycling scheme was introduced.

The high proportion of recyclers within the Paper Chain sample area choosing not to use the scheme may reflect the lack of material types collected by the scheme, and their continued use of bring sites. Prior to scheme introduction, recycling households who failed to participate claimed to recycle the following; newspapers (81.6%), magazines (67.3%), glass bottles (85.7), glass jars (44.9%), drink cans (49.0%), food cans (22.4%) and plastic bottles (38.8%).

Interestingly, of the 74 households who failed to put their intentions into practice, 18 (25%) were observed 'trying the scheme' in the second eight-week monitoring period, reducing the overall percentage of overall false claims from 34.4% to 21.4%. Alternatively, these differences may be a result of sampling error, individuals moving house and the new tenants participating etc. Observed set-out frequencies report households generally either setting out their containers only once in the second eight-week monitoring period (suggesting trying the scheme / infrequent user) or a smaller number setting out at every opportunity in the second period (suggesting sampling error / change in occupancy).

Table 6.13 Number of households who failed to put their intention to participate into practice in relation to claimed existing recycling behaviour.

		Intended Behaviour*	Actual Behaviour**	Percentage of False Claims ***
Paper Chain (Garforth)	Recyclers	96	71	26.0 %
	Non-recyclers	21	11	47.6 %
Paper Chain (Wetherby)	Recyclers	63	41	34.9 %
	Non-recyclers	29	14	51.7 %
Millennium (Bradford)	Recyclers	40	38	5.0 %
	Non-recyclers	13	13	0.0 %
Total	Recyclers	199	150	24.6 %
	Non-recyclers	63	38	39.7 %

* Relates to the number of interviewed households who claimed they would use a "door to door collection system to collect recyclable materials" 'regularly' or 'all of the time'.

** Relates to the number of interviewed households who participated at least once within the first 8-week period in a subsequently introduced, kerbside recycling scheme.

*** Relates to the proportion of interviewed households who claimed they would use a "door to door collection system to collect recyclable materials" 'regularly' or 'all of the time' who failed to set out their container within the first 8 week period.

No significant differences between household ACORN classifications were reported (table 6.14). A relatively higher proportion of E11 households, failed to participate in relation to the other groups. A slightly lower proportion of B5 households failed to participate. Socio-demographic factors included in the ACORN classification maybe influencing household intention to participate, although further research is required to be conclusive.

Table 6.14 Number of households who failed to put their intention to participate into practice in relation to ACORN Classification

	A1	B5	D9	E11	TOTAL
Intended Behaviour	23	57	94	35	209
Failed to Participate	8	17	32	15	72
Percentage of Households Failing to Put Intention into Practice	34.8%	29.8%	34.0%	42.9%	34.4%

In addition to the scheme design failing to meet household needs, there will be a proportion of households who claimed they would participate, with no intention of doing so. This could not be tested specifically in the context of these data but could be in relation to claims made once the scheme started.

To measure household direct false claims, postal questionnaire addresses collected from the same two sample areas were used. Households who had claimed to set out their recycling sack/wheeled bin, fortnightly or monthly (or weekly in the Millennium scheme), were compared with monitored set-out data collected during the six-month monitoring period. Any differences were thought to be a direct false claim by the householder. A relatively high proportion of residents, 11.0% (Wetherby) and 6.8% (Garforth), claimed to be participating in the Paper Chain scheme frequently, but had never been observed participating since the start of the scheme (figure 6.13). Only 1.2% of Bradford households made false claims, although this is more likely to reflect the high participation rate, than a significant change in peoples' tendency to mislead.

Perhaps a more effective measurement of this behaviour is to report the number of false claims in relation to the percentage of non-participants (table 6.15), as participants are unlikely to claim they do not participate when they do. In the Millennium and Paper Chain schemes, 50.0% (Bradford), 19.2% (Wetherby) and 15.0% (Garforth) of non-participants claimed to participate during the scheme operation, when they had never been observed participating during the 6-month period. When only non-participants are considered for assessing the proportion of

households who claimed they would use a recycling scheme but failed to do so on its introduction, the figures are substantially higher (table 6.15).

Figure 6.13 Number of Household Claiming to Participate and the Number of Household Observed Participating Throughout the 6 Month Pilot Period

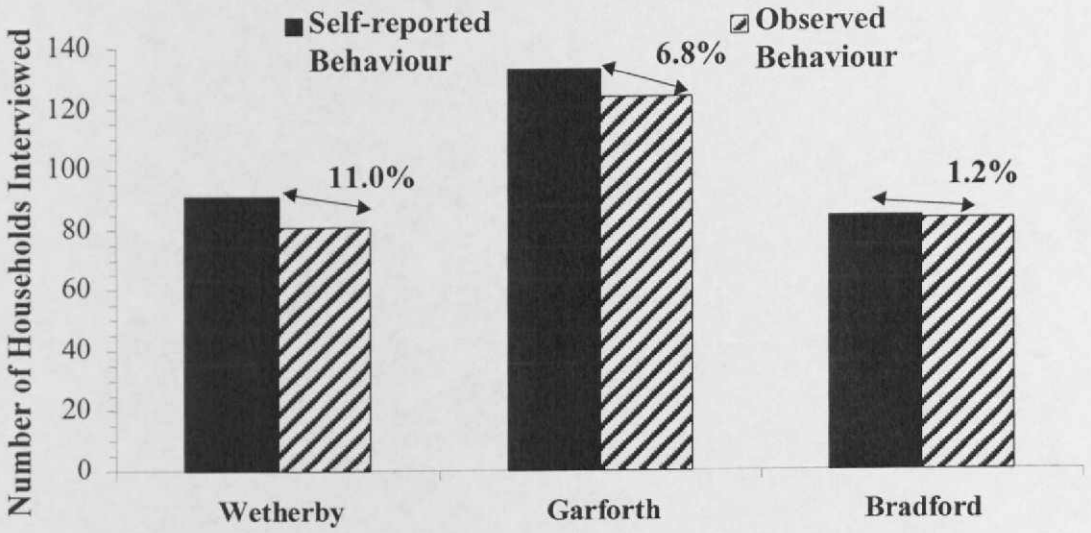


Table 6.15 False Claims in relation to Non-participants

		Non-participants	No. False Claims	%
Before Scheme	Garforth	49	35	71.4
	Wetherby	57	37	64.9
	Bradford	11	2	18.2
During Scheme	Garforth	60	9	15.0
	Wetherby	52	10	19.2
	Bradford	2	1	50.0

Respondents' higher participation ratio suggests that households who are completing the questionnaires are more likely to have an interest or view in relation to recycling, and are therefore more likely to recycle / participate. Households, who do not respond to the questionnaire, are also those who fail to participate. This is a key issue; if households who demonstrate an interest in recycling are not convinced to recycle, then the task to convince those who do not wish to respond to a questionnaire, (i.e. those who have no interest), may be even be harder to do so. The motivators and barriers to recycling presented may not represent the whole population, (especially non-recyclers) which may influence the strategy put in place to increase recycling levels. Similarly, the non-recycling households of this sub-set must therefore hold

very strong attitudes regarding this issue, and their responses should perhaps be weighted accordingly.

An interesting point to note is the difference between the respondents' participation ratio (that is those in relation to households observed participating who responded to the questionnaire) and the whole sample areas measured participation ratio (table 6.16). A lower sample area percentage is reported for both Paper Chain areas, but not Bradford. This is thought to be a result of households that anticipated not using a recycling scheme and being encouraged to participate for reasons previously outlined.

Although unlikely, household participatory behaviour within the Paper Chain sample area could have occurred outside of the 16 weeks of observation. More likely, this is evidence to back up the research findings that individuals over-exaggerate or communicate misleading reasons to 'socially desirable' questions (Warriner et al, 1984; Ball and Tavitian, 1992; Gamba and Oskamp 1994; Barker, 1994; Gamba and Oskamp, 1994; Tucker, 1998).

Table 6.16 Questionnaire Population Bias

		No. of questionnaire responses +	No. of hh. Claiming participation ++	No. of hh. Observed using the scheme	Respondents participation ratio (%) on Paper Chain	Sample area DETR measured participation ratio (%)
Pre-scheme door to door questionnaire	Garforth	131	117 (89.3%)	82	62.6%	49.0%
	Wetherby	112	92 (82.1%)	55	49.1%	37.0%
	Bradford	62	53 (85.5%)	51	82.3%	89.5%
During scheme postal questionnaire	Garforth	184	133 (72.3%)	124	67.4%	46.9%
	Wetherby	133	91 (68.4%)	81	60.9%	36.1%
	Bradford	85	84 (98.8%)	83	97.6%	88.1%

+ Only questionnaires where addresses were recorded could be used and therefore sample numbers may be smaller than the total number of questionnaires collected in the paper chain area.
++ Only included households who claimed they would use a kerbside scheme 'regularly' or 'all of the time' (Pre-scheme) and set out recycling bags 'fortnightly' or 'monthly' (During the scheme).

Due to the small sample number of households providing direct false claims, any significant correlations with ACORN grouping is very limited (table 6.17). Although the data suggests

some difference (i.e. again E11 households showing higher levels of false claims) further research is definitely required.

Table 6.17 Claimed and Observed Paper Chain Participation During the 6 month Monitoring in Relation to Households ACORN Classification

	A1	B5	D9	E11	TOTAL
Claimed Behaviour	20	64	109	31	224
Failed to Participate	1	5	9	4	19
Percentage of False Claims	5%	7.8%	8.2%	12.9%	8.5%

6.5.2 Set out Frequency

On a scheme basis, 89.2% of the 224 households claiming to participate in the Paper Chain scheme, claimed to usually set out fortnightly (on every collection day), although the areas mean observed set-out ratio is only 29.6%. On the Millennium scheme, 96% of the 84 households claiming to participate indicated setting out their wheeled bin for collection every week, although the areas mean set out ratio was 76.1%. Similar over-estimations in set-out frequency were reported by Ball and Tavitian (1992) and perhaps again demonstrates an individual tendency to communicate over-exaggerated responses, when responding to socially desirable questions.

To study this aspect in more detail, addresses of postal questionnaire respondents on the Paper Chain and Millennium schemes who had indicated their claimed set out frequency were directly compared with their observed set out frequency during the monitoring period.

186 Paper Chain participants claimed to place their recycling sack out for collection every fortnight. 12.9% were observed setting out only once or twice, 25.8% observed setting out 3 or 4 times, 31.7% observed setting out 5 or 6 times and only 29.6% were observed setting out 7 or 8 times out of the 8 potential opportunities to set out their sack. Only 10.2% of households who claimed to have set out their recycling sack every fortnight were actually observed doing so.

On the Millennium scheme, 82 of the 86 respondents claimed to be setting out their recycling bin weekly. Differences between the claimed and observed set out were less dramatic. As set out was monitored each week for a period of 23 weeks, a more detailed comparison could be made. During the 23 weeks, of the 82 respondents, 83.1% set out their recycling bin 18-23 times (effectively 3 to 4 times a month) 14.3% 10-17 times (effectively every fortnight) and 2.6% 1-9 times (around once a month). 22.1% of the 82 households claim to set out every week were observed doing so during the 6 month pilot period.

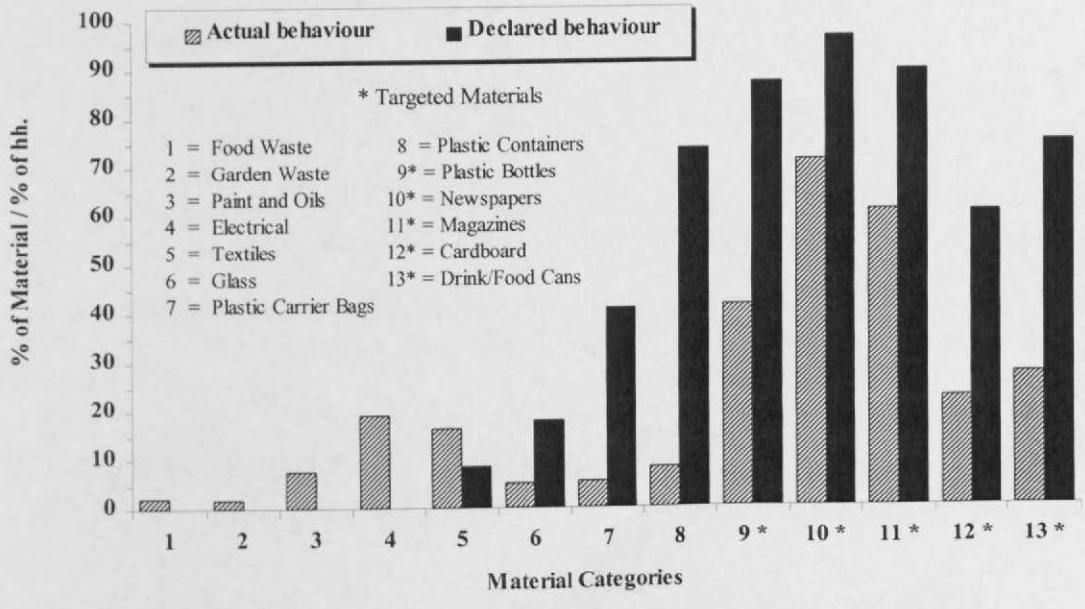
6.5.3 Materials Recycled

The Paper Chain postal questionnaire did not require households to indicate specific material disposal behaviour as only different grades of the paper fraction were collected. Questionnaire data collected from a previous M.Res. project (Perrin, 1998) reporting claimed disposal / recovery behaviour on the SORT scheme (to reduce the sampling variability between measured and self-reports), and data from the Millennium postal questionnaire (which included material specific behaviour), were compared to actual waste composition / recovery data.

Differences between actual and claimed disposal behaviour were calculated by comparing the recovery of a given waste category and the percentage of households who indicated in the questionnaire that they had disposed of the same waste category into the recycling bin (figure 6.14). As the waste analysis only included households that had a recycling bin and participation rates were high, the materials recovery data essentially represents actual segregation performance of participants. The SORT questionnaire returns covered c.27%, and the Millennium scheme c.58% of households who contributed to the waste analysis data.

Although individual households views were known, sorting of individual household waste samples was not undertaken; primarily due to resource constraints, but also as this could have been considered as an invasion of privacy. Therefore, an exact comparison-identifying if the claimed disposal of a particular material or efficiency of that behaviour, could not be undertaken. However, the average claimed response of householders to specific materials still provides some very interesting insights.

Figure 6.14 Variation Between Percentage of Households Claiming to Place a Specific Material into the SORT Recycling Bin and Percentage of Material Found in the SORT Recycling Bin



In terms of claimed behaviour on requested recyclables, 96.6% of respondents reported placing newspapers in the green bin, suggesting all scheme participants contribute this material, a result consistent with the schemes estimated "participation" in excess of 90%. Magazines report 89.7%, with the other requested materials, cans, plastic bottles and card reporting between 87.2% and 60.7%. Apart from card (60.7% claim to recycle) which was a relatively new addition to requested materials, all other categories have been part of the scheme for over 3 years. In terms of effectiveness, the measured recovery values show marked reductions for all requested categories with "actual : claimed" recovery ratios of 0.7 for newspapers and magazines and ratios of 0.5 and 0.4 for plastic bottles, card and cans.

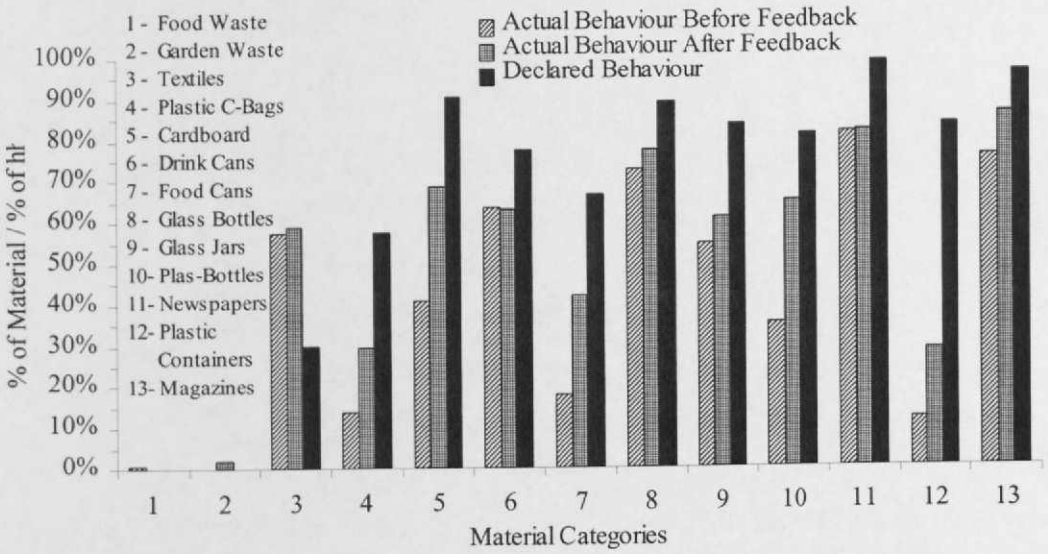
When considering non-requested materials, no householder claimed to place in the green bin categories that are clearly non recyclable or rarely requested by material recycling schemes e.g. kitchen and garden waste, paint and electrical goods. The small amounts that were found in bins reflect "mis-sorting" during sampling or at the household. Of more interest in terms of response are those materials, which are "recyclable" but are non-requested categories, such as textiles, plastic containers (yoghurt/margarine tubs), glass, and plastic carrier bags. The instructions would appear to be known for textiles, but actual behaviour suggest more is placed in the recyclable bin than respondents are prepared to own to. Textile recoveries as previously identified are dissimilar to other materials. However, the amount of textiles recovered was no more than electrical goods, and could be just mis-sorting. Claimed placement in the green bin of glass (18.0%), carrier bags (41.0%) and particularly plastic containers (73.5%) is more significant. From the actual recovery rates none report more than 8.0% in the green bin. The ratio of claimed and actual recovery for glass at 0.3 is similar to cans and could just reflect effectiveness of participation but a ratio of 0.1 is noted for the two non-requested plastic categories. This could reflect respondents' desire to be seen by the interviewer as fully using the scheme, claiming to place materials in the bin they feel are recyclable rather than communicating their real disposal behaviour, which is closer to the instructions on how to use the scheme.

Comparisons of claimed and actual disposal behaviour of materials into the Millennium recycling bin are shown in figure 6.15. Actual behaviour is derived from waste analyses before the feedback was provided, during the same period as the postal questionnaire. After feedback diversions are also included for comparisons.

Minimal amounts of non-requested materials were found in the recycling bin and no households claimed this. In terms of claimed behaviour, 98.8% of respondents reported placing newspapers, and 96.4% reported placing magazines in the Millennium recycling bin, suggesting

all participants contribute this material. 90.5% of households claim to place cardboard and 89.3% of households claim to place glass bottles in the recycling bin. Reports of other materials placed in the recycling bin vary between 29.8 % and 83.3%. Households are prepared to claim recycling some materials and not others. A lower percentage of households claim to recycle the 'less popular' materials such as plastic carrier bags and food cans in comparison to the more commonly known newspapers, magazines and glass bottles.

Figure 6.15 Variation Between Percentage of Households Claiming to Place a Specific Material into the Millennium Recycling Bin and Percentage of Material Found in the Millennium Recycling Bin



When actual recoveries (before feedback was delivered), are compared to claimed behaviour, some parallels can be made with the SORT scheme. A higher proportion of textiles were found in the Millennium recycling bin than respondents claimed . This could reflect reasons previously identified. However, an 'actual : claimed' recovery ratio of 1.9 is recorded for both schemes which may suggest a common pattern is emerging. Similar ratios of 'actual : claimed' behaviour are noticeable between newspapers (SORT – 0.7, MRS - 0.8), magazines (SORT - 0.7, MRS – 0.8), plastic bottles (SORT – 0.5, MRS – 0.4) and cardboard (SORT - 0.4 , MRS – 0.5). Glass bottles, Glass jars and drink cans, had similar ratios as the paper fraction on the Millennium scheme, with ratios of 0.8, 0.7 and 0.8 respectively.

What is interesting to note, is the similarity between the two schemes for the 'less well known' materials not targeted by the scheme, i.e. plastic and metal. Although plastic containers and carrier bags were accepted by the Millennium scheme and excluded by SORT, similar 'actual : claimed' recoveries were reported. Plastic containers reported 0.1 in both schemes and carrier

bags 0.2 in the Millennium scheme and 0.1 in SORT. Food cans reported a low ratio of 0.3 on the Millennium scheme and, although the metal can fraction could not be disentangled within the SORT data, a ratio of 0.4 for cans was also reported for the SORT scheme.

Although a higher proportion of each material was recovered in the Millennium scheme compared to the SORT scheme, similar 'actual: claimed' recovery ratios for given materials would suggest that household claims are relatively accurate. Although 100% efficiency may not be achieved if levels of efficiency vary by material, if households say they recycle plastic bottles, they do. Households are behaving no differently between schemes, which suggests the amount of material being diverted is influenced by the scheme design and how it's maintained i.e. type of message delivered. For example, a smaller number of SORT households would appear aware of what materials to recycle in comparison to the Millennium scheme. However, those who are, clearly indicate the materials they recycle and those they do not. When recycling these materials, they do so at the same efficiency for each scheme, i.e. 60% of households in the scheme are claiming to recycle plastic bottles compared to 40% in another scheme, therefore lower scheme recoveries. Therefore, the knowledge factor is determining recovery efficiency and not the scheme's operational design. The relative difference between material types i.e. plastic bottles and food cans also report similar ratios, reiterating the effect the material itself on an individuals recycling behaviour regardless of the design offered i.e. newspapers are better recovered than food cans.

When 'actual:claimed' recovery ratios are calculated for the Millennium scheme using recovery data after feedback was delivered, the ratios increase demonstrating the positive impact of feedback on improving performance. Beverage containers and paper fractions report high ratios of 0.8, and 0.9. However, ratios of food cans, plastic containers and carrier bags remain lower than other materials reporting 0.6, 0.3 and 0.5 respectively. Glass is a well-recognised recyclable material (especially for a scheme which requests ALL RECYCLABLES, yet the ratio for glass bottles (beverage) is 0.9 compared to glass jars (food) with ratios of 0.7. This suggests that the recovery levels are a function of both households awareness of what materials are targeted by the scheme and the inconvenience the material causes the household to recycle, regardless of their knowledge of its acceptability.

The increase of some material categories would suggest (on the assumption that households do behave the same in both schemes as indicated) that if the SORT scheme was maintained correctly, i.e. providing feedback to residents, then similar increases in material recoveries could be achieved. Both schemes use a wheeled bin, so storage within the household is not the issue. However, the container collection frequency and the level of information provided to the

household differ significantly. This would appear to affect the claimed and observed recovery level for all materials. However, the difference is most marked with food containers, where households appear to be unsure about their recyclablity. As a dirty material, they do not wish to store them for long periods of time and therefore do not attempt to recycle them and more importantly, openly claim not to do so.

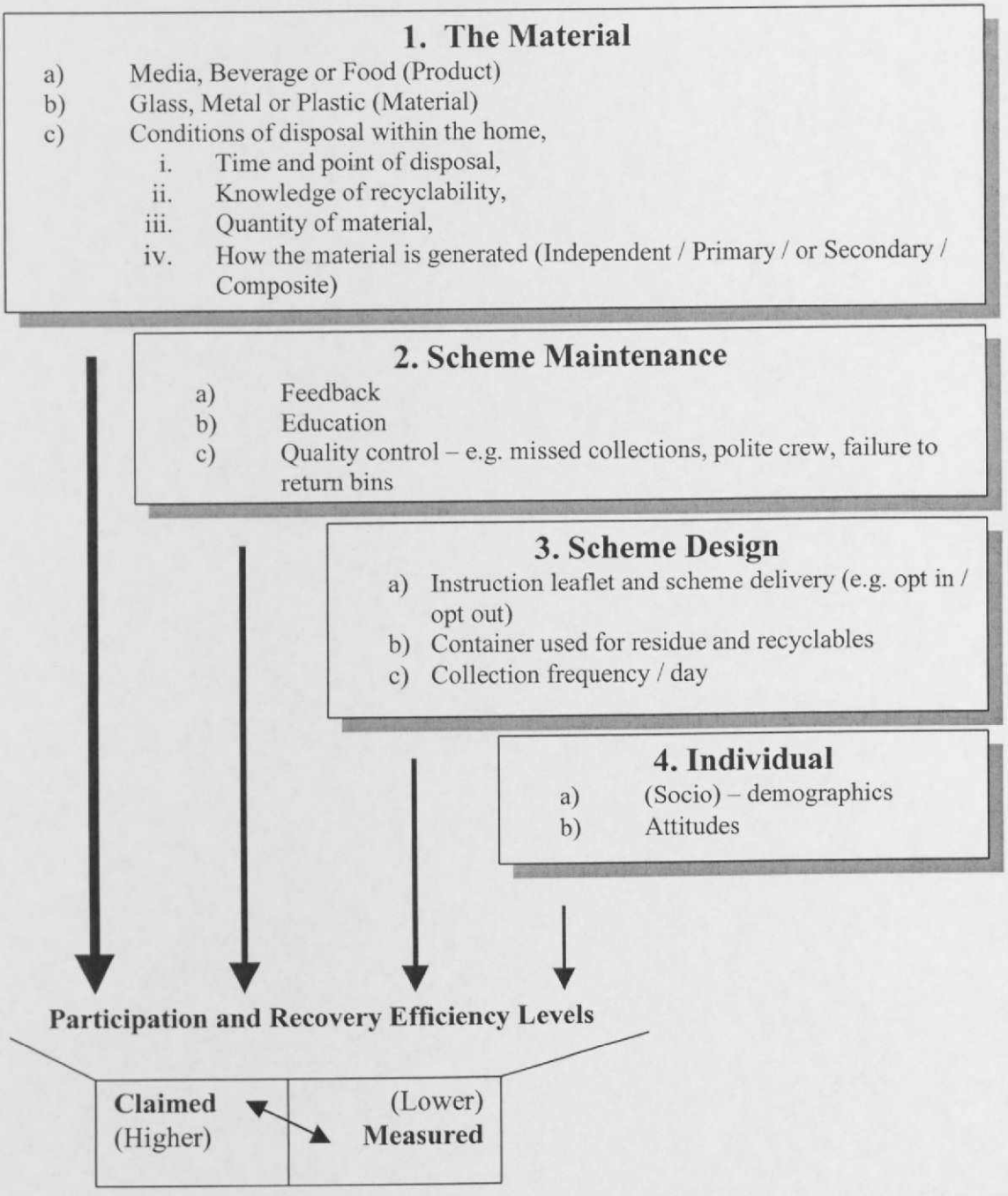
6.6 Assessment of Relative Importance

Best practice for local authorities in relation to developing kerbside recycling schemes is currently developed on a basis of previous experience within other authorities, i.e. 'it was successful there, so it should be successful here'; rather than understanding the reasons for a given success or failure. Understanding the issues involved with 'Best Guidance' for local authorities initially requires an understanding of not only the drivers and barriers to household recycling behaviour, but to recognise the relative importance and interaction between these issues. More importantly, to identify a sound approach needs to recognise the issues that are within an authority's control to bring on change.

Figure 6.16 illustrates the basis of a conceptual model that has ranked these factors in relation to their effect on determining participation and recovery levels, supported by a thorough understanding of the issues involved. The model is the result of monitoring undertaken within the thesis in relation to four broad categories and more detailed sub-categories using a wide range of primary quantitative and qualitative data collated during the development, implementation and operation phases of kerbside recycling schemes and integrated secondary data from other nationally reported projects.

The model is qualitative and no attempt has been made to 'calibrate' the rankings. However, it does provide an insight to local authorities, scheme managers etc. in the mechanisms involved and cause of currently restricted recovery levels and participation efficiency; identifying the main determining factors of household recycling behaviour and factors that are amenable to their control / influence. Waste managers need to know where the balance of service provision and behaviour / motivation lies in terms of influencing overall recycling levels and where resources are best directed to improve matters. The main finding is that traditional views of 'households are not interested in recycling', 'all schemes are the same', 'you can't achieve high diversion levels', are not the case.

Figure 6.16 Qualitative hierarchical model of influences on kerbside performance



Although the research has highlighted at a detailed level a series of relationships i.e. a box recovers more food cans than a bag, which materials are effected by feedback and to what degree etc. it goes beyond to discuss the causative factors and issues surrounding these observations. This permits a more structured and holistic approach when developing best practice guidance and should enable operators to introduce and continuously improve service provision rather than see activities as isolated measures of good or bad practice.

What materials are generated and conditions within the home is beyond the control of the scheme provider. However, as a primary issue affecting household recycling behaviour, hypothetically, resources may be more effectively utilised by addressing the storage issue caused by different materials within the home e.g. providing an indoor duo bin, than spending the additional cost of upgrading from e.g. a box to a wheeled bin. This may prevent the initial leakage of certain materials within the household that have already been lost when trying to affect their recovery at the front of house. It is within this framework approach, that any best practice guidance should be considered, where this model and its supportive data could help achieve this aim.

Although the four determining categories selected as influencing behaviour (the material, scheme maintenance, scheme design and the individual) could have been represented as having an equal effect, the findings of this thesis suggest a ranking is possible and useful. However, it must be noted that these 'rankings' are only applicable to kerbside and not bring provision. This is not to say similar principles do not apply, but to suggest that bring site behaviour was not investigated at the same level of detail as kerbside and would certainly influence the relative importance of the four factors identified.

Ultimately, this model and effectively, this thesis has been developed to assist waste managers, scheme providers, local authorities etc. when formulating waste strategies or scheme introductions / modifications in relation to kerbside recycling. Underlying this model and the suggested rankings, is the assumption that the basics of a scheme's design i.e. which materials are targeted, and recognition of other parallel operational schemes e.g. composting has been addressed. The model assesses the relative importance of factors affecting performance once a kerbside scheme is operational, and is not assessing household performance from a raw state, i.e. no recycling facility provision.

Undoubtedly, if this were not the case, then scheme design would be the most important factor affecting participation and recovery levels; without convenient services, collecting a variety of materials, recycling couldn't take place. Introducing a kerbside scheme into an area only served by bring provision will have the most significant effect on participation; if the scheme only targets either a single or limited materials then recover levels cannot physically increase more than what is available. Given the targets, it is assumed that 'best practice' would be adhered to i.e. target as many materials as reasonably possible and households would be provided with a kerbside scheme in an effective and informative manner, more than likely using an opt out approach. Therefore, the most important barriers to recycling, i.e. inconvenience, inadequate facilities etc. problems associated with households not recycling at bring sites would hopefully

have been addressed. Almost a pre-requisite to this model, is that the issue of non-recyclers as a result of the lack of any kerbside provision has already been overcome and recognition that, recycling targets cannot be met, without the universal introduction of kerbside recycling in areas of suitable housing.

It is important to recognise that all the factors within the model have been shown to have some effect on recycling participation and recovery levels. Although the relative importance of some factors may be low, this does not suggest they should be discounted when formulating any strategy, but that resources and interest / concern should be weighted accordingly. The reasons for their order of rank are described briefly, with some examples to support the view. However, reference should be made to results within the thesis to fully support the ranking chosen.

Individual characteristics have shown some links with recycling behaviour as previously suggested in the literature. For example, age, sex and presence of young children within the home. To a limited degree, relationships with ACORN grouping have been highlighted. They are not however, a major definitive predictor of recycling behaviour and efficiency of participation. Both non-recyclers and recyclers were found to have similar positive attitudes, both prior to a scheme, and once served by a kerbside-recycling scheme. Historically, literature has shown attitudes to be a major predictor of recycling behaviour, certainly regarding bring behaviour. Although it is still believed that a relatively positive environmental / recycling attitude is required to taking an initial interest in participating, efficiently, it is not believed to be as an important pre-requisite of behaviour as initially thought, and certainly not in relation to the other 3 factors. Therefore, the individual is ranked fourth in the model.

Scheme design is ranked third in the model. As previously discussed, this does not relate to 'bring' or 'kerbside', single or multi-material, but primarily the operational factors of a scheme design, i.e. box or bin, weekly or fortnightly. These operational difficulties have been shown within the thesis to present a physical barrier to some households participating and / or potentially preventing them from recycling some materials effectively, unlike the 'individual category'. An individual may have a positive attitude and correct demographics to become an effective recycler, but the schemes operational design may prevent them from putting this intention into practice.

Providing a bag (as seen in the Paper Chain scheme) which can be easily lost or discarded; inadequate (i.e. monthly), or confusing collection frequencies (i.e. different fortnightly collection on different days to refuse), contribute to households either not being able to recycle maximum amounts due to e.g. full bins, or forgetting when to put recycling containers out for

collection and loosing interest. Low amounts of heavier materials in boxes or bags has been shown to be a potential issue, due to their weight when putting them at the kerbside. Another factor is how confusing the information leaflet provided is, for the householder to recognise what is requested of them. The Millennium scheme first leaflet showed how this can cause confusion and potentially reduces participation efficiency. However, providing comprehensive lists may provide households with knowledge, but can confuse; a balance of simplicity and effectively communicating exactly what is required of the household needs to be found.

Although important, scheme design addresses primarily issues at 'the front of house' i.e collection frequency, collection day, which could potentially be addressed by households establishing a habit or receiving assistance from other individuals / the scheme provider. Of more relative importance is scheme maintenance. Households require the knowledge to participate and understand exactly what is required of them, and more importantly, why it's important. Feedback not only ensures that households are aware of how to use a scheme correctly, it also serves two additional purposes. Firstly, it provides individuals with a 'pat on the back' or encouragement, demonstrating how well / or poorly they are doing and where they can identify as being apart of / detached from their general communities behaviour. This also demonstrates a commitment from the service provider, showing they are taking an interest in what they are doing, rather than introducing a scheme and forgetting about it. Secondly, performance feedback acts as a 'policing service'. Households may recognise their behaviour is being watched and behave more meticulously.

Similarly, continual poor quality control through e.g. failure to return bins, missed / cancelled irregular collections, indecorous crew would test the patience / commitment of even the most tolerant households, regardless of their positive attitudes, and ideal recycling scheme etc. This would eventually result in a decline in participation.

Good scheme maintenance would hopefully ensure high participation and recovery levels, as households would be fully aware of how to use a reliable, high quality kerbside recycling service. However, it is still only ranked second after 'the material', which is thought to be the most important factor determining recovery levels. The importance of the material is primarily concerned with participation efficiency than actual participation levels. Participation is critical to the success of a scheme. As shown in the thesis, high participation and moderate efficiency is overall better than moderate participation and high efficiency. Given a 'best practice' approach to scheme design in response to the targets, participation rates in excess of 70% are likely to be achieved. Therefore, the focus should remain on participation efficiency. When focusing primarily on efficiency, the ranking of the other categories can be more readily understood.

Regardless of a scheme design, how it is maintained or where it is located, there remains a clear distinction between the recoveries of individual materials i.e. newspapers - high diversions, food cans - low diversions. Even if the overall diversions double, similar relative recovery ratios between materials are reported suggesting other factors are having a more important effect. These distinctions fall into three main product categories; media, beverage then food in order of their recovery efficiency. Within these products generally the more recognised material differentiation orders the recoveries with glass reporting the highest, followed by metal then plastics. Reasons for these clear distinctions where 'ceiling effects' could be suggested are thought to be a result of conditions of disposal within the home. These were thought to relate to the inconvenience the material itself presents to the householder to recycle or dispose of the material as a result of its characteristics and use.

The reason for this category being ranked as the main factor, is that, it is at this point, that recycling gets prioritised, where the initial decision is made to recycle or dispose, and where daily living issues within the household, become most involved in the recycling decision. It is also the point, where the change of the material being recycled / disposed is most vulnerable. Attitudes take a long period of time to establish, and behavioural characteristics develop slowly. A scheme design is accepted, rejected or tolerated, and the maintenance of the scheme determines effectively how aware and satisfied an individual is with a particular kerbside recycling scheme. All are important in determining behaviour and susceptible to change, or causing a change in behaviour, over a period of time. In the extreme, the 'materials effect' and conditions of disposal within the home will determine if wine bottles following a party are recycled or disposed of, or a child's cut finger as a result of playing with cans in an open recycling box results in that household no longer recycling cans. These are variables that are ultimately determining and having the most significant affect on the level of material being recycled at any given time.

The model and its rankings do not provide a blueprint for success, but highlight that perhaps the development of any strategy should consider more importantly issues within the house when a product becomes a waste material, than retaining the focus primarily at the front of house.

Self-reports from households on recycling using questionnaires and focus groups are a common method of assessing participation and scheme performance. In relation to recycling, it is thought that they are regularly over-exaggerated i.e. levels of participation and frequency, and reasons have been postulated. It is essential to recognise, there is a difference between the two levels. Although the results obtained do not suggest a large percentage of respondents deliberately lie about behaviour, the effectiveness of that behaviour is heavily influenced by scheme provision

and material characteristics, and responses cannot be used in isolation. Although questionnaire surveys are invaluable in understanding household attitudes and recycling behaviour, they cannot alone present a true picture of performance. Actual waste analysis and scheme performance data must be collected parallel, to determine a schemes true success or failure, and to address the necessary issues. This finding is illustrated conceptually in the model, by noting that the relationship between claimed and measured participation recovery levels is a function of the factors that determine recycling behaviour.

6.7 Model Calibration

6.7.1 The purpose of calibration

Quantifying this model and taking it one step further to predict actual participation and recovery levels in relation to these four main factors and associated sub-factors is an attractive concept. When considering local authorities limited resources, it may well be beneficial to understand the actual level of effect of any change on participation and recovery levels. A change in collection frequency and container type may double scheme costs but only increase participation and recovery levels by a marginal amount. Attempts have been made (Tucker 2001c) towards this concept for newspaper recycling and currently being extended to other materials, where predictions have shown to be relatively accurate in its initial stages.

To accurately undertake this task would need to take into account all scheme designs, individuals, introducing intervention strategies calibrated in different spatial and temporal conditions. The resource demands of this are immense and beyond the scope of a PhD thesis. Even if completed, its potential benefit is now constrained given the necessity to meet UK and EU targets. The challenging targets set require local authorities to introduce the necessary waste strategy and associated collection schemes to a high level and bear the costs incurred.

Providing a recycling scheme should be an integral and not an additional part of household's routine disposal behaviour. 'Convenience' in its broadest sense is central to the success of household recycling and pivotal to each of the four categories. The material itself has shown to be a main factor in determining recycling behaviour. Individual attitudes are generally positive, assuming the need and factors that lead convenient system design, effective maintenance and communication are fairly well established. Further research should now focus on understanding conditions within the home, particularly the kitchen environment and layout. For example to minimise the differentiation between material's level of 'inconvenience' dual waste bins in the kitchen could make the effort of recycling no more difficult than throwing away a material. Coggins (2001) highlighted how the modern kitchen is increasingly becoming a 'transfer

station', where the diversion will be linked to factors already highlighted in the thesis e.g. convenience, effective information and feedback etc. Clear universal product labelling and design could be addressed to make materials more identifiable. Recycling and the environment should be a marketable commodity to make it attractive and generate household's interest. Thus, in a pragmatic sense, implementation of existing knowledge and deduction from current understanding as expressed in the qualitative model is a more pressing objective than pursuing quantification.

Although a full, calibrated model has not been undertaken, the first stages to develop such a model and recognition of the issues involved have been undertaken. The most important element, the material, has been pursued and a self-calibrated predictive model has been developed. Given that the effect of attitudes has been shown to be minimal and that scheme design and maintenance would have to adopt a best practice approach, this seemed the most logical first stage.

6.7.2 A conceptual approach to calibration

These developments are not necessarily a blueprint for future development, or necessarily correct. However, they do consider the issues required in taking this qualitative model to the next stage and its practical use. In developing such a model, three issues need to be considered.

The first issue to address is the point made with regards to 'utility'. As noted, the main "user" of this thesis, are local authorities (or private sector) / scheme provider and their primary interest is in meeting diversion targets. Thus, the model output, presented as "participation and diversion levels" is appropriate, as these, combined, dictate overall diversion.

The second issue is to note the level and quality of information i.e. qualitative and quantitative, readily available to local authorities / private sector providers. If the data requirements of any model are complex, the model will be limited in its applicability. The information needs of this model are all either readily available or within easy reach for any scheme provider in relation to the sub-category factors under the main headings.

The third issue is to consider the required accuracy of the output. Effectively, scheme providers want to know which approach will meet targets, whether this relates to introducing a new scheme into an area or re-vamping an existing scheme. Although prediction of a precise participation and recovery level would be an attractive option, it is unrealistic given the readily available data. Ultimately, only an indication at a crude level of what combination would be successful and what would not is required

Given these criteria the following generic formula is suggested to allow local authorities / scheme providers i.e. "the user" to predict diversion levels for a new proposed scheme or benchmarking existing schemes to give a "first cut" assessment of how it is performing and what the response might be to expanding materials targeted etc.

Diversion rate D = Sc x P x Mt x ECM x ESM

Where D is expressed as a fraction i.e. 30% = 0.3

Sc = fraction of households covered by the scheme

P = fraction of households participating in scheme

Mt = weight fraction of all materials targeted by the scheme

ECM = recovery efficiency (as fraction) for collecting targeted materials

ESM = recovery efficiency (as fraction) for sorting materials – this term only required if MRF plant operation included in assessment of diversion

At this stage there are many uncertainties in the "typical data" used to self calibrate this model. This is partly due to lack of established schemes or schemes which address specific implementation problems (e.g. housing type, ethnic areas) that will need to be addressed in the longer term. More worrying, a larger factor is due to inadequate monitoring of the performance of existing provision. Thus, potential users are given the "health" warning, but even with the uncertainty levels, it is thought to provide a useful tool, particularly in tandem with local knowledge of the scheme provider.

Directly measured data for some of the terms are not available before a scheme operates. Even when operating, this may be difficult / expensive to gather, certainly on a routine basis. Thus, default values are presented, which reflect current knowledge but as noted in the main text, are not definitive and local circumstance will influence these. In the form presented, the formula aims to predict a diversion rate. Equally if diversion rate is known, the formula can be used to give an indication of capture efficiencies etc. To be fully utilised; Mt, ECM and ESC terms need to be dis-aggregated to an appropriate level depending on materials targeted / detail required. This is explained and default values are presented at the category level.

Sc,

The scheme coverage is mainly dependent on housing types in the authority. Not all areas will be suitable for kerbside. Estimates suggest c.70% coverage may be feasible UK wide. This percentage should be used as a fraction, i.e. 0.7. Dependant on the level, this can be changed accordingly, dependent on how many households will be / are offered the scheme.

P,

The participation rate (determined by DETR method) is mainly dependent on scheme design / opt-in opt-out introduction etc. as highlighted within the thesis. Participation levels around 70% to 90% are anticipated for opt-out well designed schemes for most suburban areas. Set-out rate is easier / cheaper to monitor than the DETR participation. Although only an indication, for kerbside systems collected weekly / fortnightly, a typical ratio of set-out to participation is c.1:1.3, i.e. a 60% set out indicates participation levels of c.80%. Again this should be used in fraction form, i.e. 0.80.

Mt,

The total weight of materials targeted, (as a fraction of collected waste), mainly depends on which materials are included. The main uncertainty is the variability in waste composition. Undertaking waste sorting or using the data from literature / similar authorities (i.e. accounting for socio-economic / service provision factors etc.) is advised to provide a more accurate prediction. "National averages" or data presented within the thesis can be used as a "first cut" estimation. Caution should be taken when referring to waste composition data, as it is usually reported "as-received" and based on sorting mixed waste – i.e. materials are wet / soiled after being in a dustbin / collection vehicle. Recyclables segregated by households will be much drier / cleaner and will represent a lower weight percentage. Conversely, targeted organic waste for collection will not loose moisture to absorbent categories prior to sorting; hence percentage weight potentially "available" will increase.

Waste composition values for typical recyclable categories commonly targeted by schemes at a broad and detailed category level are presented in tables 6.18 and 6.19. Mt will be the sum of the individual materials targeted, i.e.

$$Mt = \sum_{i=1}^{n} m_i$$

where m_i = weight fraction of material category i for a scheme targeting n categories

Table 6.18 Typical "Basic" Waste Assay Values (as received) for categories targeted for kerbside collection

Main "Recyclable" Material Categories Targeted	n=	Data Source Areas	**Mean**	Max	Min	S.D
Paper	28	M,S,I	**0.24 (24%)**	0.36	0.16	0.06
Card	28	M,S,I	**0.05 (5%)**	0.09	0.03	0.01
Glass Bottles & Jars	26	M,S,I	**0.07**	0.12	0.02	0.03
Other Glass	26	M,S,I	**0.003**	0.01	0.00	0.00
Ferrous Cans	24	M,S,I	**0.03**	0.04	0.01	0.01
Non-Ferrous Cans	24	M,S,I	**0.006**	0.02	0.002	0.00
Plastic Bottles	25	M,S,I	**0.02**	0.03	0.01	0.01
Other Rigid Plastics Packaging	26	M,S,I	**0.02**	0.08	0.008	0.01
Plastic Film	26	M,S,I	**0.05**	0.12	0.02	0.02
Textiles	28	M,S,I	**0.03**	0.08	0.01	0.02
Organic (Kitchen Compostible and Garden Waste)	10	I	**0.25**	0.44	0.13	0.10

Table 6.19 Typical "Detailed" Waste Assay Values (as received) for categories targeted for kerbside collection

Main "Recyclable" Material Categories Targeted	n=	Data Source Areas	**Mean**	Min	Max	S.D
Newspaper	26	M,S,I	**0.13 (13%)**	0.08	0.20	0.03
Magazines	26	M,S,I	**0.07 (7%)**	0.03	0.12	0.02
Mixed Paper	26	M,S,I	**0.05**	0.02	0.09	0.02
Cardboard	28	M,S,I	**0.03**	0.01	0.06	0.01
Cardboard Drink Cartons	26	M,S,I	**0.006**	0.002	0.02	0.00
Glass Bottles	6	M	**0.08**	0.06	0.10	0.01
Glass Jars	6	M	**0.03**	0.03	0.03	0.00
Other Glass	26	M,S,I	**0.003**	0.00	0.01	0.00
Ferrous Drink Cans	15	M,I	**0.002**	0.001	0.004	0.00
Ferrous Food Cans	15	M,I	**0.02**	0.01	0.03	0.01
Aluminium Drink Cans	15	M,I	**0.003**	0.001	0.007	0.00
Aluminium Food Cans	15	M,I	**0.002**	0.00	0.008	0.00
Plastic Bottles (PET)	26	M,S,I	**0.007**	0.002	0.01	0.00
Plastic Bottles (HDPE)	25	M,S,I	**0.01**	0.004	0.08	0.01
Plastic Food Containers	26	M,S,I	**0.02**	0.01	0.04	0.01
Plastic Films	26	M,S,I	**0.05**	0.02	0.12	0.02
Textiles (Clothes)	28	M,S,I	**0.03**	0.01	0.08	0.02
Organic (Compostible)	10	I	**0.11**	0.07	0.14	0.02
Organic (Non-compostible)	10	I	**0.05**	0.03	0.07	0.01
Garden Waste	26	M,S,I	**0.12**	0.01	0.36	0.09
Fines (Overall)	28	M,S,I	**0.09**	0.02	0.23	0.07
Fines Millennium (<50mm)	*8*	*M*	**0.18**	0.12	0.23	0.04
Fines SORT (<20mm)	*10*	*S*	**0.05**	0.02	0.10	0.03
Fines Project Integra (<10mm)	*10*	*I*	**0.04**	0.02	0.07	0.02

M = Millennium, S = SORT, I = Project Integra (Hampshire).

ECM

The average recovery efficiency achieved by participating householders for the materials targeted is often referred to as the 'capture rate'. As noted in the main text, this varies between materials and for assessment of a multi-material system, separate capture rates should be used for each material / product type. For prediction purposes, tables 6.20 and 6.21 present min / max and typical levels by broad and detailed category classification. Although considered typical, clearly these are very dependent on household characteristics, scheme design and maintenance. The values selected assume an opt-out scheme. For opt-in schemes, participants will be dominated by the committed recyclers (mainly those that currently use bring systems) and capture rates may well exceed the range given, particularly if participation rates are below 30%. The range values assume participation is at least 65% and upper levels, particularly for dirty packaging items will not be achieved without considerable encouragement / feedback to the householders.

Table 6.20 Typical Capture Rates for "Basic" Recyclables (Scheme Participants)

Main "Recyclable" Material Categories Targeted	n=	Data Source Areas	**Mean**	Max	Min	S.D
Paper	26	M,S,I	**0.69 (69%)**	0.90	0.36	0.16
Card	26	M,S,I	**0.35 (35%)**	0.81	0.00	0.22
Glass Bottles & Jars	4	M	**0.78**	0.83	0.69	0.06
Other Glass	4	M	**0.43**	0.66	0.16	0.22
Ferrous Cans	24	M,S,I	**0.33**	0.60	0.15	0.14
Non-Ferrous Cans	24	M,S,I	**0.32**	0.68	0.07	0.15
Plastic Bottles	23	M,S,I	**0.50**	0.72	0.25	0.15
Other Rigid Plastics Packaging	4	M	**0.25**	0.38	0.09	0.13
Plastic Film	4	M	**0.24**	0.38	0.14	0.11
Textiles	6	M	**0.59**	0.78	0.47	0.13
Organic (Kitchen Compostible and Garden Waste)	1	I	**0.63**	0.63	0.63	-

M = Millennium, S = SORT, I = Project Integra (Hampshire).

Table 6.21 Typical Capture Rates for "Detailed" Recyclables (Scheme Participants)

Main "Recyclable" Material Categories Targeted	n=	Data Source Areas	**Mean**	Max	Min	S.D
Newspaper	24	M,S,I	**0.81 (81%)**	0.98	0.54	0.12
Magazines	24	M,S,I	**0.69 (69%)**	1.0	0.23	0.23
Mixed Paper	22	M,S,I	**0.39**	0.68	0.21	0.17
Cardboard	22	M,S,I	**0.44**	0.87	0.17	0.25
Cardboard Drink Cartons	22	M,S,I	**0.22**	0.49	0.03	0.14
Glass Bottles	4	M	**0.83**	0.86	0.80	0.02
Glass Jars	4	M	**0.64**	0.77	0.45	0.14
Other Glass	4	M	**0.43**	0.65	0.16	0.21
Ferrous Drink Cans	13	M,I	**0.55**	0.89	0.19	0.21
Ferrous Food Cans	13	M,I	**0.31**	0.58	0.14	0.15
Aluminium Drink Cans	13	M,I	**0.46**	0.74	0.21	0.19
Aluminium Food Cans	13	M,I	**0.16**	0.31	0.04	0.14
Plastic Bottles (PET)	13	M,I	**0.54**	0.89	0.23	0.20
Plastic Bottles (HDPE)	12	M,I	**0.52**	0.75	0.27	0.15
Plastic Food Containers	13	M,I	**0.25**	0.38	0.09	0.13
Plastic Films	13	M,I	**0.24**	0.38	0.14	0.11
Textiles (Clothes)	4	M	**0.59**	0.78	0.47	0.13
Organic (Kitchen Compostible and Garden Waste)	1	I	**0.63**	0.63	0.63	-

M = Millennium, S = SORT, I = Project Integra (Hampshire).

The average recovery is obtained from the sum of individual capture rates weighted on the basis of amounts of each material targeted. Values should be entered in fraction format, i.e. 90% capture is 0.9.

$$ECM = \frac{\sum_{i=1}^{n} m_i ecm_i}{\sum_{i=1}^{n} m_i}$$

It can be noted that the denominator is the same as Mt, hence if individual material capture rates are used, they cancel out when calculating the Diversion Rate.

ESM,

Refers to the efficiency of sorting the mix of recyclables collected. Essentially, the efficiency of the MRF. If kerbside sorting occurs, such systems tend to report very high efficiencies (i.e. low rejection rates/contamination levels) and this term can be ignored or a general, non-material specific value of 0.95 used.

For commingled collections, assuming a good scheme design is used and well maintained, matched by an effective MRF, residue levels overall, also tend to be low, below 10% and a general non-material specific value of 0.9 can be used. Reject rates of over 30% can occur in poorly managed collection schemes and/or poorly designed MRF's and should be reflected in the model if necessary. However, given the high values and that diversion is usually reported in terms of amount collected for processing rather than considering losses at the processing plant this term is less important for assessing diversion. From a revenue / cost perspective, it should be given consideration and for certain high value materials, e.g. aluminium, separate sorting efficiency data may be important. Plant design, installation and operating practices are diverse, as are the recovery efficiencies between materials, and even product categories. Providing "typical" recovery efficiencies for an individual material is not possible, and no attempt has been made to accommodate this in the model. However if estimates were to be made, the formula used for calculating ECM would be used.

An example of how diversion would be calculated using the model is shown in figure 6.17. Scheme area diversion expected would be c. 18% and, if sorting losses at the MRF ignored, this would be c. 20%. While such values are very useful for scheme assessment, they should not be presented in a manner that suggests the district as a whole is / can achieve such rates.

This calculation illustrates that to achieve long-term diversion targets, suitable provision in areas unsuited to kerbside needs developing. Major contributions will have to be made at CA sites (e.g. green waste, white goods etc). Bio-waste collections are likely to be required and / or dry recyclable schemes may have to target other plastics, composites, cartons etc. Clearly appropriate processing capacity and end-markets for such materials will need developing.

Although this model refers to household collected waste, the thesis has shown that kerbside recycling provision usually leads to an increase in the total amount of waste due to redirecting materials from existing bring recycling activity and/or providing more space for wastes in the residual bin that may have been handled at CA sites or other routes. This effect needs to be taken into account as the targets cover all household waste flows. In particular, if schemes are opt-in and only attract a low take-up, it is likely that all good bring-site users i.e. the committed recycler, will participate and the occasional / non-recyclers will continue to remain outside the system, leading to minimal impact on overall recycling rates. This will merely transfer materials being collected from kerbside rather than bring sites, increasing collection costs with no real impact on diversion levels.

Figure 6.17 Example Calculation

Scheme information

Sc, scheme coverage = 70% of District

P, Household Participation: Assume 80% for opt-in scheme

Mt and ECM Targeting 7 materials: 1=Newspaper, 2=Magazines, 3=Card, 4&5=Cans (Ferrous & Aluminium), 6=Plastic bottles, 7=Glass Bottles & Jars, 8=Textiles – used to calculate Mt and ECM - assume mean values for waste composition and material capture rates.

ESM, assume MRF efficient, non-material specific recovery efficiency of 0.9 (90%)

Calculating Diversion,

$$D = Sc \times P \times Mt \times ECM \times ESM$$

Expanding Mt and ECM terms for material specific calculation,

$$D = Sc \times P \times \sum_{1}^{8} m_i \times \frac{\sum_{i}^{8} m_i ecm_i}{\sum_{i}^{8} m_i} \times ESM$$

Simplifying formula by eliminating the "Mt" terms,

$$D = 0.7 \times 0.8 \times 0.9 \times \sum_{1}^{8} m_i ecm_i$$

Using data from tables 6.18-6.20,

$$D = 0.504 \text{ x } ((0.13 \text{ x } 0.81) + (0.07 \text{ x } 0.69) + (0.05 \text{ x } 0.35) + (0.03 \text{ x } 0.33) + (0.006 \text{ x } 0.32) + (0.02 \text{ x } 0.50) + (0.07 \text{ x } 0.78) + (0.03 \text{ x } 0.24))$$

Including losses on sorting, contribution to collected household waste recycling/diversion rate in area = 0.504 x 0.25472 = c. 0.13 or 13%

Mean waste compositions and capture rates have been used in the calculation. Waste composition can vary significantly between areas dependent on a series of factors previously identified within the literature. However, it is recommended that "users" substitute this data with their own waste analysis data to provide a more accurate prediction. Similarly, capture rates will vary dependent on the scheme design offered and how it is maintained. Figure 6.18 illustrate how "users" could make an assessment of a scheme design and maintenance by determining the "quality" of their proposed / existing scheme. The assumption is that the higher the cumulative score, the more likely the higher capture rates would be achieved. Similarly, if

scheme score is low, then perhaps the minimum values should be used when estimating predicted diversion levels.

Figure 6.18 Scheme Quality Assessment

Scheme Design Assessment:

Points	Collection Day	Collection Frequency	Collection Container	Requested Materials
1	Different Day to Residue	Monthly	Sack	Complicated
2	Same Day as Residue	Fortnightly	Box	Simple
3	-	Weekly	Wheeled Bin	-

Scheme Maintenance Assessment :

Score	Scheme Instructions	Missed Collections (%)	Collection Crew	Performance Feedback	Education
1	Poor	10+	Poor	Poor	National i.e. TV advert
2	Average	5-10	Average	Average	Area/city wide i.e. Road show
3	Good	1-5	Good	Good	Personal Contact i.e. Leaflet
4	Very Good	0-1	Very Good	Very Good	Personal Meeting i.e. Door to Door

Example Score
Millennium Scheme,

Scheme Design,
Same day as residue collection = 2
Weekly Collection = 3
Wheeled Bin = 3
Simple requested materials = 2
Sub total = 10

Scheme Maintenance,
Good Scheme Instructions = 3
Late Collections = 4
Collection Crew = 4
Performance Feedback = 4
Education = 3
Sub total = 18

Grand Total Score = 28

Min score = 9 Max score = 30

Although the variables used to assess the quality of a scheme are accurate and have been shown to effect scheme performance, the arithmetic score is not quantifiable, as the scores allocated to

each variable are not weighted according to their relative effect on scheme performance. The quality assessment score is merely a rough guide, to identify the methodical approach that "users" need to adopt when considering their scheme, and predicting its performance. Practically, a scheme with a score of 9 is unlikely to achieve the maximum capture rate values for reasons previously identified within the thesis.

6.8 Recommendations and Future Work

Within the UK, there are numerous kerbside recycling schemes, each different in their size, operational design, how effectively they are maintained, the materials they collect, with different instruction / education leaflets etc. Often the monitoring of these schemes is equally inconsistent, in both the methods used and quality of data attained. Together, this makes any assessment of understanding what determines a good or bad scheme difficult. Although standardised performance indicators are now available, it is often still difficult to identify if a participation rate refers to a DETR measured rate, an estimated rate, a set out rate or an 'opt in rate' i.e. the number of households requesting a recycling container. Waste analysis studies are often categorised according to local circumstances making comparisons between authorities difficult and potentially inaccurate. Standardising terms and reporting procedures, is an area that needs to be addressed, urgently.

Complete standardisation of waste analysis procedures / sorting categories, and reporting of scheme performance data would assist in understanding the 'global picture' and how best to proceed.

All authorities should have a thorough understanding of their waste composition for the main spatial and temporal conditions within their district. If you don't measure it, you can't manage it effectively. If we are to introduce and run cost effective kerbside systems, monitoring must be at a level of any industrial process that takes a raw material and produces a product.

Results of best practice, scheme performance and waste composition should be disseminated as widely as possible leading to a potential creation of a UK waste database encompassing all activity within the UK.

Many recycling schemes have been located in "affluent suburban areas" and "cherry picking" to achieve respectable recycling levels. This study focused primarily on these areas although recognising that many poor communities, areas with certain housing types i.e. high rise flats, student accommodation or sectors of communities which produce different compositions of

waste i.e. ethnic populations have previously been excluded from kerbside recycling schemes. Many of these areas exist within the UK and will need to be targeted if 70-80% coverage is to be achieved successfully.

More research is needed to understand the issues involved in encouraging recycling and design / implement suitable recycling provision for areas currently avoided i.e. high rise flats, high ethnic populations to identify best practice.

This thesis was primarily concerned with dry recyclables. However, many of the principles are thought to apply to bio-waste collections. The model has recognised that there will be a need for local authorities to adopt bio-waste collections to meet medium and long term recycling targets. The recent introduction and requirements of the landfill directive and the weight of the residual fraction suggest local authorities will have to process this fraction.

More research is needed on bio-waste collection, assessing experiences from overseas and understanding which are the most appropriate waste streams to target and technologies to employ.

This research has identified minor differences in environmental and recycling attitudes between recyclers and non-recyclers. Although household attitudes have been well documented, there is perhaps a need to undertake "check surveys" reflecting the continual changes in service provision and local conditions. However, there is still a degree of uncertainty regarding specific population groups e.g. students. Student populations are very mobile, but little is known of the waste they produce, recycling attitudes and behaviour.

Attitudinal surveys and waste analyses of specific population groups e.g. students, should be completed to identify potential opportunities / barriers to the development of recycling initiatives.

Although this study has highlighted that high participation levels can be achieved without the need for variable charging, variable charging systems remain a possibility to encourage recycling and waste minimisation and have been shown to be successful oversees. The householder remains the only non-obligated party in the waste chain and the UK is faced with challenging targets.

There is a need to undertake pilot research programmes within the UK to identify the level of effect on attitudes, recycling behaviour etc and gauge the actual level of public

opposition. This should enable the option to be fully understood so that it can remain available for implementation should it become necessary to meet future recycling and recovery targets.

Throughout the study, the results have shown that a scheme design is critical is determining high participation and recovery levels. Kerbside schemes achieve higher participation levels than bring provision and a significant increase in kerbside provision is required to meet targets. However, not all households are suited to kerbside and it is essential that these households are not excluded from any recycling strategy.

Therefore, further research is required to assist in the planning / optimising of bring provision as kerbside provision becomes widespread to ensure maximum recoveries.

Households cannot be expected to source separate according to which materials are marketable and those that are not i.e. clear but not coloured PET bottles. Scheme instructions have to be simple, and the scheme design as convenient to the household as possible. Any kerbside recycling scheme should be an integral and not additional service provision. This should be reflected in the resources allocated, the operational design and the materials collected.

Industry needs to research and respond to any potential change in feedstock as a result of making instructions more simple to households, e.g. mixed paper or plastic grades. Markets should be developed on a basis of assured supply. The operational design should be as convenient as possible to the household to guarantee this supply. Developing markets for these materials should be viewed as an opportunity and not a hindrance.

Glass is currently excluded from many kerbside recycling schemes due to perceived handling / safety problems. Glass is currently recovered effectively from bring sites, and where undertaken, kerbside. However, the research suggests that the proportion of households recycling glass may decrease once widespread kerbside provision is completed, as a result of households being content with recycling a large percentage of their materials on their new kerbside scheme. Because of its high weight contribution, the inclusion of glass warrants careful consideration.

Research is required to investigate the effect of kerbside schemes on glass bottle bank recoveries and to identify how to overcome the perceived barriers that currently exclude glass from most commingled kerbside collection schemes.

Although kerbside recycling schemes are often operated by the same service provider, using the same vehicles/collection containers i.e. wheeled bins, as refuse collection, the two services are completely different in relation to household behaviour and tolerance levels. Households can easily opt-out of a recycling service. A recycling scheme needs to be offered on the same basis as a service i.e. retail, treating households as customers. Scheme operators should make decisions based on this, prioritising recycling collections over refuse when feasibly possibly.

Although most operators now provide effective information at the scheme launch, they often fail to budget for on-going support. People move, lose stickers and leaflets, become lazy or start to think nobody cares. Recoveries drop, contamination levels increase and problems set in. Feedback to householders has been shown to be an effective way to maintain interest and household performance. When considering scheme information, scheme providers should also access the considerable expertise and publicity material available from industry. For example, all sectors of the packaging chain are obligated to recover packaging waste and have a wealth of experience and, at the retail end, direct contact with householders to help determine what, when, where and how to communicate with them. National campaigns need to be carefully introduced to educate households. Local initiatives need to complement and not contradict these messages.

More research is needed to understand which forms of feedback and delivery methods are the most effective and why. There is a need to understand at what intervals feedback should be delivered to households to retain household's interest and performance. National education campaigns should be intense and ongoing to ensure households are fully aware and understand recycling, its benefits and the urgency to bring about change.

Materials targeted by many kerbside-recycling schemes are constrained by the level of sorting considered feasible at a smaller MRF plant. As future targets increase, larger flows become available and more sophisticated MRF designs will be needed to handle the more complex feedstock. When designing larger plants future changes need to be considered and flexibility to respond built in.

The model provided in this thesis has provided a useful tool to predict diversion/recovery levels. This is underpinned by a thorough understanding of the issues involved affecting recycling behaviour, identifying their relative importance in determining participation and recovery levels.

There is now a need to continually develop and calibrate this model and disseminate the results as widely as possible to ensure current and future recycling targets are met and best practice universally adopted.

7.0 CONCLUSION

Unlike many environmental problems, i.e. global warming and deforestation, recycling waste is not only recognised and of interest to the general public, they can easily identify how to participate in its solution. This study has reiterated previous research findings that householders are concerned about the environment, at least claiming this as their main motivation to recycle. Households are eager to be seen as 'environmentally aware', even if their actions due to individual circumstances prevent them from putting their intentions into action. It was the intention of this study to identify and assess the relative importance of these factors with the view of providing local authorities / scheme operators etc. with a tool to assist them in complying with current and future recycling targets.

Widespread adoption of kerbside collection for dry recyclables and / or bio-waste will be necessary to meet medium and longer term recycling targets. At the present time, system design and approach to implementation of such schemes operating in the UK display considerable variability. Method of introduction (opt-in / opt-out), housing areas selected, materials targeted, number and type of container provision, collection frequency, vehicle design, location of sorting stage (at kerbside or Material Recovery Facility (MRF)) are among the many factors that differentiate schemes, sometimes within the same authority. This diversity compounds the problems faced by scheme operators when deciding on appropriate provision and optimisation. Scheme comparison using performance measures such as diversion, set out and participation rates, materials recovered rarely provide a consistent or complete picture.

Although concerned, households are opposed to mandatory or fiscal actions to bring about a change in recycling, regardless of their current behaviour or scheme offered, bring or convenient kerbside. Unlike other countries, the UK has not chosen to place mandatory recycling on the household or directly charge for the service. The development of legislation from both the UK and EU regarding diverting waste from landfill has significantly increased within the past decade and targets have increased. Voluntary measures have been replaced by mandatory obligations, firstly with industry and more recently local authorities. Measures are in place or planned to make it certain that the financial cost will be paid regardless of adopting an effective, user-friendly system. Households are the only "non-obligated" party in the waste chain. Their co-operation, participation, involvement etc. is crucial to success.

A plethora of issues have been identified which could potentially influence household recycling behaviour in relation to participation and participation efficiency. Understanding why

household's recycle and what factors of a recycling scheme help achieve maximum recoveries has proven to be a complex task and there is no single answer.

This study has shown a difference between claimed and observed behaviour. A proportion of non-recyclers are prepared to claim they recycle, to at least look as though they are doing their bit. The difference in claimed and observed participation behaviour can be significant even when a scheme is in operation. Recyclers are prepared to overestimate their frequency of recycling to portray the image of fully utilising a system. It is difficult to assess if a household claims to recycling specific materials is correct, although differences noted were thought to reflect participation efficiency rather than an individual's intention to mislead.

Recycling behaviour would appear to be related to four main factors. These have been categorised, and an attempt to rank these factors in order of importance has been made, to suggest where the balance of service provision and behaviour / motivation lies in influencing overall recycling levels. Ultimately, the model's intention was to assist waste managers in their decision to direct resources to increase recycling and assist in developing waste strategies in relation to kerbside recycling. In order of importance, these are as follows, 1) " the material itself", 2) "scheme maintenance", 3) "scheme design" and 4) "the individual".

Both recyclers and non-recyclers attitude towards the environment and recycling are generally positive; therefore a poor predictor of recycling behaviour. More importantly, the design of a scheme and how it is maintained will determine participation levels and the efficiency in which households participate. General "good" and "bad" principles of scheme design and maintenance have been identified, recognising the need to possibly collect materials that traditionally present difficulties to sorting / reprocessing facilities and may not have established markets; an issue which should be the responsibility of the scheme provider, industry etc, and not the householder. Market development must respond to this potential change in feedstock on a basis of assured supply. The widespread inclusion of glass in kerbside collections warrants careful consideration given its weight and recovery efficiency. Glass recovery rates could potentially reduce as kerbside provision becomes more widespread as households 'recycling utility' is satisfied through the recycling of all other materials. Informative education and effective performance feedback can not be underestimated. Adequate financial provision should be made for regular communication with households to retain interest, support and performance in order to increase materials recycling in the UK.

The 'material itself', regarding its composition characteristics, conditions of disposal within the home etc. were found to primarily influence individual material diversion levels, independent of

a scheme design, maintenance or the individuals served. Although "technically" beyond the scheme provider's control, this issue can be addressed within the home, at the point of disposal, as well as at "the front of house" i.e. providing duo bins to make the task of recycling no more difficult than disposal. In the longer term, changes in product design may be needed to ensure such materials can be effectively utilised.

To develop this qualitatively ranked model into a useful predictive tool, three issues needed to be considered; firstly "utility" – ultimately the local authority (private sector) / service provider who have a responsibility to meet statutory targets. Secondly, the level and quality of information readily available; the information would have to be simple and within reach of local authorities / service providers and finally; the required accuracy of any model output. Essentially, local authorities / scheme providers require a 'rough guide estimate' to determine if a recycling scheme will succeed or fail to meet short, medium and long term recycling targets. Recognising these three issues, a model was developed to predict diversion levels. Although not fully calibrated, it is thought to provide a useful tool, particularly in tandem with local knowledge of the scheme provider.

Convenience is aspired to in all aspects of modern day life, recycling is no different. Households are the key link in increasing recycling levels. Providing a recycling scheme should be an integral and not an additional part of household's routine disposal behaviour. Recycling is a voluntary service within the UK, and like any other service, if the consumer is not satisfied with the service in relation to its quality, meeting demands, convenience and being continually reminded it's there and how to use it; they simply will not use it. UK and EU targets, however are mandatory and challenging.

When one has to get to town in 3 hours, many routes and transport modes will meet the deadline, if you have to be there in 5 minutes, the options narrow down considerably; UK recycling targets are set at a level and time-scale the equivalent of 5 minutes away, householders need to be provided with a taxi-service convenience.

8.0 REFERENCES

ADME, 1998. REMECOM Executive Summary. Measurement Campaign. Spring 1997-1998. Raunboullet, France. September, 1998.

ARGUS, 2001. European Commission. DGXI. E.3. European Packaging Waste Management Systems. Final Report, 2001.

Audit Commission, 1997. Waste Matters. Good practice in waste management. Audit Commission.London.

Audit Commission, 2001. Waste Management – The Strategic Challenge. Audit Commission. London.

Aumonier S. Troni J., 2001. Research study on International recycling experience. Department of the Environment, Transport and the Regions. April, 2001. Report No. 6607.

Aylesford Newsprint., 1998. Recycling in the community. The Aylesford Newsprint Recycling Report, 1998. Kent.

Aylesford Newsprint, 2000. Achieving Recycling Targets, Best Practice in Materials Recycling. Kent.

Azjen I., 1985. From Intentions to Actions: A theory of planned behaviour. In: Tucker, P., 2001d. Understanding Recycling Behaviour. Technical Monograph. Newspaper Industry Environmental Technology Initiative. University of Paisley.

Ball R and Tavitian N., 1992. Public response to waste paper recycling schemes. Resource, Conservation and Recycling., 6: 117-131.

Barker K. Fong L. Grossman S. Quin C and Reid, R., 1994. Comparison of self-reported Recycling attitudes and behaviours with actual recycling behaviour. Psychological Reports., 75: 571-577.

Barlishen K,D. Baetz B,W., 1996. Development of a Decision Support System for Municipal Solid Waste Management Systems Planning. Waste Management and Research., 14: 71-86.

Barton J., 1997. Review of UK waste policy and legislation. University of Leeds. Leeds.

Barton J. Freer E., 2001. Packaging in the household waste stream. A review of recovery and recycling of selected materials. The University of Leeds.

Barton J. Perrin D. Barton J., 2001. The Millennium Recycling Scheme. Results and Analysis. Report. The University of Leeds. ISBN 0 85316 221 2.

Bell S., 1997. Chapter 13. Waste management. In: Ball and Bell on Environmental law. pp.363-432. 4th Edition. Blackstone press Ltd. London.

Bickerstaffe J., 1994. Packaging and packaging waste. Journal of Waste Management and Resource Recovery., 1 (3): 91-96

Boldero J., 1995. The Prediction of household recycling of newspapers: The role of attitudes, intentions and situational factors. Journal of Applied Social Psychology., 25 (5): 440-462.

Burnley S. and Parfitt J., 2000. Public attitudes to waste and waste management. The Open University. September 2000.

CACI, 1997. The ACORN user guide index. CACI Information Services Limited. London.

Caulter P., 2001. 'The Legislative Driver'. The Sustainable Waste Management Agenda. Conference. London. 28th March

Chan K., 1998. Mass-communication and core-environmental behaviour: waste recycling in Hong Kong. Journal of Environmental Management., 52: 317-325.

Coggins C., 1994. Who is the recycler? Journal of Waste Management and Resource Recovery., 1 (2): 69-75.

Coggins, C., 2001. 'Summary'. The Sustainable Waste Management Agenda. Conference. London. 28th March

Coggins C., 2001b. Waste Prevention – An issue of shared responsibility for UK producers and consumers: policy options and measurement. Resources, Conservation and Recycling., 32: 181-190

Corral-Verdugo V. Bernache G. Encina L. Garibaldi L,C., 1995. A comparison of two measures of refuse and recycling behavior: self-report and materials culture. Journal of Environmental Systems., 23 (4): 313-327.

Corral-Verdugo V., 1997. Dual 'realities' of conservation behavior: self-reports vs observations of re-use and recycling behavior. Journal of Environmental Psychology., 17: 135-145

Daniel T,C and Ittelson W,H., 1981. Conditions for environmental perception research: Comment on "The psychological representation of moral physical environments" by Ward and Russell. Journal of Experimental Psychology: General., 110 (2): 153-157.

DeLeon I,G and Fuqua R.W., 1995. The effects of public commitment and group feedback on curbside recycling. Environment and Behaviour., 27 (2): 233-250.

Department of the Environment, 1994. The technical aspects of controlled waste management. National Household Waste Analysis Project – Phase 2 Volume 1. Report on composition and weight data. Prepared by Warren Spring Laboratory and Aspinwall & Company Ltd. Report no. CWM 082/94.

Department of the Environment, 1995. Making Waste Work. A strategy for sustainable waste management in England and Wales. London, UK.

Department of the Environment, 1997. The Producer Responsibility Obligations (Packaging Waste) Regulations 1997. London. UK.

Department for Environment, Food and Rural Affairs, 2000a. Municipal Waste Management Survey. 1997/1998. London. UK.

Department for Environment, Food and Rural Affairs, 2000b. Municipal Waste Management Survey. 1998/99 London. UK.

Department for Environment, Food and Rural Affairs, 2001. Municipal Waste Management Survey. 1999/2000. London. UK.

Department of the Environment, Transport and the Regions, 1998a. Review of the Producer Responsibility Obligations (Packaging Waste) Regulations 1997. A consultation paper. In co-operation with the Scottish office and Welsh office. London. UK.

Department of the Environment, Transport and the Regions, 1998b. Less Waste More Value. Consultation paper on the Waste Strategy for England and Wales. London. UK

Department of the Environment, Transport and the Regions, 1999a. Increasing recovery and recycling of packaging waste in the United Kingdom, The challenge ahead, a forward look for planning purposes. June, 1999. London. UK

Department of the Environment, Transport and the Regions, 1999b. A way with waste. A draft waste management strategy for England and Wales.

Department of the Environment, Transport and the Regions, 1999c. Monitoring and evaluating recycling, composting and recovery programmes. Welsh Office. February 1999. London.

Department of the Environment, Transport and the Regions, 1999d. Report of the Market Development Group. HMSO. London.

Department of the Environment, Transport and the Regions, 1999e. Limiting Landfill. HMSO. London.

Department of the Environment, Transport and the Regions, 2000a. Waste Strategy 2000. England and Wales. Part 1. HMSO. London , UK. May 2000.

Department of the Environment, Transport and the Regions, 2000b. Waste Strategy 2000. England and Wales. Part 2. HMSO. London, UK. May 2000.

Department of the Environment, Transport and the Regions, 2000c. Consultation paper on recovery and recycling targets for Packaging Waste in 2001. The Producer Responsibility Obligations (Packaging Waste) Regulations. August 2000. London.

Department of the Environment, Transport and the Regions, 2001a. Digest of Environmental Statistics.

Department of the Environment, Transport and the Regions, 2001b. Guidance on Municipal Waste Management Strategies. March 2001. London. UK.

De Young R., 1986. Some Psychological Aspects of Recycling, The structure of conservation Satisfactions. Environment and Behavior., 18 (4): 435-449.

De Young R., 1989. Exploring the difference between recyclers and non-recyclers: The role of information. Journal of Environmental Systems., 18 (4): 341-351.

De Young R. Boerschig S. Carney S. Dillenbeck A. Elster M. Horst S. Kleiner B and Thompson, B., 1995. Recycling in multi-family dwellings: Increasing participation and decreasing contamination. Population and Environment., 16 (3): 253-267.

Dougherty D., 2001. 'Market development and WRAP'. Recycle North Conference. Bradford Business and Environment Forum. February 2001.

Department of Trade and Industry, 2002. Consultation Paper on the Proposed Council Directive 2001/0291/(COD) of 11 December 2001 Concerning a Proposal for a Directive of the European Parliament and of the Council Amending Directive 94/62/EC on Packaging and Packaging Waste. COM (2001) 729 Final. March 2002.

Duxbury R and Morton S., 1995. Statutes on Environmental Law. Second Edition. Blackstones.

Ebreo A and Vining J., 2000. Motives as predictors of the publics attitudes toward solid waste issues. Environmental Management., 25 (2): 153-168.

Ecotec, 2000. Beyond the Bin: The Economics of Waste Management Options. A final report to Friends of the Earth, UK Waste and Waste Watch.

Everett J.W and Peirce J, J., 1992. Measuring the success of recycling programmes. Resources, Conservation and Recycling., 6: 355-370

Everett J.W and Peirce J,J., 1993. Curbside recycling in the U.S.A: Convenience and mandatory participation. Waste Management and Research., 11: 49-61.

Evison T and Read A D., 2001. Local authority recycling and waste-awareness publicity/promotion. Resource, Conservation and Recycling., 32 : 275-291

Fishbein M and Azjen I., 1975. Belief, Attitude, Intention and Behaviour: An introduction to Theory and Research. In: Tucker P., 2001d. Understanding Recycling Behaviour. Technical Monograph. Newspaper Industry Environmental Technology Initiative. University of Paisley.

Folz D,H., 1991. Recycling programme design, management, and participation: A National survey of municipal experience. Public Administration Review., 51 (3): 222-231.

Folz D,H and Hazlett J,M., 1991. Public Participation and recycling performance: Explaining programme success., Public Administration Review., 51 (6): 526-532.

Foxley L., 1997. A technical assessment of Leeds councils recycling plant for commingled recyclables from households. Unpublished Masters Thesis. The University of Leeds. School of Civil Engineering.

Foster J.J and Parker I., 1995. Carrying out investigations in psychology. Methods and statistics. BPS Books. Leicester.

Franco J,F and Huerta E., 1997. Modelling household behaviour in municipal solid waste recycling programmes. Journal of Waste Management and Resource Recovery., 3 (4): 145-155.

French-Brooks J., 2001. 'Waste and Resources Action Programme: focusing on paper'. Conference. Newspaper, the environment, and the future. The University of Paisley, May 15th, 2001.

Fullerton D. Kinnaman T,C., 1996. Household responses to pricing garbage by the bag. The American Economic Review., 86 (4): 971-984

Gamba R,J. and Oskamp S., 1994. Factors influencing community residents' participation in commingled curbside recycling programmes. Environment and Behavior., 26 (5): 587-612.

Glenn J., 1988. Junior, take out the recyclables. Biocycle., May/June, 26-31.

Goldenbar L,M and Connell C, M., 1993. Effects of educational and feedback interventions on recycling knowledge, attitudes, beliefs and behaviours. Journal of Environmental Systems., 21(4): 321-333.

Greene J and D'Oliveira M., 1983. Learning to use statistical tests in psychology. A students guide. The Open University Press.

Greenpeace, 2001. How to comply with the landfill directive without incineration: a Greenpeace blueprint. London.

Guagnano G,A. Stern P,C and Dietz T., 1995. Influences on Attitude-Behaviour relationships. A natural experiment with curbside recycling. Environment and Behaviour., 27 (5): 699-718.

Hamburg K,T. Haque C,E and Everitt J, C., 1997. Municipal Waste Recycling in Brandon, Manitoba: Determinants of participatory behaviour. The Canadian Geographer., 41 (2): 149-165.

Harder G and Knox L. 1992. Implementing variable trash collection rates. Biocycle., April 1992: 66-69

Hawkins D,J., 1991. Recycling Container Study 1991. City of Waverly, Victoria Australia. In: Wang F,S. Richardson A,J and Roddick F,A., 1997. Relationships between set-out rate, participation and set-out quantity in recycling programmes. Resources, Conservation and Recycling., 20: 1-17.

Herritedge B., WEMRU conference 2001. Waste and Environmental Management Research Unit, Kingston University. May 2001.

House of Commons, 2001. Delivering sustainable waste management. Environment, Transport and Regional Affairs Committee. March 2001.

Hong S. Adams R,M and Love H,A., 1993. An economic analysis of household recycling of solid wastes: The case of Portland, Oregon. Journal of Environmental Economics and Management., 25:136-146

Howenstine E., 1993. Market segmentation for recycling. Environment and Behaviour., 25 (3): 86-102.

Jacobs H,E. Bailey J,S and Crews J,I., 1984. Development and analysis of a community based Resource Recovery Programme. Journal of Applied Behaviour Analysis., 17 (2): 127-145

Jones S. Read A and Robinson G,M., 2001.Effective local authority recycling campaigns. Marketing recycling services to the public. Report of the Recycling Roadshow in The Royal Borough of Kensington and Chelsea. Waste and Environmental Management Research Unit, Kingston University.

Katzev R and Mishima H.R., 1992. The use of posted feedback to promote recycling. Psychological Reports., 71:259-264.

King G., 2000. Recycling and home composting in Milton Keynes. Wastes Management. November 2000: 47-49.

Kneass D., 1997. Promoting recycling collection. Resource Recycling., January 1997.

Lake I,R. Bateman I,J and Parfitt J,P., 1996. Assessing a kerbside recycling scheme: A quantitative and willingness to pay case study. Journal of Environmental Management., 46: 239-254.

Lansana F,M., 1992. Distinguishing recyclers from non-recyclers: A basis for developing recycling strategies. Journal of Environmental Education., 23 (2): 16-23.

Lansana F,M., 1993. A comparative analysis of curbside recycling behaviour in urban and suburban communities. Professional Geographer., 45 (2): 169-179.

Leeds City Council., 1999. Leeds City Council Draft Recycling Plan 1999/00 – 2001/2 Consultation document. January 1999.

Leeds City Council., 2001. An Integrated Waste Management Strategy for Leeds – Consultation Document. November 2001.

Leyland G,T., 2001. An evaluation of Leeds S.O.R.T kerbside collection scheme. Undergraduate Thesis. School of Environmental Management. The University of Leeds.

Lober D,J., 1996. Municipal solid waste policy and public participation in household source reduction. Waste Management and Research., 14: 125-143

Lowe A., 2000. Recycling in Bradford. A wasted opportunity. Unpublished Masters Thesis. The University of Leeds. School of Civil Engineering.

Macquillin I., 1998. Cash for co££ections. The waste manager., October 1998: 16-19

McCarty J,A and Shrum L,J., 1994. The recycling of solid wastes: Personal values, value orientations, and attitudes about recycling as antecedents of recycling behavior. Journal of Business Research., 30: 53-62.

McDonald S and Ball R., 1998. Public participation in plastics recycling schemes. Resource, Conservation and Recycling., 22: 123-141.

McGuire R,H., 1984. Recycling. Great expectations and garbage outcomes. American Behavioral Scientist., 28: 93-114.

McKenney M and Hruska J., 1996. Measuring the effectiveness of recycling messages. Resource Recycling., September 1996.

Mansell D., 2001. Bristol recycling participation study. Summary report for the recycling consortium. March 2001.

Martinez M,D and Schicchitano M,J., 1998. Who listens to trash talk? Education and public media effects on recycling behaviour. Social Science Quarterly., 79 (2):287-300

Maryon S and Roes N., 1997. New guidance heralds final push towards 2000's recycling targets. Environmental Health. April., 1997: 97-99

M-E-L, 1999. Project Integra – Kerbside and Household Waste Recycling Centre. Waste Analysis and Questionnaire Survey Results. M-E-L Research Limited. Birmingham.

Miller Associates, 1999. Project Integra Research Attitudes and Behaviour. Report 1:Main Findings. Southampton.

Miranda M,L and Aldy J,E., 1998. Unit pricing of residential municipal solid waste: lessons from nine case study communities. Journal of Environmental Management., 52: 79-93

Noehammer H,C and Byer P,H., 1997. Effect of design variables on participation in residential curbside recycling programmes. Waste Management and Research., 15:407-427.

Nyamwange M., 1996. Public perception of strategies for increasing participation in recycling programmes. The Journal of Environmental Education., 27 (4): 19-22.

Ogilvie S,M and Poll A,J., 1999. Developing markets for recycled materials. A report produced for DTI. AEA Technology plc. Abingdon.

Oppenhgeim A,N., 1979. Questionnaire Design and Attitude Measurement. Heinemann. London.

Oppenhgeim A,N.,1992. Questionnaire Design, Interviewing and Attitude Measurement, Printer. London.

Oskamp S. Harrington M,J. Edwards T,C. Sherwood D,L. Okuda S,M and Swanson D,C., 1991. Factors influencing household recycling behaviour. Environment and Behavior., 23 (4): 494-519.

Oxford Brooks University, 1999. National Survey on Waste. ONYX Environmental Trust. Oxford Brookes University. School of Business. July 1999.

Parfitt J. Flowerdew R and Docktor P., 1994. Socio-economic variables in household waste modelling: Two case studies. Report CWM 105/94. Department of the Environment, London. In: Tucker, P, Murney, G, Lamont, J., 1997a. Participation in Recycling: A Comparative Study of Four Kerbside Collection Schemes. Journal of Waste Management and Resource Recovery., 4 (1): 11-25.

Parfitt J. Flowerdew R and Pocock R., 1997. A Review of the United Kingdom Household Waste Arisings and Compositional Data. M-E-L Research. For Department of the Environment, Wastes Technical Division.

Parfitt J., 1997. Questionnaire design and sampling. In: Flowerdew R and Martin D., 1997. Methods in Human Geography. Longman and Harlow. Pp. 76-108.

Parfitt J,P. Lovett A,A and Sunnenberg G., 2001. A classification of Local Authority waste collection and recycling strategies in England and Wales. Resource, Conservation and Recycling., 32: 239-257.

Perrin D., 1998. The Potential structural change of Leeds recycling system: towards producer and consumer responsibility. Unpublished Masters Thesis. The University of Leeds. School of Civil Engineering.

Perry E., 1997. Should households be rewarded to recycle? Materials Recycling Weekly., 6th June: 38-40

Pocock B., 2001. 'Operational and Functional Drivers' The Sustainable Waste Management Agenda. Conference. London. 28th March

Poll A, J., 1991. Assessment of the Milton Keynes kerbside collection scheme- October 1991. AEA Technology. Oxford.

PRG, 1994. Real Value from Packaging Waste. A way forward. A detailed report. By the Producer Responsibility Industrial Group. February 1994.

Price J,L., 2001. The Landfill Directive and the Challenge Ahead: Demands and pressures on the UK householder. Resources, Conservation an Recycling., 32: 333-348.

Read A., 1997. Going on the road raises recycling numbers. Resource Recycling., September 1997.

Read A., 1999. "A weekly doorstep recycling collection, I had no Idea we could!" Overcoming the local barriers to participation. Resources, Conservation and Recycling., 26: 217-249.

Rathje W,L., 1984. "Where's the Beef?" American Behavioral Scientist., 28 (1): 71-91.

Rathje W,L., 1989. The three faces of garbage – measurements, perceptions, behaviors. Journal of Resource Management and Technology., 17 (2): 61-65.

Reams M,A and Ray B,M., 1993. The effects of three prompting methods on recycling participation rates: A filed study. Journal of Environmental Systems., 22 (4): 371-379.

Roberts P and Glynn L., 2001. Recycling in action. Leading case studies Across England and Wales. Community Recycling Network. Bristol.

Scott D., 1999. Equal opportunities, unequal results. Determinants of household recycling Intensity. Environment and Behaviour., 31 (2):267-290

Seligman C. Becker L,J. and Darley J.M., 1981. Encouraging residential energy conservation through feedback. In: Schultz P,W. Oskamp S and Mainieri T., 1995. Who recycles and when? A review of personal and situational factors. Journal of Environmental Psychology., 15: 105-121.

Schultz P,W and Oskamp S., 1994. Environmental concern and pro-environmental behaviours Do only the concerned recycle? In: Schultz P,W. Oskamp S and Mainieri T., 1995. Who recycles and when? A review of personal and situational factors. Journal of Environmental Psychology., 15: 105-121.

Schultz P,W and Oskamp S., 1996. Effort as a moderator of the attitude-behavior relationship: General environmental concern and recycling. Social Psychology Quarterly. 59 (4): 375-383.

Schultz P,W. Oskamp S and Mainieri T., 1995. Who recycles and when? A review of personal and situational factors. Journal of Environmental Psychology., 15: 105-121.

Schultz P,W., 1998. Changing behaviour with normative feedback interventions: A field experiment on curbside recycling. Basic and Applied Social Psychology., 21 (1): 25-36.

Simmons D, Widmar R., 1990. Motivations and barriers to recycling: Toward a strategy for public education. Journal of Environmental Education., 22: 13-18.

Skumatz L. Truitt E and Green J., 1997. The state of variable rates: economic signals move into the mainstream. Resource Recycling., August: 29-35. In: Price J,L., 2001. The Landfill Directive and the Challenge Ahead: Demands and Pressures on the UK Householder. Resources, Conservation an Recycling., 32: 333-348.

Sparaccarelli S. Zolik E and Jason L,A., 1989. Effects of verbal prompting on and block characteristics on participation in curbside newspaper recycling. Journal of Environmental Systems., 19 (1): 45-57.

Speirs D and Tucker P., 2001. Urban and Rural Recyclers – Are they Different?. Towards the future – Waste in the 21st Century conference proceedings. January 2001.

SWAP, 1993. Local Authority Recycling Strategy. November 1993. Leeds.

Taylor S and Todd P., An integrated model of waste management behaviour. A test of household recycling and composting intentions. Environment and Behaviour., 27 (5): 603-630.

Thogerson J., 1994. A model of recycling behaviour, with evidence from Danish source separation programmes., 11: 145-163.

Thogerson J., 1996. Recycling and morality. A critical review of the literature. Environment and Behaviour. 28 (4): 536-558.

Thomas C., 1996. Milton Keynes household source separation recycling scheme – Evaluation of public perception and participation. Unpublished Report. Open University.

Thomas C., 2000. Evaluating the role of public understanding in determining the effectiveness of kerbside recycling schemes in Hampshire. Interim report for Hampshire County Council and Project Integra. Open University. November 2000

Thomas C., 2001. Public understanding and its effect on recycling performance in Hampshire and Milton Keynes. Resources, Conservation and Recycling., 32:259-274.

Tucker P. Murney G and Lamont J., 1997a. Participation in recycling: A comparative study of four kerbside collection schemes. Journal of Waste Management and Resource Recovery., 4 (1): 11-25.

Tucker P. Murney G and Lamont J., 1997b .What newspaper recyclers recycle and what they do not recycle. Environmental and Waste Management., 1 (1): 33-56.

Tucker P. Lamont J. Murney G and Smith D., 1998. Material capture rates in household waste recycling schemes. Environmental and Waste Management., 1 (3): 169-181.

Tucker P., 1999a. A survey of attitudes and barriers to kerbside recycling. Environmental and Waste Management., 2 (1): 55-63.

Tucker P., 1999b. Normative influences in household waste recycling. Journal of Environmental Planning and Management., 42 (1) 63-82.

Tucker P. Speirs D and Smith D., 2000. The impact of a change in collection frequency on kerbside recycling behaviours. Environmental Planning and Management., 43 (3): 335-350.

Tucker P., 2000b. Modelling public behaviours and attitudes towards recycling. 'Waste 2000'Conference Proceedings. October 2000.

Tucker P., 2001a. Getting the newspapers back – with magazines, bottles, and cans as well. Conference. Newspaper, the environment, and the future. The University of Paisley, May 15th, 2001.

Tucker P., 2001b. Recycling Behaviour. Wastes Management. May 2001: 18-22.

Tucker P. Grayson J and Speirs D., 2001a, Integrated effects of a reduction in collection frequency for a kerbside newspapers recycling scheme. Resources, Conservation and Recycling., 31: 149-170.

Tucker P., 2001d. Understanding Recycling Behaviour. Technical Monograph. Newspaper Industry Environmental Technology Initiative. University of Paisley.

UEA, 2000. A study of the composition of collected household waste in the United Kingdom – with particular reference to packaging waste. University of East Anglia. Environment Agency. R&D Technical Report P347.

Vining J and Ebreo A., 1990. What makes a recycler? A comparison of recyclers and non recyclers. Environment and Behavior., 22 (1): 55-73.

Vining J and Ebreo A., 1992. Predicting recycling behaviour from global and specific environmental attitudes and changes in recycling opportunities. Journal of Applied Social Psychology., 22 (20): 1580-1607.

Vining J. Linn N and Burdge R.J., 1992. Why recycle? A comparison of recycling motivations in four communities. Environmental Management., 16 (6): 785-797.

Wang F,S. Richardson A,J and Roddick, F.A., 1997. Relationships between set-out rate, participation and set-out quantity in recycling programmes. Resources, Conservation and Recycling., 20: 1-17.

Warriner K,G. McDougall G,H,G and Claxtone J,D., 1984. Any data or none at all? Living with inaccuracies in self–reports of residential energy consumption. Environment and Behavior., 16 (4): 503-526.

Wastes Management, 2002. April 2002.p.13.

Waste Research Limited, 2001. Assessment of kerbside collection schemes for dry recyclables. Resource Recovery Forum. Skipton.

Waste Watch., 1998. What people think about waste. Attitude and awareness research into waste management and recycling, in collaboration with NOP Research Group Ltd. London.

Waste Watch., 1999a. What people think about waste. Attitude and awareness research into waste management and recycling, in collaboration with NOP Research Group Ltd. London.

Waste Watch., 1999b. Diverting messages. Results of the waste watch public communication programme as an element of the Daventry District Council Green Waste Trial. London.

Watts B,M., 2000. Regional strategies for managing and developing household waste recycling. PhD. Thesis. European Business Management School. The University of Swansea, Wales.

Werner C,M. Turner J. Shipman K. Twitchell S. Dickson B,R. Bruschke G,V. Bismarck W,B., 1995. Commitment, behavior and attitude change: An analysis of voluntary recycling. Journal of Environmental Psychology. 15 : 197-208.

Werner C,M and Makela E., 1998. Motivations and behaviors that support recycling. Journal of Experimental Psychology., 18: 373-386.

Williams P,T., 1998. Waste Treatment and Disposal. Wiley./

Woodard R. Harder M,K. Bench M and Philip M., 2001. Evaluating the performance of a fortnightly collection of household waste separated into compostables, recyclates and refuse in the south of England. Resources, Conservation and Recycling., 31: 265-284.

Youngman M,B., 1979. Analysing social and educational research data. McGraw and Hill. Berkshire.

Appendix 1: ACORN Classifications

ACORN Category	Percentage of UK Population	ACORN Groups		Percentage of UK Population
A *THRIVING*	19.8 %	1	Wealthy Achievers, Suburban Areas	15.1 %
		2	Affluent Greys, Rural Communities	2.3 %
		3	Prosperous Pensioners, Retirement Areas	2.4 %
B *EXPANDING*	11.6 %	4	Affluent Executives, Family Areas	3.8 %
		5	Well-Off Workers, Family Areas	7.8 %
C *RISING*	7.8 %	6	Affluent Urbanities, Town & City Areas	2.3 %
		7	Prosperous Professionals, Metropolitan Areas	2.1 %
		8	Better-Off Executives, Inner City Areas	3.4 %
D *SETTLING*	24.0 %	9	Comfortable Middle Agers, Mature Home Owning Areas	13.4 %
		10	Skilled Workers, Home Owning Areas	10.6 %
E *ASPIRING*	13.7 %	11	New Home Owners, Mature Communities	9.7 %
		12	White Collar Workers, Better-Off Multi-Ethnic Areas	4.0 %
F *STRIVING*	22.6 %	13	Older People, Less Prosperous Areas	3.6 %
		14	Council Estate Residents, Better-Off Homes	11.5 %
		15	Council Estate Residents, High Unemployment	2.7 %
		16	Council estate Residents, Greatest Hardship	2.7 %
		17	People in Multi-Ethnic, Low-Income Areas	2.2 %

Taken from (CACI 1997)

Appendix 2: Data Collection Timelines

Paper Chain Recycling Scheme – Period 1
(8th April, 1999 – 2nd July)

Date	Activity
8th – 10th April	Pre-scheme Questionnaire (Wetherby)
10th, 12th -13th April	Pre-scheme Questionnaire (Garforth)
12th April	Paper Chain information leaflets delivered to households (Wetherby)
13th April	Baseline sort (PS1) for Wetherby
14th April	Baseline sort (PS1) for Garforth
19th April	Paper Chain information leaflets delivered to households (Garforth)
20th April	Before leaflets sort (PS2) for Wetherby
28th April	First Paper Chain collections start (Wetherby)
28th – 29th April	Before leaflets sort (PS2) for Garforth
28th April	Monitored Wetherby sample area set out rate
6th May	First Paper Chain collections start (Garforth)
	Monitored Garforth sample area set out rate
12th May	Monitored Wetherby sample area set out rate
20th May	Monitored Garforth sample area set out rate
26th May	Monitored Wetherby sample area set out rate
3rd June	Monitored Garforth sample area set out rate
9th June	Monitored Wetherby sample area set out rate
17th June	Monitored Garforth sample area set out rate
18th – 19th June	Comparative sort of Rothwell paper bank material and residence times sort (P1a)
22nd June	During scheme sort (PS3) for Wetherby
23-24th June	Comparative Sort of Wetherby Kerbside material (P1) and residence times sort
30th June	During scheme sort (PS3) for Garforth
1st – 2nd July	Comparative Sort of Garforth Kerbside material (P1) and residence times sort

Time Line –Paper Chain Recycling Scheme – Period 2
(6th August 1999 – 1st December 1999)

Date	Activity
6th -7th and 9th – 13th August	Posted and collected Garforth second questionnaire
14th, 16th – 20th August	Posted and collected Wetherby second questionnaire
26th August	Monitoring of Garforth delayed due to technical difficulties
1st September	Monitored Wetherby sample area set out rate
9th September	Monitored Garforth sample area set out rate
15th September	Monitored Wetherby sample area set out rate
23rd September	Monitored Garforth sample area set out rate
29th September	Monitored Wetherby sample area set out rate
7th October	Monitored Garforth sample area set out rate
13th October	Monitored Wetherby sample area set out rate
21st October	Monitored Garforth sample area set out rate
26th October	After six months sort (PS4) for Wetherby
27th October	Second comparative sort of Wetherby Kerbside material (P2) and material prepared for residence times sort
3rd November	After six months sort (PS4) for Garforth
4th November	Second comparative sort of Garforth Kerbside material (P2) and material prepared for residence times sort
11th November	Second residence times sort completed (Wetherby)
16th November	Second residence times sort completed (Garforth)
30th November	Second comparative sort of Rothwell paper bank material and material prepared for residence times sort (P2a)
1st December	Second residence times sort completed (Rothwell)

Millennium Recycling Scheme
(10th May, 2000 – 9th November 2000)

(B) = Sorted into basic 13 material categories (D) = Sorted into detailed 58 or 68 material categories

Date	Activity
10th – 13th May	Questionnaire 1
18th –19th May	Scheme information leaflet delivered, Started collecting residue Baseline sort 1 - Residue (D)
22nd May	Wheeled bin delivery notice leaflet delivered
25th –26th May	Wheeled bin delivered and Baseline sort 2 - Residue (D)
1st June	Start of recycling collections
1st - 2nd June	Waste sort 3 –Residual set out (D) Residual non-set out (B) Recyclables (D)
8th June	Residue and recycling collection
8th - 9th June	Waste sort 4 – Residual set out (B) Residual non-set out (B) Recyclables (B) (Detailed on metal and glass fraction only)
15th June	Residue and recycling collection
15th -16th June	Waste sort 5 – Residual set out (B) Recyclables (D)
22nd June	Residue and recycling collection
29th June	Residue and recycling collection
29th – 30th June	Waste sort 6 – Residual set out (B) Recyclables (B) (Detailed for glass only)
6th July	Residue and recycling collection
13th July	Residue and recycling collection and MRF recovery assessment
20th July	Residue and recycling collection
20th –21st July	Waste sort 7 – Residual non-set out (D)
27th July	Residue and recycling collection
3rd Aug	Residue and recycling collection
8- 9th Aug	Posted questionnaire 2
10th Aug	Residue and recycling collection.
10th –11th Aug	Waste sort 8 – Residual non set out (D) Non-participant (D)
14th –16th Aug	Collected questionnaire 2
17th Aug	Residue and recycling collection
24th Aug	Feedback letter delivered to every household in sample area. Residue and recycling collection
31st Aug	Residue and recycling collection
7th Sept	Residue and recycling collection
14th Sept	Residue and recycling collection
14th – 15th Sept	Waste sort 9 – Residual participant (D) Residual non-participant (D) Recyclables (D)
21st Sept	Residue and recycling collection
28th Sept	Residue and recycling collection
5th Oct	Residue and recycling collection
12th Oct	Residue and recycling collection
19th Oct	Residue and recycling collection
19th – 20th Oct	Waste Sort 10 – Residual participant (D) Residual non-participant (D) Recyclables (D)
26th Oct	Residue and recycling collection
2nd Nov	Residue and recycling collection
9th Nov	Focus group

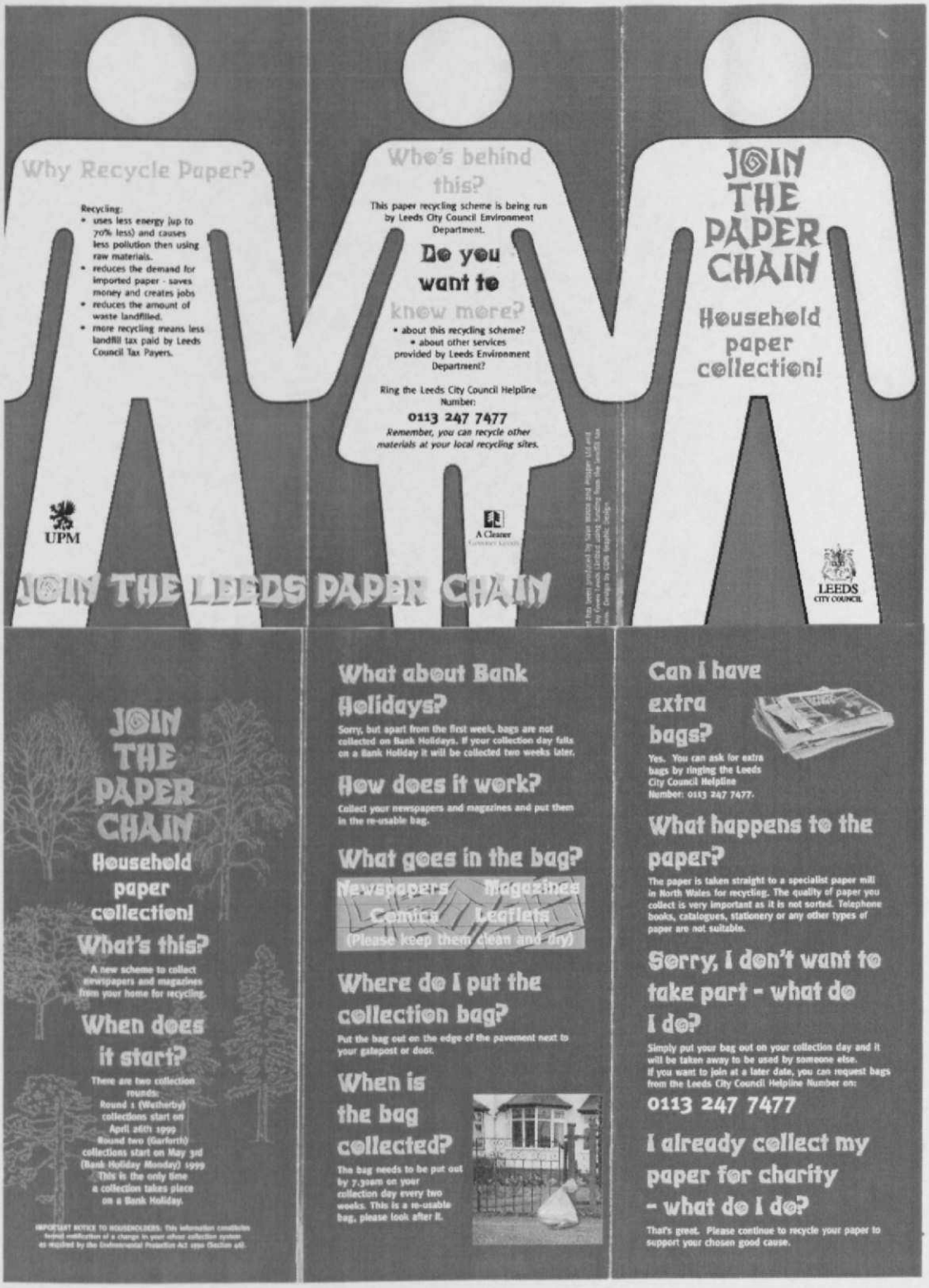
Appendix 3 : Millennium Waste Sorting Categories

Basic (13)	Detailed (58)	Detailed (71 – extra 13)
PUTRESCIBLE	Food Waste	
	Garden Waste	
PAPERS	Packaging	
	Newspapers	
	Mags/Ads/Glossy/Brochures	
	Other paper	
	Flat packaging card	
CARD	Corrugated card	
	Other card	
	Cardboard composites and packaging	
COMPOSITES	Other composites packaging	
	Other compo non-pack	
TEXTILES	Packaging Text	
	Other Text	
HEALTHCARE TEXTILES	Healthcare Textiles	
PLASTICS	Clear PVC (3) Bottles	
	Coloured PVC (3) jars & Bottles	
	Clear PET (1) Bottles	
	Coloured PET (1) Jars and Bottles	
	PS (6) Packaging	
	LDPE (4) Packaging	
	HDPE (2) Opaque Bottles	
	HDPE (2) mixed colours bottles	
	All Plastic Bags (PE & PP)	
	PP (5) Packaging	
	Other Plastic Packaging (unidentifiable)	
	Other Plastic Waste e.g garden hose	
COMBUSTIBLES	Wood Packaging	
	Other Combustibles Packaging	
	Other unclassified combustibles	

Basic (13)	Detailed (58)	Detailed (71 – extra 13)
GLASS	Total green glass packaging	Green glass packaging (Beer Bottles)
		Green glass pack (Wine Bottles)
		Green glass pack (Non-alch bev)
		Green glass pack (Spirit bottles)
		Green glass packaging (Food Packaging)
	Total brown glass packaging	Brown glass packaging (Beer Bottles)
		Brown glass pack (Wine Bottles)
		Brown glass pack (Non-alch bev)
		Brown glass pack (Spirit bottles)
		Brown glass packaging (Food Packaging)
	Total clear glass packaging	Clear glass packaging (Beer Bottles)
		Clear glass pack (Wine Bottles)
		Clear glass pack (Non-alch bev)
		Clear glass pack (Spirit bottles)
		Clear glass packaging (Food Packaging)
	Pack glass other colours	
	Other glass waste	
METALS	Fe Drink Cans	
	Fe Food Cans	
	Other Fe Metal Packaging	
	Total Fe Metal Packaging	
	Other Fe Metal	
	Alu Drink Cans	
	Alu Food	
	Other Aluminium Packaging	
	Total Aluminium Packaging	
	Other Al Metal	
	Other metal pack	
	Other metal waste	
INCOMBUSTIBLES	Unclass incomb pack	
	Other unclass incomb	
SPECIAL WASTE	Paints, inks, pastes & resins, varnishes	
	Solvents	
	Chemicals 4 Photography	
	Pesticides	
	Fluorescent and other Mercury Containers	
	Batteries and accumulators	
	Aerosols spray	
	Other domestic special	
FINES	Fines	

Appendix 4 : Information Leaflets

Paper Chain Instruction Leaflet



Your paper will be collected on: Monday Tuesday Wednesday Thursday Friday
Monday Tuesday Wednesday Thursday Friday

April 1999

mon	tues	wed	thurs	fri
26	27	28	29	30

May 1999

mon	tues	wed	thurs	fri
3	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28
✕				

✕ *Bank Holidays - No collections*

June 1999

mon	tues	wed	thurs	fri
	✕	2	3	4
7	8	9	10	11
14	15	16	17	18
21	22	23	24	25
28	29	30		

July 1999

mon	tues	wed	thurs	fri
			1	2
5	6	7	8	9
12	13	14	15	16
19	20	21	22	23
26	27	28	29	30

August 1999

mon	tues	wed	thurs	fri
2	3	4	5	6
9	10	11	12	13
16		18	19	20
23	24	25	26	27
✕	✕			

September 1999

mon	tues	wed	thurs	fri
		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	

October 1999

mon	tues	wed	thurs	fri
				1
4	5	6	7	8
11	12	13	14	15
18	19	20	21	22
25	26	27	28	29

November 1999

tues	wed	thurs	fri
2	3	4	5
9	10	11	12
16	17	18	19
23	24	25	26
30			

December 1999

mon	tues	wed	thurs	fri
		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
✕	✕	29	30	31

January 2000

mon	tues	wed	thurs	fri
✕	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28
31				

February 2000

tues	wed	thurs	fri
1	2	3	4
8	9	10	11
15	16	17	18
22	23	24	25
29			

March 2000

mon	tues	wed	thurs	fri
		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	31

Your paper will be collected on: Monday Tuesday Wednesday Thursday Friday
Monday Tuesday Wednesday Thursday Friday

Sort Reminder Bin Sticker

Millennium First Scheme Instruction Leaflet

WHEN DOES THE SCHEME START?

The scheme will start on **Thurs 1st June** and run for a trial period of approximately 6 months.

WHEN DO WE GET OUR RECYCLING BIN?

Your recycling bin will be delivered to your property the week before the scheme starts.

WHAT IF I ALREADY RECYCLE?

This scheme offers the convenience of having your recyclable materials collected from your home. However, if you feel happier recycling at other facilities then please continue to do so.

WHAT IS THE MILLENNIUM RECYCLING SCHEME?

The Millennium Recycling Scheme is a unique non-profit making project managed by the University of Leeds that aims to collect ALL the recyclable material from your home. As well as being good for the environment it can save you the trouble of making special trips to bottle or newspaper banks.

WHY DO WE NEED TO RECYCLE?

- every year we dispose of enough rubbish to fill 5 million dumper trucks!
- to help the environment by saving valuable natural resources
- it makes sense to make new out of old

AND.... you'll be surprised at the reduction in the amount of waste in your normal black bin.

IMPORTANT NOTICE TO HOUSEHOLDERS
This information constitutes formal notification of a change in your refuse collection system as required by the Environmental Protection Act 1990 (Section 46).

I DON'T GET ENOUGH MATERIALS TO FILL THE RECYCLING BIN

It doesn't matter how much each of us recycles as long as we all do!!

WHAT IF WE REALLY DON'T WANT TO TAKE PART?

Please DO NOT use the recycling sack or bin for anything else but leave them EMPTY at the front of your property on the collection day and we will remove them.

MILLENNIUM RECYCLING CUSTOMER SERVICE HELPLINE

0113 233 2324

HOW DO WE USE THE SCHEME?

Please put all your recyclable material into the recycling sacks provided and place this into the recycling bin. All other waste goes into your normal refuse bin.

YES	NO
✓	✗
ALL RECYCLABLES	FOOD OR GARDEN WASTE

HOW WILL THE RECYCLABLE MATERIAL BE COLLECTED?

Please leave the recycling bin on the kerbside at the front of your property by no later than 7 a.m. on Thursdays.

We will then collect the sack from the recycling bin and supply you with a new sack.

RECYCLING
MILLENNIUM
SCHEME 2000

....EVERY BIT HELPS!

...IN PARTNERSHIP WITH

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

Biffa

YOUR RECYCLING BIN WILL BE COLLECTED ON THURSDAYS

CALENDAR

June 2000

			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

July 2000

					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

August 2000

	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

September 2000

				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

October 2000

						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

November 2000

		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Millennium Feedback Leaflet

Remember...

I don't have to be clean to be in the recycling scheme

Please empty your containers but you don't need to clean them !

Please leave your wheeled bin on **Thursday morning at the kerbside** before 7.00am to guarantee collection

Your recycling bin is for **ALL** your recyclables

NO FOOD or GARDEN WASTE

MILLENNIUM RECYCLING
CUSTOMER SERVICE
HELPLINE (ANSWERPHONE)
0113 233 2324

CARDBOARD PAPER
GLASS PACKAGING
METALS PLASTICS
MAGAZINES BOOKS
TOYS CLOTHES
ALL RECYCLABLES

Recycling
MILLENNIUM
Scheme 2000

Since the scheme started in June we have collected **over 10 tons of recyclables** from your wheeled recycling bins

Over 90% ! of households who were offered the scheme currently participate.

IN PARTNERSHIP WITH ....

BRADFORD COUNCIL SERVICES

Biffa

How are we doing ?

Well Done ! Keep it up !

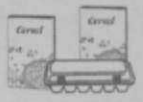
Around 90% of your newspapers are put into the recycling bin

Around 80% of your magazines leaflets are put into the recycling bin

Around 75% of your glass jars and bottles are put into the recycling bin

Around 75% of your Drink Cans are put into the recycling bin

Not bad, Could be better ?



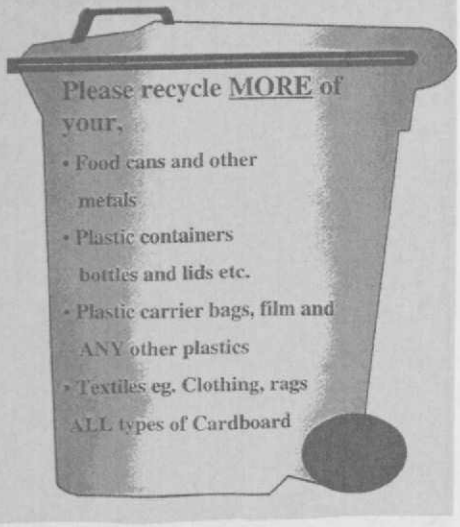
Only 60% of your cardboard is put into the recycling bin !!

Only 55% of your textiles are put into the recycling bin ! !

Please recycle MORE of these materials !

Only 20% of your Food cans are put into the recycling bin !!

Only 25% of your plastic bottles, carrier bags and other plastics are put into the recycling bin ! !



Appendix 5: Questionnaires

Paper Chain Pre-scheme Questionnaire

PART 1. RECYLING BEHAVIOUR.

1. **Do you or members of your household recycle?** Yes ☐ 1 No ☐ 2
   If yes go to question 2, If no go to question 9

2. **Which THREE of the following reasons best describes why you recycle?**

Good facilities nearby / convenient	☐ 1	Saves waste / landfill space	☐ 3	Saves dustbin space	☐ 5
For the future environment / generations	☐ 2	Personal Satisfaction / habit	☐ 4	Peer pressure / duty	☐ 6

3. **Which of the following materials do you or members of your household usually recycle?**

Newspapers	☐ 1	Other Paper	☐ 4	Glass Bottles	☐ 7	Plastic Bottles	☐ 10
Magazines	☐ 2	Drink Cans	☐ 5	Glass Jars	☐ 8	Plastic Carrier Bags	☐ 11
Cardboard	☐ 3	Food Cans	☐ 6	Textiles	☐ 9	Plastic Containers	☐ 12

4. **When did you last go to a recycling bank?**

Yesterday	☐ 1	Two weeks ago	☐ 3	A Longer Period	☐ 5
Last week	☐ 2	Last month	☐ 4		

5. **When you last went to a recycling bank, how far did you travel?**

Less than ½ mile	☐ 1	1 - 2 miles	☐ 3	3 – 4 miles	☐ 5
½ mile – 1 mile	☐ 2	2 - 3 miles	☐ 4	More than 4 miles	☐ 6

6. **How did you travel there?**

Walk ☐ 1 Cycle ☐ 2 Car / Van ☐ 3 Bus ☐ 4 Train ☐ 5

7. **When you last went to a recycling bank did you go....**

Just to the recycling bank	☐ 1	As part of another journey (i.e. going to work)	☐ 3
To the supermarket as well	☐ 2	To a civic amenity site as well	☐ 4
Other (please specify)	☐ 5		

8. **Where do you normally store your materials to be recycled?**

Kitchen ☐ 1 Hallway ☐ 2 Porch ☐ 3 Elsewhere indoors ☐ 4 Garage ☐ 5

Backyard / Garden ☐ 6 Other (Please specify) ☐ 7..... ***Go to question 10***

9. **Please indicate up to 3 of the following reasons which best describe your reason(s) for not recycling?**

Inconvenient / no time	☐ 1	Too much effort	☐ 4	Lack of information	☐ 6
Facilities too far away / inadequate	☐ 2	Storage / handling problems	☐ 5	Never really thought about it	☐ 7
Not enough materials to recycle	☐ 3	Other (Please specify)	☐ 8		

10. **If a door to door collection system was introduced in your area to collect recyclable materials, how often do you think you would use the scheme ?**

Never ☐ 1 Occasionally ☐ 2 Regularly ☐ 3 All of the time ☐ 4

11. **If you could only have 5 materials in a kerbside scheme, which of the following materials would you choose?**

Newspapers	☐ 1	Other Paper	☐ 4	Glass Bottles	☐ 7	Plastic Bottles	☐ 10
Magazines	☐ 2	Drink Cans	☐ 5	Glass Jars	☐ 8	Plastic Carrier Bags	☐ 11
Cardboard	☐ 3	Food Cans	☐ 6	Textiles	☐ 9	Plastic Containers	☐ 12

12. **Please indicate your preferred storage method and collection frequency for a kerbside collection scheme.**

Container	Bag/Bin Liner	☐ 1	Plastic Recycling box	☐ 2	Bin	☐ 3	Other	☐ 4
Collection Frequency	Weekly	☐ 1	Fortnightly	☐ 2	Monthly	☐ 3	A longer period	☐ 4

13. **If a kerbside collection scheme was introduced where you had to rinse the materials prior to disposing of them in the recycling bin, how would you feel?**

Wouldn't mind	☐ 1	Wouldn't rinse but would participate	☐ 3		
Would reluctantly participate	☐ 2	Wouldn't rinse and wouldn't participate	☐ 4	Don't Know	☐ 5

PART 2. ATTITUDES & OPINIONS.

Please indicate your level of agreement/disagreement to the following statements by placing a tick in the appropriate box.

		SA	A	N	D	SD
14.	I would recycle more if a door to door kerbside collection scheme were in place.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
15.	The current waste management system adequately suits my needs.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
16.	The local bring site facilities are regularly overflowing and untidy.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
17.	Bring facilities should be more adequately sign posted and better managed.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
18.	I regard myself as somebody who is environmentally conscious.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
19.	Recycling facilities are a long way from my place of residence.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
20.	We should still recycle even if it costs more than landfill.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
21.	Recycling labels printed on the product's packaging encourages me to recycle it.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
22.	The recycled content of a product/packaging influences my purchasing decision.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
23.	I always try to buy the most environmentally friendly products.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
23.	To reduce waste and increase recycling, households should be directly charged by the amount of unsorted waste they produce.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
24.	A law should be introduced to make people recycle more.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
25.	The quality and amount of information on recycling in Leeds is insufficient.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

PART 3. ABOUT YOURSELF

26. **Are you?** Male ☐ 1 Female ☐ 2

27. **To which age group do you belong?**

Under 26 yrs	☐ 1	35 - 44 yrs	☐ 3	55 - 59 yrs	☐ 5
26 – 34 yrs	☐ 2	45 - 54 yrs	☐ 4	60 yrs or over	☐ 6

28. **What is your full home postcode?** .....

29. **How many persons live within this household?** ☐ 1

30a. **How many children (under 18 yrs) live within this household?** ☐ 1

30b. **Please state age(s)** ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

31. **How many cars/vans (including company vehicles) does your household own?**

None	☐ 1	2	☐ 3	More than 3	☐ 5
1	☐ 2	3	☐ 4		

32a. **What is your occupation ?** .....

32b. **Please indicate your approximate total household income bracket (before tax) per year.**

Up to £10,000	☐ 1	£20,000 - £29,000	☐ 3	£50,000 – 69,000	☐ 5
£10,000 - £19,000	☐ 2	£30,000 - £49,000	☐ 4	£70,000 or over	☐ 6

Thank you for your time and co-operation

Paper Chain Postal (During Scheme) Questionnaire

Hello my name is Darren. I am doing a PhD at The University of Leeds studying recycling behaviour. **Your opinions are important !** I would appreciate it if you could spend a few minutes of your time completing this short questionnaire. There are no correct or incorrect answers. If you are unsure about some answers, please give your best estimate. I will be returning to collect the questionnaire on _____ JULY 1999. If you have any queries or wish to post your response then send to,

Darren Perrin
School of Civil Engineering
The University of Leeds
Leeds
LS2 9JT.

Please tick the appropriate box(s) for each question unless indicated to do otherwise. For example ☐ ☐

PART 1 – RECYCLING BEHAVIOUR

1. **Do you recycle?** Yes ☐ 1 No ☐ 2

If yes go to question 2, If no go to question 11.

2. **Please tick THREE of the following boxes which best describes why you recycle?**

Good facilities nearby / convenient ☐ 1 Saves waste / landfill space ☐ 2 Saves dustbin space ☐ 3
For the future environment / generations ☐ 4 Personal Satisfaction / habit ☐ 5 Peer pressure / duty ☐ 6

3. **Which of the following materials do you or members of your household usually recycle?**

Newspapers	☐ 1	Other Paper	☐ 4	Glass Bottles	☐ 7	Plastic Bottles	☐ 10
Magazines	☐ 2	Drink Cans	☐ 5	Glass Jars	☐ 8	Plastic Carrier Bags	☐ 11
Cardboard	☐ 3	Food Cans	☐ 6	Textiles	☐ 9	Plastic Containers	☐ 12

4. **Please indicate which of the following recycling methods you currently use (Please tick as many as apply)**

Leeds City Council door to door paper collection scheme ☐ 1 Supermarket car-park recycling centres ☐ 2
Council run civic amenity site recycling centres (beside tip) ☐ 3 Charity collection schemes ☐ 4
Other methods ☐ 5 (Please specify)_____

5. **Where do you normally store your materials to be recycled?**

Kitchen ☐ 1 Hallway ☐ 2 Porch ☐ 3 Elsewhere indoors ☐ 4 Garage ☐ 5
Backyard / Garden ☐ 6 Other (Please specify) ☐ 7 _____

6. **Did you previously recycle any materials before the paper collection scheme was introduced in your area?**

Yes ☐ 1 No ☐ 2

7. **Did you previously recycle newspapers before the paper collection scheme was introduced in your area?**

Yes ☐ 1 No ☐ 2 ***If yes go to question 8, If no go to question 10.***

8. **Where did you previously recycle your newspapers?**

Supermarket car-park recycling centres ☐ 1 Council run civic amenity site recycling centres (beside tip) ☐ 2
Charity collection schemes ☐ 3 Other methods ☐ 4 (Please specify) _____

9. **In your opinion would you say that you recycle more newspapers since the introduction of Leeds City Council door to door paper collection scheme?**

Yes ☐ 1 No ☐ 2 Don't Know ☐ 3

Please go to PART TWO

10. **Please tick TWO the following reasons which best describe why you previously did not recycle newspapers.**

Inconvenient / no time ☐ 1 Too much effort ☐ 2 Lack of information ☐ 3
Facilities too far away / inadequate ☐ 4 Storage / handling problems ☐ 5 Never really thought about it ☐ 6
Other (Please specify) ☐ 7 _____

Please go to PART TWO

11. **Please tick UP TO THREE of the following reasons which best describe your reason(s) for not recycling?**

Inconvenient / no time ☐ Too much effort ☐ 2 Lack of information ☐ 3
Facilities too far away / inadequate ☐ 4 Storage / handling problems ☐ 5 Never really thought about it ☐ 6
Not enough materials to recycle ☐ 7 Other (Please specify) ☐ 8 _____

PART 2 – NEWSPAPER CONSUMPTION

12. **How many free newspapers were delivered to your house last week?** ☐

13. **Have you bought a newspaper within the last month?** Yes ☐ 1 No ☐ 2

If yes go to question 14, If no go to question 17.

14. **How many newspapers have you bought within the last full week ?** ☐

15. **Please indicate the following daily newspaper(s) you have bought within the last full week**

The Sun ☐ 1 The Sport ☐ 4 The Observer ☐ 7 The Financial Times ☐ 10
The Mirror ☐ 2 The Guardian ☐ 5 The Yorkshire Post (Evening) ☐ 8 The Express ☐ 11
The Star ☐ 3 The Telegraph ☐ 6 The Times ☐ 9 The Mail ☐ 12
Other(s) (please specify) 13 _____

16. **Please indicate the following Sunday newspaper(s) you bought last Sunday**

The Guardian ☐ 1 The Sunday Sport ☐ 5 The Sunday Express ☐ 9
The Telegraph ☐ 2 The Mail on Sunday ☐ 6 The Sunday Mirror ☐ 10
The Observer ☐ 3 The Sunday Times ☐ 7
The News of the World ☐ 4 The People ☐ 8 Did not buy a paper ☐ 11
Other(s) (Please Specify) 12 _____

17. **How many magazines have you bought within the last month ?** ☐

PART 3 – PAPER COLLECTION SCHEME

18. **How often do you leave your newspapers and magazines out for collection for the paper recycling collection scheme in your area?**

Never ☐ 1 — If you have ticked this box then please go to question 19.

Every 2 weeks ☐ 2

Once a Month ☐ 3 — If you have ticked one of these three boxes then please go to question 21

Less Frequent ☐ 4

19. **Please tick up to 3 reasons which best describe why you do not use the paper collection scheme.**

Inconvenient ☐ 1 No Time ☐ 2 The schemes untidy ☐ 3 Not interested ☐ 4

The schemes operated by Leeds City Council ☐ 5 Not enough newspapers to recycle ☐ 6

Have to put the bags out beside the pavement ☐ 7 Forget to leave the papers out ☐ 8

Don't like the recycling bag ☐ 9 Information is insufficient ☐ 10 I don't understand what to do ☐ 11

My bag is not always collected ☐ 12 Other (please specify) 13 _____

20. **Which of the following reasons would encourage you to use the current door to door paper collection scheme in you area? (Please tick as many boxes as apply)**

A financial reward for taking part was offered ☐ 1 If using the scheme was made law ☐ 2

A private company operated the scheme ☐ 3 If collections were more frequent ☐ 4

If a bin was used to store the materials and not a bag ☐ 5 If all recyclable materials were accepted ☐ 6

If any profit made form the scheme was donated to local charities ☐ 7

Nothing would encourage me to use the scheme ☐ 8 If information about the scheme improved ☐ 9

Other reasons (Please Specify) 10 _____

21. **On a scale of 1 *(Very Satisfied)* to 5 *(Very dis-satisfied)* please circle your level of satisfaction towards the following 3 services currently offered to you,**

i. **The door to door paper recycling collection scheme**

1 2 3 4 5

ii. **The supermarket car-park recycling centres**

1 2 3 4 5

iii. **The quality and quantity of information offered to you about the paper recycling scheme.**

1 2 3 4 5

22. **Please tick THREE of the following changes you would like to see happen to the current door to door paper collection scheme.**

Change from a fortnightly to a weekly collection ☐ 1 Change from a bag to a bin (i.e. wheelie bin) ☐ 2

Change from a fortnightly to a monthly collection ☐ 3 Increase the size of the bag ☐ 4

Include more recyclable materials in the scheme other than paper i.e glass, plastic, cans etc. ☐ 5

Having the bags collected from beside the normal bin ☐ 6 Improve information about the scheme ☐ 7

Other (Please Specify) ☐ 8 _____

PART 4. ENVIRONMENTAL BEHAVIOUR & PURCHASING

Please indicate your level of agreement or disagreement with the following statements by placing a tick in the appropriate box.

SA = Strongly Agree A = Agree N = No Opinion D = Disagree SD = Strongly Disagree

		SA	A	N	D	SD
23.	I regard myself as somebody who is environmentally conscious.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
24.	We should still recycle even if it costs more than landfill.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
25.	The quality and amount of information on recycling in Leeds is insufficient.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
26.	A law should be introduced to make people recycle more.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
27.	The cost of your waste / refuse collection and disposal should be charged separately from your council tax. For example, like electricity / gas.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
28.	I always try to buy the most environmentally friendly products.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
29.	The recycled content of a product / packaging influences what I buy.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
30.	Recycling labels printed on the product's packaging encourages me to recycle it.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
31.	Waste collection should be charged per bag or bin to encourage us to recycle more and put out less for refuse collection.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
32.	I am aware of recycling from information passed on by children I know currently at school.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
33.	The current waste collection service as a whole in Leeds is a good service and currently suits my needs.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
34.	Seeing my neighbours recycling bags left out to be collected encourages me to recycle.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
35.	My neighbours, friends and family recycling encourages me to recycle.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

PART 5. ABOUT YOURSELF

36. **Are you?** Male ☐ 1 Female ☐ 2

37. **To which age group do you belong?**

Under 26 years ☐ 1 35 - 44 years ☐ 2 55 - 59 years ☐ 3
26 – 34 years ☐ 4 45 - 54 years ☐ 5 60 years or over ☐ 6

38. **What is your full home postcode?** _____

39. **How many persons live within this household?** ☐ 1

40. **How many children (under 18 years) live within this household?** ☐ 1

41. **Please state age(s)** ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

42. **How many cars/vans (including company vehicles) does your household own?**

None ☐ 1 Two ☐ 3 More than three ☐ 5
One ☐ 2 Three ☐ 4

43. **What is your occupation ?** _____

44. **What is your partners occupation ?** _____

45. **Please indicate your approximate total household income bracket (before tax) per year. (Optional)**

Up to £19,000 ☐ 1 £20,000 - £39,000 ☐ 2 £49,000 – 69,000 ☐ 3 £70,000 or over ☐ 4

Thank you for your time and co-operation

Millennium Pre-scheme Questionnaire

PART 1. RECYLING BEHAVIOUR.

1. **Do you or members of your household recycle?** Yes ☐ 1 No ☐ 2
   If yes go to question 2, If no go to question 9

2. **Which THREE of the following reasons best describes why you recycle?**

   Good facilities nearby / Convenient ☐ 1 Saves waste / Landfill space ☐ 3 Saves dustbin space ☐ 5
   For the future environment / Generations ☐ 2 Personal Satisfaction / Habit ☐ 4 Peer pressure / Duty ☐ 6

3. **Which of the following materials do you or members of your household usually recycle?**

Newspapers	☐ 1	Other Paper	☐ 4	Glass Bottles	☐ 7	Plastic Bottles	☐ 10
Magazines	☐ 2	Drink Cans	☐ 5	Glass Jars	☐ 8	Plastic Carrier Bags	☐ 11
Cardboard	☐ 3	Food Cans	☐ 6	Textiles	☐ 9	Plastic Containers	☐ 12

4. **How often do you normally go to a recycling bank to recycle these materials?**

   Daily ☐ 1 Fortnightly ☐ 3 A Longer Period ☐ 5
   Weekly ☐ 2 Monthly ☐ 4

5. **When you last went to a recycling bank, how far did you travel?**

   Less than ½ mile ☐ 1 1 - 2 miles ☐ 3 3 – 4 miles ☐ 5
   ½ mile – 1 mile ☐ 2 2 - 3 miles ☐ 4 More than 4 miles ☐ 6

6. **How did you travel there?**

   Walk ☐ 1 Cycle ☐ 2 Car / Van ☐ 3 Bus ☐ 4 Train ☐ 5

7. **When you last went to a recycling bank did you go....**

   Just to the recycling bank ☐ 1 As part of another journey (i.e. going to work) ☐ 3
   To the supermarket as well ☐ 2 To a civic amenity site as well ☐ 4
   Other (please specify) ☐ 5 .....

8. **Where do you normally store your materials to be recycled?**

   Kitchen ☐ 1 Hallway ☐ 2 Porch ☐ 3 Elsewhere indoors ☐ 4 Garage ☐ 5

   Backyard / Garden ☐ 6 Other (Please specify) ☐ 7..... ***Go to question 10***

9. **Please indicate up to 3 of the following reasons which best describe your reason(s) for not recycling?**

   Inconvenient / no time ☐ 1 Too much effort ☐ 4 Lack of information ☐ 6
   Facilities too far away / inadequate ☐ 2 Storage / handling problems ☐ 5 Never really thought about it ☐ 7
   Not enough materials to recycle ☐ 3 Other (Please specify) ☐ 8 .....

10. **If a door to door collection system was introduced in your area to collect recyclable materials, how often do you think you would use the scheme ?**

    Never ☐ 1 Occasionally ☐ 2 Regularly ☐ 3 All of the time ☐ 4

11. **If you could only have 5 materials in a kerbside scheme, which of the following materials would you choose?**

Newspapers	☐ 1	Other Paper	☐ 4	Glass Bottles	☐ 7	Plastic Bottles	☐ 10
Magazines	☐ 2	Drink Cans	☐ 5	Glass Jars	☐ 8	Plastic Carrier Bags	☐ 11
Cardboard	☐ 3	Food Cans	☐ 6	Textiles	☐ 9	Plastic Containers	☐ 12

12. **Please indicate your preferred storage method and collection frequency for a kerbside collection scheme.**

Container	Bag/Bin Liner	☐ 1	Plastic Recycling box	☐	Bin	☐ 3	Other ☐ 4
Collection Frequency	Weekly	☐ 1	Fortnightly	☐ 2	Monthly	☐ 3	A longer period ☐ 4

13. **If a kerbside collection scheme was introduced where you had to rinse the materials prior to disposing of them in the recycling bin, how would you feel?**

Wouldn't mind	☐ 1	Wouldn't rinse but would participate	☐ 3	
Would reluctantly participate	☐ 2	Wouldn't rinse and wouldn't participate	☐ 4	Don't Know ☐ 5

PART 2. ATTITUDES & OPINIONS.

Please indicate your level of agreement/disagreement to the following statements by placing a tick in the appropriate box.

	SA	A	N	D	SD
14. **I would recycle more if a door to door kerbside collection scheme were in place.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
15. **The current waste management system adequately suits my needs.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
16. **The local bring site facilities are regularly overflowing and untidy.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
17. **Bring facilities should be more adequately sign posted and better managed.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
18. **I regard myself as somebody who is environmentally conscious.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
19. **Recycling facilities are a long way from my place of residence.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
20. **We should still recycle even if it costs more than landfill.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
21. **Recycling labels printed on the product's packaging encourages me to recycle it.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
22. **The recycled content of a product/packaging influences my purchasing decision.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
23. **I always try to buy the most environmentally friendly products.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
24. **To reduce waste and increase recycling, households should be directly charged by the amount of unsorted waste they produce.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
25. **A law should be introduced to make people recycle more.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
26. **The quality and amount of information on recycling in Leeds is insufficient.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
27. **I feel more could be done to improve the level of recycling within Bradford.**	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

28. **Which day of the week is your refuse normally collected on ?** _____

PART 3. ABOUT YOURSELF

29. **Are you?** Male ☐ 1 Female ☐ 2

30. **To which age group do you belong?**

Under 26 yrs	☐ 1	**35 - 44 yrs**	☐ 3	**55 - 59 yrs**	☐ 5
26 – 34 yrs	☐ 2	**45 - 54 yrs**	☐ 4	**60 yrs or over**	☐ 6

31. **What is your full home postcode?** .....

32. **How many persons live within this household?** ☐ 1

33a. **How many children (under 18 yrs) live within this household?** ☐ 1

33b. **Please state age (s)** ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

34. **How many cars/vans (including company vehicles) does your household own?**

None	☐ 1	2	☐ 3	More than 3	☐ 5
1	☐ 2	3	☐ 4		

35. **What is the occupation of the main income earner?** .....

Millennium Postal (During Scheme) Questionnaire

Hello my name is Darren. I am doing a PhD at The University of Leeds studying recycling behaviour. Your opinions are important ! I would appreciate it if you could spend a few minutes of your time completing this short questionnaire. There are no correct or incorrect answers. If you are unsure about some answers, please give your best estimate. I will be returning to collect the questionnaire on _____ AUGUST 2000. If you have any queries or additional comments or wish to post your response then please send to, Darren Perrin, School of Civil Engineering, The University of Leeds, Leeds, LS2 9JT.

Please tick the appropriate box(s) for each question unless indicated to do otherwise. For example ☐ ☐

PART 1 – RECYCLING BEHAVIOUR

1. **Do you recycle?** Yes ☐ 1 No ☐ 2

   If yes go to question 2, If no go to question 11.

2. **Please tick UP TO THREE of the following boxes which best describes why you recycle?**

   Good facilities nearby / convenient ☐ 1 Saves waste / landfill space ☐ 2 Saves dustbin space ☐ 3
   For the future environment / generations ☐ 4 Personal satisfaction / habit ☐ 5 Peer pressure / duty ☐ 6

3. **Which of the following materials do you or members of your household usually recycle?**

   Newspapers ☐ 1 Other Paper ☐ 4 Glass Bottles ☐ 7 Plastic Bottles ☐ 10
   Magazines ☐ 2 Drink Cans ☐ 5 Glass Jars ☐ 8 Plastic Carrier Bags ☐ 11
   Cardboard ☐ 3 Food Cans ☐ 6 Textiles ☐ 9 Plastic Containers ☐ 12

5. **Please indicate which of the following recycling methods you currently use (Please tick as many as apply)**

   Millennium Recycling Scheme ☐ 1 Supermarket car-park recycling centres ☐ 2
   Council run civic amenity site recycling centres (beside tip) ☐ 3 Charity collection schemes ☐ 4
   Other methods ☐ 5 (Please specify) _____

6. **If you use other methods of recycling other than the Millennium Recycling Scheme, where do you store your materials to be recycled?**

   Kitchen ☐ 1 Hallway ☐ 2 Porch ☐ 3 Elsewhere indoors ☐ 4 Garage ☐ 5
   Backyard / Garden ☐ 6 Other (Please specify) ☐ 7 _____

6. **Did you previously recycle any materials before the Millennium Recycling Scheme was introduced in your area?**

   Yes ☐ 1 No ☐ 2

   If yes please go to question 7, If no please go to question 10

7. **Which of the following materials did you or members of your household previously recycle before the Millennium Recycling Scheme ?**

   Newspapers ☐ 1 Other Paper ☐ 4 Glass Bottles ☐ 7 Plastic Bottles ☐ 10
   Magazines ☐ 2 Drink Cans ☐ 5 Glass Jars ☐ 8 Plastic Carrier Bags ☐ 11
   Cardboard ☐ 3 Food Cans ☐ 6 Textiles ☐ 9 Plastic Containers ☐ 12

8. **Where did you previously recycle your materials ?**

Supermarket car-park recycling centres ❑ 1 Council run civic amenity site recycling centres (beside tip) ❑ 2

Charity collection schemes ❑ 3 Other methods ❑ 4 (Please specify) _____

9. **In your opinion would you say that overall you recycle more since the introduction of the Millennium Recycling Scheme?**

Yes ❑ 1 No ❑ 2 Don't Know ❑ 3 ***Please go to PART TWO***

10. **Please tick UP TO THREE of the following reasons which best describe why you previously did not recycle.**

Inconvenient / no time ❑ 1 Too much effort ❑ 2 Lack of information ❑ 3

Facilities too far away / inadequate ❑ 4 Storage / handling problems ❑ 5 Never really thought about it ❑ 6

Not enough materials to recycle ❑ 7 Other (Please specify) ❑ 8 _____

Please go to PART TWO

11. **Please tick UP TO THREE of the following reasons which best describe your reason(s) for not recycling?**

Inconvenient / no time ❑ 1 Too much effort ❑ 2 Lack of information ❑ 3

Facilities too far away / inadequate ❑ 4 Storage / handling problems ❑ 5 Never really thought about it ❑ 6

Not enough materials to recycle ❑ 7 Other (Please specify) ❑ 8 _____

Please go to PART TWO

PART 2 – DISPOSAL BEHAVIOUR

12. **Please indicate by placing a tick in the appropriate column where you dispose of EACH of the following materials.**

Materials	Millennium Recycling Wheeled Bin	Normal Refuse (rubbish) Bin	Recycling Centre (i.e. bottle banks)
Newspapers	❑	❑	❑
Garden Waste	❑	❑	❑
Cardboard	❑	❑	❑
Junk Mail and Stationary	❑	❑	❑
Drink Cans	❑	❑	❑
Food Cans	❑	❑	❑
Glass Bottles	❑	❑	❑
Glass Jars	❑	❑	❑
Electrical Goods	❑	❑	❑
Plastic Bottles	❑	❑	❑
Food Waste	❑	❑	❑
Paints and Oils	❑	❑	❑
Plastic Containers	❑	❑	❑
Magazines	❑	❑	❑
Wood	❑	❑	❑
Textiles	❑	❑	❑
Plastic Carrier Bags	❑	❑	❑

PART 3 –THE MILLENNIUM RECYCLING SCHEME

13. Please indicate where you STORE EACH of the following recyclable materials IMMEDIATLEY after using them by placing a tick in the appropriate column.

Material	Directly into the Millennium Recycling bin	Kitchen	Hall/ Porch	Elsewhere Indoors	Garage/ Garden	Other	Don't recycle this material
Newspapers							
Magazines							
Cardboard							
Glass bottles							
Glass Jars							
Plastic Bottles							
Plastic Containers							
Plastic Bags							
Textiles							
Food Cans							
Drink Cans							

14. How often do you leave your Millennium Recycling bin at the kerbside for collection ?

Never ☐ 1 **If you have ticked this box then please go to question 15.**

Every week ☐ 2 Once a Month ☐ 4 **If you have ticked one of these four**

Every 2 weeks ☐ 3 Less Frequent ☐ 5 **boxes then please go to question 17.**

15. Please tick UPTO 3 reasons which best describe why you do not use the Millennium Recycling Scheme.

Inconvenient ☐ 1 No Time ☐ 2 The schemes untidy ☐ 3 Not interested ☐ 4

Operated by Bradford City Council /Leeds University ☐ 5 Not enough materials to recycle ☐ 6

Have to put the bin out beside the pavement ☐ 7 Forget to leave the bin out ☐ 8

Don't like the recycling bin ☐ 9 Information is insufficient ☐ 10 I don't understand what to do ☐ 11

My bin is not always collected ☐ 12 Other (please specify) 13 _____

16. Which of the following reasons would encourage you to use the Millennium Recycling Scheme

(Please tick as many boxes as apply)

A financial reward for taking part was offered ☐ 1 If using the scheme was made law ☐ 2

A private company operated the scheme ☐ 3 If collections were less frequent ☐ 4

If a bag/box was used to store the materials and not a bin ☐ 5 If feedback about the scheme was provided ☐ 6

If any profit made from the scheme was donated to local charities ☐ 7

Nothing would encourage me to use the scheme ☐ 8 If information about the scheme improved ☐ 9

Other reasons (Please Specify) ☐ 10 _____

17. On a scale of 1 *(Very Satisfied)* to 5 *(Very dis-satisfied)* please circle your level of satisfaction towards the following 3 services currently offered to you,

iv. The Millennium Recycling Scheme

1 2 3 4 5

v. The supermarket car-park and civic amenity recycling centres (e.g. bottle banks)

1 2 3 4 5

vi. The quality and quantity of information offered to you about the Millennium Recycling Scheme.

1 2 3 4 5

18. Please tick UPTO THREE of the following changes you would like to see happen to the Millennium Recycling Scheme.

Change from a morning to afternoon collection ☐ 1 Change from a wheeled bin to a re-usable bag/box ☐ 2

Change the type/size of the Millennium collection sack ☐ 3 Increase the size of the wheeled bin ☐ 4

Provide more detailed instructions about exactly what materials to put in the recycling bin ☐ 5

Having the wheeled bin collected from beside the normal bin ☐ 6 Introduce household feedback about the scheme ☐ 7

Provided with an additional indoor recycling bin ☐ 8 Other (Please Specify) ☐ 9 _____

PART 4. ENVIRONMENTAL BEHAVIOUR & PURCHASING

Please indicate your level of agreement or disagreement with the following statements by placing a tick in the appropriate box. SA= Strongly Agree A = Agree N = No Opinion D = Disagree SD = Strongly Disagree

	SA	A	N	D	SD
19. I regard myself as somebody who is environmentally conscious.	1☐	2☐	3☐	4☐	5☐
20. We should still recycle even if it costs more than landfill.	1☐	2☐	3☐	4☐	5☐
21. The quality and amount of information on recycling in Bradford is insufficient.	1☐	2☐	3☐	4☐	5☐
22. A law should be introduced to make people recycle more.	1☐	2☐	3☐	4☐	5☐
23. The cost of your waste / refuse collection and disposal should be charged separately from your council tax. For example, like electricity / gas.	1☐	2☐	3☐	4☐	5☐
24. I always try to buy the most environmentally friendly products.	1☐	2☐	3☐	4☐	5☐
25. The recycled content of a product / packaging influences what I buy.	1☐	2☐	3☐	4☐	5☐
26. Recycling labels printed on the product's packaging encourages me to recycle it.	1☐	2☐	3☐	4☐	5☐
27. Waste collection should be charged per bag or bin to encourage us to recycle more and put out less for refuse collection.	1☐	2☐	3☐	4☐	5☐
28. The current waste collection service as a whole in Bradford is a good service and currently suits my needs.	1☐	2☐	3☐	4☐	5☐
29. Seeing my neighbours recycling bin left out for collection encourages me to recycle	1☐	2☐	3☐	4☐	5☐
30. My neighbours, friends and family recycling encourages me to recycle.	1☐	2☐	3☐	4☐	5☐
31. My neighbours frequently leave their recycling bin out for collection	1☐	2☐	3☐	4☐	5☐

PART 5. ABOUT YOURSELF

32. Are you? Male ☐ 1 Female ☐ 2

33. To which age group do you belong?

Under 26 years ☐ 1 35 - 44 years ☐ 2 55 - 59 years ☐ 3

26 – 34 years ☐ 4 45 - 54 years ☐ 5 60 years or over ☐ 6

34. How many persons live within this household? ☐

35. How many children (under 18 years) live within this household? ☐

35a. Please state age(s) ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

36. How many cars/vans (including company vehicles) does your household own?

None ☐ 1 One ☐ 2 Two ☐ 3 Three ☐ 4 More than three ☐ 5

37. What is your occupation ? _____

38. What is your partners occupation ? _____

Hello my name is Geoff Leyland. I am a student at the University of Leeds. I would appreciate it if you could spend a few minutes of your time completing this short questionnaire. YOUR OPINIONS ARE IMPORTANT. There are no correct or incorrect answers. If you are unsure about some answers, please give your best estimate. I will be returning to collect the questionnaire on _____ December 2000. If you have any queries, additional comments or wish to post your response, then please send them to

F.A.O. Geoff Leyland,
School of the Environment
The University of Leeds
Leeds, LS2 9JT

Please tick the appropriate box (es) for each question unless indicated to do otherwise. ☐

PART 1 – RECYCLING BEHAVIOUR

1. **Please circle the day of the week your BLACK (REFUSE) bin is collected:**

Monday Tuesday Wednesday Thursday Friday Saturday Sunday

2. **Do you recycle?** Yes ☐ 1 No ☐ 2

***If yes, please go to* question 3. *If no, please go to* question 5.**

3. **Please tick UP TO THREE of the following boxes which best describes why you recycle?**

Good facilities nearby / convenient ☐ 1 Saves waste / landfill space ☐ 2 Saves dustbin space ☐ 3
For the future environment / generations ☐ 4 Personal satisfaction / habit ☐ 5 Peer pressure / duty ☐ 6

4. **Please indicate by placing a tick in the appropriate column where you dispose of EACH of the following materials.**

(PLEASE TICK AS MANY BOXES AS APPLY)

Materials	Normal Refuse (rubbish) Bin	Green Bin (SORT) Recycling Scheme	Supermarket and Recycling Centres (i.e. bottle banks)	Charity Collection Schemes	Other (Please Specify)
Example: Drink cans	/		/		
Newspapers					
Cardboard					
Food Cans					
Textiles					
Garden Waste					
Other Paper					
Drink Cans					
Glass Bottles					
Plastic Bottles					
Food Waste					
Plastic Containers					
Magazines					
Plastic Bags					

5. **Please indicate your current use of the Green Bin (SORT) Recycling Scheme.**

I currently use the SORT Recycling Scheme ☐ 1 ***Please go to* Question 9 PART 3**

I have never used the SORT Recycling Scheme ☐ 2 ***Please go to* Question 6.**

I have stopped using the SORT Recycling Scheme ☐ 3 ***Please go to* Question 7.**

PART TWO – THE GREEN BIN (SORT) SCHEME

6. **Please indicate UP TO THREE of the following that best describes why you have never used the Green Bin (SORT) Recycling Scheme.**

Inconvenient / No time ☐ 1 Not interested ☐ 2 Not enough materials to recycle ☐ 3

Never been asked to participate ☐ 4 I would forget to leave the bin out ☐ 5 No space for additional bin ☐ 6

I don't understand how to use the scheme ☐ 7 Other (please specify) ☐ 8 _____

***Please go to* Question 8**

7. **Please indicate UP TO THREE of the following reasons why you have stopped participating in the Green Bin (SORT) Recycling Scheme.**

Poor Service ☐ 1 Inconvenient / No time ☐ 2 Not enough materials to recycle ☐ 3 Lost interest ☐ 4 Bin not always collected ☐ 5 Prefer to use recycling centres ☐ 6 Forget to leave bin out ☐ 7

Became confuse about how to use the scheme ☐ 8 Other reasons (Please specify) ☐ 9 _____

8. **Which of the following reasons would encourage you to use, or reuse the Green Bin (SORT) Recycling Scheme? (Please tick as many boxes that apply)**

If more recyclable material was collected in the scheme (i.e. glass) ☐ 1 If collections were more frequent ☐ 2

If a container was supplied for use within the home ☐ 3 Nothing would encourage me to use the SORT scheme ☐ 4

If I received more information about how to use the scheme ☐ 5 If feedback about the scheme was provided ☐ 6

If the wheeled bin was replaced by a bag/box ☐ 7 A financial reward for taking part was offered scheme ☐ 8

A private company operated the scheme ☐ 9 Other reasons (Please Specify) ☐ 10 _____

Please go to *Question 14 PART 4*

PART THREE – PARTICIPATION IN THE GREEN BIN (SORT) RECYCLING SCHEME

9. **How often do you forget to put the green bin out on collection day?**

Never ☐ 1 Occasionally ☐ 2 Frequently ☐ 3

10. **Approximately how full is your GREEN BIN when you put it at the kerbside for collection?**

¼ full ☐ 1 ½ full ☐ 2 ¾ full ☐ 3 full ☐ 4 Overflowing ☐ 5

10a. **If full or overflowing, how many weeks after your bin has been collected is it full?**

1 week ☐ 1 2 weeks ☐ 2 3 weeks ☐ 3 4 weeks ☐ 4 Just before the next collection ☐ 5

11 **Please put the date of your next GREEN BIN collection on the line below:**

_____

12. **If your green recycling bin is FULL, what do you do with each of the following materials?**

(PLEASE TICK AS MANY BOXES AS APPLY)

Materials	Dispose of in the Black (refuse) wheeled bin	Store the materials for the following collection	Take the materials to the nearest recycling centre
Newspapers/Magazines			
Drink Cans			
Food Cans			
Plastic Bottles			

13. **Please indicate which of the following materials you rinse before putting them in the green wheeled recycling bin (Please tick as many boxes that apply)**

None ❑ 1 Drink Cans ❑ 2 Food Cans ❑ 3 Pet Food Cans ❑ 4 Plastic ❑ 5

PART FOUR – SATISFACTION OF SERVICE PROVISIONS

14. **How often do you put your BLACK (REFUSE) WHEELED BIN at the kerbside for collection?**

Weekly ❑ 1 Fortnightly ❑ 2 Monthly ❑ 3 Less Often ❑ 4

15. **Approximately how full is your BLACK (REFUSE) WHEELED BIN when you put it at the kerbside for collection?**

¼ Full ❑ 1 ½ Full ❑ 2 ¾ Full ❑ 3 Full ❑ 4 Overflowing ❑ 5

16. **On a scale of 1 *(Very Satisfied)* to 5 *(Very dis-satisfied)* please circle your level of satisfaction towards the following 3 services currently offered to you:**

vii. **The Green Bin (SORT) Recycling Scheme**

1 2 3 4 5

viii. **The supermarket car-park and civic amenity recycling centres (e.g. bottle banks)**

1 2 3 4 5

ix. **The quality and quantity of information offered to you about the SORT Recycling Scheme.**

1 2 3 4 5

17. **Please tick UP TO THREE of the following changes you would like to see happen to the Green Bin (SORT) Recycling Scheme**

Change from a wheeled bin to a re-usable bag/box ❑ 1 Increase the size of the wheeled bin ❑ 2

Reduce the size of the wheeled bin ❑ 3 Have the recycling bin collected more frequently ❑ 4

Have separate containers for each recyclable material ❑ 5 Provide an additional indoor recycling container ❑ 6

Provide more detailed instructions about exactly how to use the green bin scheme ❑ 7

Provide households with feedback about their performance ❑ 8 Collect more recyclable materials (i.e. glass) ❑ 9

Other (Please Specify) ❑ 10

_____

PART 4 – SCENARIOS

Please indicate your level of agreement or disagreement with the following statements by placing a tick in the appropriate box. SA = Strongly Agree A = Agree N = No Opinion D = Disagree SD = Strongly Disagree

		SA	A	N	D	SD
18.	**I would prefer to replace the green bin (SORT) scheme with a recycling scheme which collects only newspaper.**	❑	❑	❑	❑	❑
19.	**A weekly collection service would be more desirable than the current collection frequency.**	❑	❑	❑	❑	❑
20.	**I would recycle more of my waste if the green bin was collected more frequently.**	❑	❑	❑	❑	❑
21.	**The presence of the green wheeled recycling bin is a visual reminder to recycle.**	❑	❑	❑	❑	❑
22.	**If I could place materials directly into the green wheeled recycling bin without Rinsing them I would recycle more.**	❑	❑	❑	❑	❑
23.	**The cost of your waste / refuse collection and disposal should be charged separately from your council tax. For example, like electricity / gas.**	❑	❑	❑	❑	❑
24.	**Waste collection should be charged per bag or bin to encourage us to recycle more and put out less for refuse collection.**	❑	❑	❑	❑	❑
25.	**I would not use the SORT Scheme if a recycling centre was more convenient.**	❑	❑	❑	❑	❑
26.	**Regular information from the Council about how well I used the Green Bin (SORT) recycling scheme would encourage me to recycle more.**	❑	❑	❑	❑	❑
27.	**I would find it easier to use a box/bag to collect my recyclables than the wheeled bin.**	❑	❑	❑	❑	❑
28.	**Cleaning the green wheeled bin on a regular basis is required to prevent odours.**	❑	❑	❑	❑	❑
29.	**I find the Green Bin (SORT) recycling scheme very confusing and unsure of exactly what materials to put into the recycling bin.**	❑	❑	❑	❑	❑
30.	**The council constantly remind me how to use the recycling scheme and when the collection dates are.**	❑	❑	❑	❑	❑

PART 5 - ABOUT YOURSELF

31. **Are you?** Male ❑ 1 Female ❑ 2

32. **To which age group do you belong?**

Under 26 years ❑ 1 35 - 44 years ❑ 2 55 - 59 years ❑ 3
26 – 34 years ❑ 4 45 - 54 years ❑ 5 60 years or over ❑ 6

33. **How many persons live within this household?** ☐

34. **How many children (under 18 years) live within this household?** ☐

34a. **Please state age(s)** ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

35. **How many cars/vans (including company vehicles) does your household own?**

None ❑ 1 One ❑ 2 Two ❑ 3 Three ❑ 4 More than three ❑ 5

36. **What is your occupation ?** _____

37. **What is your partners occupation ?** _____

- THANK YOU FOR YOUR TIME IN COMPLETING THIS QUESTIONNAIRE -

Appendix 6. Pre-scheme Selected RAW Questionnaire Data from Paper Chain (Wetherby / Garforth) and Millennium (Bradford).

		Non-recyclers				Recyclers			
	Sample Size	**Garforth n=33**	**Wetherby n=46**	**Bradford n=14**	**Total n=93**	**Garforth n=108**	**Wetherby n=75**	**Bradford* n=48**	**Total n=231**
Reasons for Recycling	Good Facilities/Convenience					53.7%	45.3%	58.3%	51.9%
	Future Environments/Generations					73.1%	73.3%	81.3%	74.9%
	Saves Waste/Landfill Space					60.2%	58.7%	52.1%	58.0%
	Personal Satisfaction/Habit					43.5%	62.7%	52.1%	51.5%
	Saves Dustbin Space					47.2%	34.7%	33.3%	40.3%
	Peer Pressure/Duty					6.5%	9.3%	6.3%	7.4%
Materials Recycled	Newspaper					88.0%	85.3%	85.4%	86.6%
	Magazines					78.7%	72.0%	70.8%	74.9%
	Cardboard					27.8%	38.7%	58.3%	37.7%
	Other Paper					40.7%	32.0%	37.5%	37.2%
	Drink Cans					50.0%	48.0%	31.3%	45.5%
	Food Cans					18.5%	26.7%	10.4%	19.5%
	Glass Bottles					81.5%	86.7%	83.3%	83.5%
	Glass Jars					52.8%	54.7%	54.2%	53.7%
	Textiles					19.4%	18.7%	29.2%	21.2%
	Plastic Bottles					43.5%	49.3%	35.4%	43.7%
	Plastic Carrier Bags					39.8%	41.3%	31.3%	38.5%
	Plastic Containers					20.4%	32.0%	20.8%	24.2%
When did you last go to a Recycling Bank	Yesterday/Daily*					13.9%	13.3%	2.1%	11.3%
	Last week/Weekly*					44.4%	53.3%	14.6%	41.1%
	Two weeks ago/Fortnightly*					22.2%	12.0%	52.1%	25.1%
	Last month/Monthly*					13.0%	16.0%	27.1%	16.9%
	A longer period					6.5%	5.3%	4.2%	5.6%
How far did you travel	< 1/2 mile					43.5%	42.7%	16.7%	37.7%
	1/2 mile to 1 mile					38.0%	33.3%	52.1%	39.4%
	1 - 2 miles					5.6%	6.7%	22.9%	9.5%
	2 - 3 miles					6.5%	1.3%	6.3%	4.8%

	0 - 0 miles					2.8%	1.3%	2.1%	2.2%
	> 4 miles					3.7%	14.7%	0.0%	6.5%
	Walk					5.6%	22.7%	2.1%	10.4%
	Cycle					0.0%	0.0%	0.0%	0.0%
How did you travel there	Car/Van					92.6%	77.3%	97.9%	88.7%
	Bus					1.9%	0.0%	0.0%	0.9%
	Train					0.0%	0.0%	0.0%	0.0%
	Just to the recycling bank					22.2%	38.7%	50.0%	33.3%
When you last went to	To the supermarket as well					59.3%	30.7%	25.0%	42.9%
the recycling bank did	As part of another journey (e.g. work)					13.9%	29.3%	16.7%	19.5%
you go…	To a civic amenity site					3.7%	0.0%	10.4%	3.9%
	Other					0.9%	1.3%	0.0%	0.9%
	Kitchen					25.0%	17.3%	16.7%	20.8%
	Hallway					3.7%	2.7%	0.0%	2.6%
Where do you normally	Porch					1.9%	14.7%	4.2%	6.5%
store your materials to	Elsewhere indoors					9.3%	6.7%	6.3%	7.8%
be recycled	Garage					49.1%	37.3%	68.8%	49.4%
	Backyard/Garden					5.6%	12.0%	4.2%	7.4%
	Other					5.6%	9.3%	0.0%	5.6%
	Inconvenient/Not time	51.5%	50.0%	64.3%	52.7%				
	Facilities too far away/Inadequate	45.5%	52.2%	42.9%	48.4%				
	Not enough materials to recycle	21.2%	21.7%	14.3%	20.4%				
	Too much effort	9.1%	21.7%	7.1%	15.1%				
Reasons for not recycling	Storage/handling problems	36.4%	34.8%	50.0%	37.6%				
	Lack of Information	42.4%	19.6%	28.6%	29.0%				
	Never really thought about it	30.3%	17.4%	7.1%	20.4%				
	Other	12.1%	6.5%	0.0%	7.5%				
	Never	0.0%	4.3%	0.0%	2.2%	1.9%	1.3%	2.1%	1.7%
Would use a door to door	Occasionally	24.2%	19.6%	7.1%	19.4%	5.6%	9.3%	14.6%	8.7%
recycling collection	Regularly	45.5%	32.6%	64.3%	41.9%	48.1%	44.0%	41.7%	45.5%
system if	All of the time	30.3%	41.3%	28.6%	35.5%	44.4%	45.3%	41.7%	44.2%
introduced	Newspaper	87.9%	73.9%	78.6%	79.6%	94.4%	86.7%	89.6%	90.9%
	Magazines	48.5%	41.3%	71.4%	48.4%	68.5%	65.3%	54.2%	64.5%

5 Preferred Materials to be included within a Kerbside Scheme	Cardboard	18.2%	23.9%	42.9%	24.7%	13.0%	24.0%	29.2%	19.9%
	Other Paper	24.2%	17.4%	21.4%	20.4%	29.6%	10.7%	10.4%	19.5%
	Drink Cans	48.5%	32.6%	35.7%	38.7%	43.5%	42.7%	27.1%	39.8%
	Food Cans	54.5%	56.5%	42.9%	53.8%	26.9%	38.7%	31.3%	31.6%
	Glass Bottles	75.8%	76.1%	64.3%	74.2%	87.0%	84.0%	87.5%	86.1%
	Glass Jars	21.2%	47.8%	28.6%	35.5%	35.2%	44.0%	52.1%	41.6%
	Textiles	3.0%	8.7%	7.1%	6.5%	2.8%	5.3%	18.8%	6.9%
	Plastic Bottles	51.5%	52.2%	57.1%	52.7%	53.7%	57.3%	56.3%	55.4%
	Plastic Carrier Bags	39.4%	37.0%	35.7%	37.6%	28.7%	17.3%	25.0%	24.2%
	Plastic Containers	24.2%	28.3%	14.3%	24.7%	15.7%	12.0%	20.8%	15.6%
	Bag/Bin Liner	30.3%	37.0%	50.0%	36.6%	27.8%	28.0%	16.7%	25.5%
	Plastic Recycling Box	18.2%	30.4%	14.3%	23.7%	32.4%	29.3%	50.0%	35.1%
Preferred Storage Method	Bin	51.5%	28.3%	35.7%	37.6%	36.1%	41.3%	29.2%	36.4%
	Other	0.0%	4.3%	0.0%	2.2%	3.7%	1.3%	2.1%	2.6%
	Weekly	54.5%	47.8%	64.3%	52.7%	43.5%	33.3%	33.3%	38.1%
Preferred Collection Frequency	Fortnightly	36.4%	37.0%	21.4%	34.4%	38.9%	48.0%	54.2%	45.0%
	Monthly	6.1%	15.2%	14.3%	11.8%	17.6%	18.7%	8.3%	16.0%
	Longer Period	3.0%	0.0%	0.0%	1.1%	0.0%	0.0%	2.1%	0.4%
	Wouldn't Mind	81.8%	71.7%	85.7%	77.4%	88.9%	90.7%	93.8%	90.5%
How would you feel if you had to rinse materials prior to disposal	Would reluctantly participate	6.1%	13.0%	0.0%	8.6%	7.4%	5.3%	0.0%	5.2%
	Wouldn't rinse but would participate	9.1%	10.9%	0.0%	8.6%	2.8%	0.0%	4.2%	2.2%
	Wouldn't rinse or participate	0.0%	4.3%	14.3%	4.3%	0.0%	0.0%	0.0%	0.0%
	Don't know	3.0%	0.0%	0.0%	1.1%	0.9%	4.0%	0.0%	1.7%
I would recycle more if a door to door kerbside collection scheme were in place	Strongly Agree	39.4%	41.3%	35.7%	39.8%	27.8%	36.0%	35.4%	32.0%
	Agree	60.6%	52.2%	64.3%	57.0%	48.1%	38.7%	41.7%	43.7%
	No Opinion	0.0%	4.3%	0.0%	2.2%	9.3%	12.0%	6.3%	9.5%
	Disagree	0.0%	0.0%	0.0%	0.0%	13.9%	12.0%	12.5%	13.0%
	Strongly Disagree	0.0%	2.2%	0.0%	1.1%	0.9%	1.3%	4.2%	1.7%
The current waste management system adequately suits my needs	Strongly Agree	0.0%	6.5%	14.3%	5.4%	3.7%	5.3%	2.1%	3.9%
	Agree	33.3%	34.8%	28.6%	33.3%	50.9%	36.0%	52.1%	46.3%
	No Opinion	18.2%	10.9%	14.3%	14.0%	12.0%	16.0%	6.3%	12.1%
	Disagree	42.4%	32.6%	35.7%	36.6%	30.6%	32.0%	35.4%	32.0%
	Strongly Disagree	6.1%	15.2%	7.1%	10.8%	2.8%	10.7%	4.2%	5.6%

The local bring site facilities are regularly overflowing and untidy	Strongly Agree	33.3%	28.3%	0.0%	25.8%	35.2%	30.7%	8.3%	28.1%
	Agree	15.2%	19.6%	21.4%	18.3%	37.0%	45.3%	16.7%	35.5%
	No Opinion	36.4%	34.8%	35.7%	35.5%	12.0%	8.0%	12.5%	10.8%
	Disagree	15.2%	15.2%	35.7%	18.3%	15.7%	16.0%	50.0%	22.9%
	Strongly Disagree	0.0%	2.2%	7.1%	2.2%	0.0%	0.0%	12.5%	2.6%
Bring facilities should be more adequately signposted and better managed	Strongly Agree	27.3%	21.7%	14.3%	22.6%	16.7%	25.3%	12.5%	18.6%
	Agree	66.7%	52.2%	42.9%	55.9%	49.1%	49.3%	35.4%	46.3%
	No Opinion	3.0%	19.6%	42.9%	17.2%	11.1%	13.3%	20.8%	13.9%
	Disagree	3.0%	6.5%	0.0%	4.3%	22.2%	12.0%	31.3%	20.8%
	Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%	0.4%
I regard myself as somebody who is environmentally conscious	Strongly Agree	0.0%	8.7%	21.4%	7.5%	24.1%	21.3%	16.7%	21.6%
	Agree	60.6%	43.5%	42.9%	49.5%	61.1%	68.0%	68.8%	64.9%
	No Opinion	30.3%	13.0%	21.4%	20.4%	9.3%	8.0%	12.5%	9.5%
	Disagree	9.1%	30.4%	14.3%	20.4%	5.6%	2.7%	2.1%	3.9%
	Strongly Disagree	0.0%	4.3%	0.0%	2.2%	0.0%	0.0%	0.0%	0.0%
Recycling facilities are a long way from my place of residence	Strongly Agree	3.0%	19.6%	21.4%	14.0%	1.9%	5.3%	0.0%	2.6%
	Agree	42.4%	37.0%	35.7%	38.7%	7.4%	16.0%	10.4%	10.8%
	No Opinion	6.1%	19.6%	7.1%	12.9%	3.7%	9.3%	8.3%	6.5%
	Disagree	48.5%	23.9%	35.7%	34.4%	73.1%	61.3%	60.4%	66.7%
	Strongly Disagree	0.0%	0.0%	0.0%	0.0%	13.9%	8.0%	20.8%	13.4%
We should still recycle even if it costs more than landfill	Strongly Agree	24.2%	17.4%	21.4%	20.4%	14.8%	17.3%	27.1%	18.2%
	Agree	69.7%	65.2%	71.4%	67.7%	74.1%	69.3%	62.5%	70.1%
	No Opinion	3.0%	10.9%	0.0%	6.5%	8.3%	10.7%	6.3%	8.7%
	Disagree	0.0%	6.5%	7.1%	4.3%	2.8%	2.7%	4.2%	3.0%
	Strongly Disagree	3.0%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%
Recycling labels printed on the products packaging encourages me to recycle it	Strongly Agree	0.0%	6.5%	7.1%	4.3%	5.6%	0.0%	6.3%	3.9%
	Agree	36.4%	26.1%	28.6%	30.1%	26.9%	38.7%	37.5%	32.9%
	No Opinion	9.1%	19.6%	21.4%	16.1%	3.7%	16.0%	8.3%	8.7%
	Disagree	54.5%	47.8%	35.7%	48.4%	58.3%	44.0%	43.8%	50.6%
	Strongly Disagree	0.0%	0.0%	7.1%	1.1%	5.6%	1.3%	4.2%	3.9%
The recycled content of a product/ packaging encourages	Strongly Agree	0.0%	0.0%	7.1%	1.1%	0.9%	2.7%	2.1%	1.7%
	Agree	21.2%	10.9%	7.1%	14.0%	15.7%	22.7%	16.7%	18.2%
	No Opinion	9.1%	13.0%	0.0%	9.7%	6.5%	9.3%	18.8%	10.0%

my purchasing decision	Disagree	57.6%	73.9%	78.6%	68.8%	62.0%	58.7%	56.3%	59.7%
	Strongly Disagree	12.1%	2.2%	7.1%	6.5%	14.8%	6.7%	6.3%	10.4%
	Strongly Agree	3.0%	4.3%	7.1%	4.3%	2.8%	2.7%	2.1%	2.6%
I always try to buy	Agree	27.3%	21.7%	28.6%	24.7%	31.5%	37.3%	31.3%	33.3%
the most environmentally	No Opinion	6.1%	10.9%	14.3%	9.7%	15.7%	16.0%	27.1%	18.2%
friendly products	Disagree	54.5%	60.9%	42.9%	55.9%	44.4%	41.3%	33.3%	41.1%
	Strongly Disagree	9.1%	2.2%	7.1%	5.4%	5.6%	2.7%	6.3%	4.8%
To reduce waste and	Strongly Agree	0.0%	6.5%	7.1%	4.3%	0.9%	5.3%	6.3%	3.5%
increase recycling, hh	Agree	21.2%	43.5%	14.3%	31.2%	24.1%	21.3%	31.3%	24.7%
should be directly	No Opinion	9.1%	0.0%	21.4%	6.5%	15.7%	24.0%	18.8%	19.0%
charged	Disagree	42.4%	34.8%	42.9%	38.7%	40.7%	44.0%	33.3%	40.3%
by the amount of waste they produce	Strongly Disagree	27.3%	15.2%	14.3%	19.4%	18.5%	5.3%	10.4%	12.6%
	Strongly Agree	6.1%	2.2%	14.3%	5.4%	6.5%	5.3%	12.5%	7.4%
A law should be	Agree	36.4%	37.0%	28.6%	35.5%	35.2%	40.0%	22.9%	34.2%
introduced to make	No Opinion	12.1%	13.0%	14.3%	12.9%	9.3%	14.7%	12.5%	11.7%
people recycle more	Disagree	39.4%	34.8%	28.6%	35.5%	41.7%	34.7%	50.0%	41.1%
	Strongly Disagree	6.1%	13.0%	14.3%	10.8%	7.4%	5.3%	2.1%	5.6%
The quality and amount	Strongly Agree	12.1%	21.7%	7.1%	16.1%	12.0%	12.0%	4.2%	10.4%
of information on	Agree	57.6%	52.2%	85.7%	59.1%	53.7%	54.7%	47.9%	52.8%
recycling	No Opinion	12.1%	15.2%	7.1%	12.9%	18.5%	18.7%	27.1%	20.3%
in Leeds/Bradford is	Disagree	18.2%	10.9%	0.0%	11.8%	14.8%	14.7%	18.8%	15.6%
insufficient	Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	2.1%	0.9%
Sex	Male = 1	48.5%	30.4%	50.0%	39.8%	37.0%	41.3%	37.5%	38.5%
	<26 years	6.1%	15.2%	7.1%	10.8%	3.7%	5.3%	2.1%	3.9%
	26 - 34 years	21.2%	23.9%	14.3%	21.5%	16.7%	18.7%	8.3%	15.6%
	35 - 44 years	24.2%	28.3%	14.3%	24.7%	15.7%	16.0%	10.4%	14.7%
Respondents Age	45 - 54 years	18.2%	13.0%	28.6%	17.2%	30.6%	10.7%	35.4%	25.1%
	55 59 years	18.2%	8.7%	7.1%	11.8%	8.3%	13.3%	12.5%	10.8%
	60 +	12.1%	10.9%	28.6%	14.0%	25.0%	36.0%	31.3%	29.9%

Appendix 6. Postal (Second) RAW Questionnaire Data

		Paper Chain (Garforth)				Paper Chain (Wetherby)				Millennium
		Recyclers			Non-Recycler	Recyclers			Non-Recycler	Recycler
		Participants	Non-Participants	Sub-Total		Participants	Non-Participants	Sub-Total		
	Sample Size	**156**	**35**	**191**	**18**	**99**	**18**	**117**	**27**	**84**
Reasons for Recycling	Good facilities nearby/Convenient	56%	74%	59%		51%	50%	50%		58%
	Saves waste /landfill space	65%	63%	65%		62%	61%	62%		64%
	Saves dustbin space	41%	34%	40%		37%	39%	38%		27%
	For future environment/generations	65%	69%	66%		69%	72%	69%		69%
	Personal satisfaction/habit	47%	40%	46%		48%	50%	49%		49%
	Peer pressure/duty	4%	3%	4%		2%	6%	3%		2%
Materials usually recycled	Newspapers	100%	89%	98%		100%	50%	92%		99%
	Magazines	90%	80%	88%		83%	50%	78%		93%
	Cardboard	22%	20%	21%		17%	11%	16%		89%
	Other paper	51%	40%	49%		47%	6%	41%		82%
	Drink cans	31%	40%	33%		23%	50%	27%		70%
	Food cans	10%	17%	11%		11%	17%	12%		60%
	Glass bottles	65%	89%	69%		58%	89%	62%		88%

	Glass jars	53%	69%	56%	42%	61%	45%	81%
	Textiles	24%	29%	25%	20%	17%	20%	33%
	Plastic bottles	38%	51%	40%	30%	44%	32%	81%
	Plastic carrier bags	42%	37%	41%	30%	22%	29%	56%
	Plastic containers	31%	29%	30%	16%	39%	20%	76%
	Kerbside	100%	0%	82%	100%	0%	85%	98%
Recycling methods currently used	Supermarket	74%	100%	79%	39%	72%	44%	12%
	Council	23%	17%	22%	37%	39%	38%	33%
	Charity	47%	31%	44%	36%	22%	34%	35%
	Other	7%	6%	7%	11%	6%	10%	0%
	Kitchen	21%	29%	22%	21%	39%	24%	
	Hall	8%	3%	7%	6%	6%	6%	
	Porch	6%	3%	6%	15%	6%	14%	
Storage of recyclables	Elsewhere indoors	15%	14%	15%	29%	17%	27%	
	Garage	62%	57%	61%	22%	22%	22%	
	Backyard/garden	12%	17%	13%	17%	11%	16%	
	Other	7%	6%	7%	16%	6%	15%	
	Any materials	81%	97%	84%	68%	83%	70%	70%
Recycle before	Newspapers	67%	89%	71%	53%	39%	50%	
	Newspapers							88%
	Magazines							71%
	Cardboard							49%
	Other paper							42%
Which materials previously recycled before the MRS	Drink cans							29%
	Food cans							7%
	Glass bottles							78%
	Glass jars							51%
	Textiles							29%
	Plastic bottles							27%
	Plastic carrier bags							22%
	Plastic containers							20%
Where did you previously	Supermarket	91%	94%	92%	52%	57%	53%	47%

recycle your newspapers (PC = Paper; MRS= Any materials)	Council	12%	13%	13%		63%	29%	59%		64%			
	Charity	19%	6%	16%		10%	0%	8%		31%			
	Other	4%	10%	5%		12%	14%	12%		0%			
Recycle more (PC=newspapers) (MRS=All materials) since the kerbside scheme introduced	Yes	33%	3%	26%		40%	0%	36%		86%			
	No	67%	90%	72%		54%	86%	58%		10%			
Previously did not recycle newspapers (MRS = any materials)	Inconvenient /No time	51%	0%	47%		34%	9%	29%		48%			
	Too much effort	16%	25%	16%		4%	0%	3%		36%			
	Lack of Information	24%	50%	25%		19%	27%	21%		28%			
	Facilities too far away/Inadequate	33%	25%	33%		49%	18%	43%		44%			
	Storage /Handling Problems	25%	0%	24%		13%	9%	12%		32%			
	Never really thought about it	25%	0%	24%		40%	27%	38%		20%			
	Not enough materials to recycle (MRS Only)									24%			
	Other	10%	75%	15%		13%	64%	22%		4%			
Reasons for not recycling	Inconvenient /No time				28%				37%				
	Too much effort				17%				15%				
	Lack of Information				33%				30%				

	Facilities too far away/Inadequate				28%				41%
	Storage /Handling Problems				44%				63%
	Never really thought about it				11%				26%
	Not enough materials to recycle				50%				19%
	Other				17%				7%
Newspaper and Magazine Purchases	Free newspaper qty	1.9	1.7	1.9	2.2	1.5	1.7	1.5	1.4
	News last month	90%	94%	91%	67%	95%	78%	92%	81%
	Bought newspaper qty	5.9	5.5	5.8	4.4	6.3	3.8	5.9	3.4
	Sun	12%	3%	10%	8%	26%	21%	25%	23%
	Mirror	13%	9%	12%	8%	19%	29%	20%	23%
	Star	4%	3%	3%	0%	4%	21%	6%	0%
	Sport	0%	0%	0%	0%	1%	0%	1%	5%
	Guardian	7%	9%	7%	8%	2%	7%	3%	5%
	Telegraph	9%	15%	10%	8%	13%	7%	12%	0%
	Observer	0%	0%	0%	0%	1%	0%	1%	0%
	Yorkshire post	50%	42%	48%	42%	29%	43%	31%	18%
	Times	8%	6%	7%	0%	4%	14%	6%	14%
	Financial times	1%	0%	1%	0%	1%	0%	1%	5%
	Express	13%	27%	16%	8%	15%	21%	16%	14%
	Mail	28%	33%	29%	17%	18%	7%	17%	9%
	Other daily	6%	3%	5%	8%	32%	29%	31%	27%
	Sunday guardian	0%	0%	0%	8%	0%	0%	0%	0%
	Sunday telegraph	4%	9%	5%	0%	7%	0%	6%	0%
	Sunday observer	1%	0%	1%	0%	2%	0%	2%	5%
	Sunday news of the world	11%	9%	11%	0%	21%	14%	20%	14%
	Sunday sport	0%	0%	0%	0%	0%	0%	0%	0%

	Sunday mail	23%	27%	24%	42%	11%	0%	9%	5%	
	Sunday times	8%	9%	8%	0%	6%	7%	6%	14%	
	Sunday people	9%	12%	10%	8%	11%	14%	11%	0%	
	Sunday express	10%	9%	10%	0%	11%	0%	9%	14%	
	Sunday mirror	9%	0%	7%	0%	13%	21%	14%	14%	
	Sunday other	7%	6%	7%	0%	10%	0%	8%	0%	
	Magazine qty	3.21	3.40	3.25	2.78	3.00	4.22	3.19	2.26	
	Never	0%	100%	18%	100%	0%	100%	15%	100%	
	Weekly (Bradford Only)									96%
Claimed Set out rate	Bi-weekly	90%	0%	74%	0%	83%	0%	70%	0%	1%
	Monthly	7%	0%	6%	0%	15%	0%	13%	0%	1%
	Less	3%	0%	2%	0%	2%	0%	2%	0%	0%
	Frequent									
Reasons for not participating in PC scheme	Inconvenient	0%	9%	2%	6%	0%	6%	1%	7%	
	Not time	0%	3%	1%	6%	0%	0%	0%	11%	
	The schemes Untidy	0%	14%	3%	0%	0%	6%	1%	11%	
	Not interested	0%	9%	2%	0%	0%	0%	0%	11%	
	The schemes operated by LCC	0%	3%	1%	6%	0%	6%	1%	0%	
	Not enough newspapers to recycle	0%	14%	3%	44%	0%	22%	3%	26%	
	Have to put the bags out on the pavement	0%	31%	6%	17%	0%	17%	3%	4%	
	Forget to leave bags out	0%	11%	2%	6%	0%	28%	4%	19%	
	Don't like the recycling bag	0%	3%	1%	11%	0%	0%	0%	4%	
	Information is insufficient	0%	11%	2%	22%	0%	0%	0%	33%	
	I do not understand what to do	0%	6%	1%	0%	0%	6%	1%	7%	

	My bag is not always collected	0%	11%	2%	11%	0%	0%	0%	4%	
	Other	0%	54%	10%	28%	0%	56%	9%	33%	
	Financial reward	0%	11%	2%	6%	0%	6%	1%	11%	
	Scheme was made law	0%	6%	1%	11%	0%	22%	3%	19%	
	Private company operated scheme	0%	0%	0%	0%	0%	0%	0%	4%	
	If collections were more frequent	0%	23%	4%	17%	0%	0%	0%	19%	
Encourage non-participant to participate	If a bin was used to store the materials and not a bag	0%	14%	3%	33%	0%	44%	7%	33%	
	If all recyclable materials were accepted	0%	31%	6%	22%	0%	39%	6%	15%	
	If any profit made from the scheme was donated to charity	0%	17%	3%	17%	0%	33%	5%	4%	
	Nothing would encourage	0%	17%	3%	0%	0%	11%	2%	11%	
	If Info improved	0%	26%	5%	33%	0%	11%	2%	37%	
	Other	0%	17%	3%	22%	0%	22%	3%	19%	
kerbside PC/MRS satisfaction	Very Satisfied	63%	9%	53%	17%	63%	11%	55%	0%	65%
	Satisfied	19%	0%	15%	0%	18%	6%	16%	19%	21%
	No opinion/average	10%	54%	18%	56%	12%	67%	21%	56%	7%
	dis-satisfied	7%	9%	7%	11%	2%	6%	3%	11%	2%
	Very dis-satisfied	2%	29%	7%	17%	5%	11%	6%	15%	5%
Supermarket satisfaction	Very Satisfied	29%	46%	32%	17%	11%	39%	15%	7%	13%
	Satisfied	29%	23%	28%	6%	15%	17%	15%	15%	9%
	No opinion/average	30%	14%	27%	61%	60%	39%	56%	63%	68%
	dis-satisfied	8%	11%	9%	17%	8%	0%	7%	7%	7%
	Very dis-satisfied	3%	6%	4%	0%	6%	6%	6%	7%	2%
Information	Very Satisfied	33%	3%	28%	6%	29%	6%	26%	0%	27%

PC/MRS satisfaction	Satisfied	24%	9%	21%	6%	15%	6%	14%	15%	15%
	No opinion/average	29%	46%	32%	28%	43%	56%	45%	41%	38%
	dis-satisfied	8%	11%	9%	11%	4%	6%	4%	19%	8%
	Very dis-satisfied	4%	31%	9%	50%	8%	28%	11%	26%	12%
Preferred Scheme Changes (PC)	Fortnightly to weekly collection	28%	40%	30%	28%	35%	39%	36%	33%	
	Change from bag to bin	21%	23%	21%	39%	19%	50%	24%	52%	
	Change from fortnightly to monthly collection	3%	0%	3%	6%	11%	0%	9%	7%	
	Increase size of bag	14%	0%	12%	0%	22%	0%	19%	4%	
	Include more recyclable materials in the scheme	74%	43%	69%	44%	74%	50%	70%	48%	
	Having the bags collected from beside normal bin	41%	51%	43%	50%	35%	33%	35%	41%	
	Improve info about the scheme	19%	31%	21%	28%	16%	17%	16%	33%	
	Other	12%	11%	12%	17%	13%	17%	14%	4%	
	No Answer	8%	23%	11%	0%	7%	22%	9%	7%	
Preferred Scheme Changes (MRS)	Morning to afternoon collection									6%
	Wheeled bin to re-usable bag/box									6%
	Change type/size of MRS sack									52%
	Increase size of wheeled bin									12%
	Provide more detailed instructions about exactly what to put in									51%

	Have the wheeled bin collected from beside normal bin									35%
	Introduce hh feedback									24%
	Provide with additional indoor recycling bin									20%
	Other/No Answer									12%
I regard myself as somebody who is environmentally conscious	Strongly Agree	28%	34%	29%	6%	21%	33%	23%	0%	29%
	Agree	63%	66%	64%	50%	63%	56%	62%	59%	54%
	No Opinion	7%	0%	6%	33%	16%	11%	15%	22%	15%
	Disagree	2%	0%	2%	11%	0%	0%	0%	7%	1%
	Strongly Disagree	0%	0%	0%	0%	0%	0%	0%	11%	0%
We should still recycle even if it costs more than landfill	Strongly Agree	29%	23%	28%	22%	31%	28%	31%	11%	21%
	Agree	53%	66%	55%	50%	41%	56%	44%	41%	62%
	No Opinion	12%	6%	11%	11%	24%	0%	21%	37%	12%
	Disagree	4%	3%	4%	17%	3%	17%	5%	0%	2%
	Strongly Disagree	2%	3%	2%	0%	0%	0%	0%	11%	2%
The quality and amount of information on recycling in Leeds is insufficient	Strongly Agree	8%	14%	9%	33%	10%	11%	10%	30%	13%
	Agree	46%	37%	44%	33%	37%	50%	39%	33%	44%
	No Opinion	28%	29%	28%	11%	38%	33%	38%	30%	26%
	Disagree	17%	20%	17%	22%	12%	6%	11%	7%	15%
	Strongly Disagree	3%	0%	2%	0%	2%	0%	2%	0%	2%
A law should be introduced to make people recycle more	Strongly Agree	13%	9%	12%	0%	9%	17%	10%	22%	13%
	Agree	29%	14%	27%	11%	34%	28%	33%	30%	32%
	No Opinion	24%	23%	24%	50%	29%	33%	30%	37%	33%
	Disagree	28%	40%	30%	22%	17%	11%	16%	4%	15%
	Strongly Disagree	6%	14%	7%	17%	10%	11%	10%	7%	7%
The cost of your waste/refuse collection disposal should	Strongly Agree	1%	0%	1%	0%	6%	0%	5%	15%	2%
	Agree	8%	14%	9%	0%	8%	6%	8%	11%	9%
	No Opinion	17%	11%	16%	11%	16%	6%	15%	15%	22%
	Disagree	34%	31%	34%	28%	18%	28%	20%	30%	36%

be charged separately from your council tax	Strongly Disagree	40%	43%	41%	61%	52%	61%	53%	30%	29%
I always try to buy the most environmentally friendly products	Strongly Agree	6%	3%	5%	0%	7%	6%	7%	4%	5%
	Agree	32%	40%	34%	17%	34%	39%	35%	22%	32%
	No Opinion	38%	31%	37%	44%	40%	44%	41%	56%	41%
	Disagree	22%	26%	23%	39%	16%	11%	15%	19%	20%
	Strongly Disagree	2%	0%	2%	0%	2%	0%	2%	0%	2%
The recycled content of a product packaging influences what I buy	Strongly Agree	2%	0%	2%	0%	3%	0%	3%	0%	1%
	Agree	10%	26%	13%	11%	17%	17%	17%	11%	12%
	No Opinion	43%	31%	41%	22%	41%	50%	43%	52%	40%
	Disagree	42%	43%	42%	28%	36%	33%	36%	22%	40%
	Strongly Disagree	4%	0%	3%	39%	2%	0%	2%	15%	7%
Recycling labels printed on the products packaging encourages me to recycle it	Strongly Agree	3%	9%	4%	0%	9%	6%	9%	4%	13%
	Agree	22%	26%	23%	6%	25%	39%	27%	11%	31%
	No Opinion	36%	29%	35%	22%	37%	33%	37%	52%	32%
	Disagree	33%	31%	33%	44%	26%	22%	26%	22%	19%
	Strongly Disagree	6%	6%	6%	28%	2%	0%	2%	11%	6%
Waste collection should be charged per bag or bin encourage us to recycle more and put out less for refuse collection	Strongly Agree	5%	3%	5%	0%	3%	0%	3%	4%	6%
	Agree	13%	17%	14%	11%	12%	28%	15%	33%	7%
	No Opinion	17%	9%	16%	22%	24%	11%	22%	26%	27%
	Disagree	35%	31%	34%	28%	20%	44%	24%	7%	33%
	Strongly Disagree	29%	40%	31%	39%	40%	17%	37%	30%	27%
I am aware of recycling form information passed on by children I know	Strongly Agree	2%	0%	2%	6%	2%	0%	2%	0%	
	Agree	7%	3%	6%	6%	13%	0%	11%	22%	
	No Opinion	47%	31%	44%	28%	41%	67%	45%	59%	
	Disagree	31%	34%	32%	39%	20%	33%	22%	7%	

children I know currently at school	Strongly Disagree	13%	31%	16%	22%	23%	0%	20%	11%	
The current waste collection service as a whole in Leeds is a good service and currently suits my needs	Strongly Agree	11%	6%	10%	6%	18%	0%	15%	4%	13%
	Agree	57%	40%	54%	33%	49%	44%	49%	37%	65%
	No Opinion	17%	17%	17%	33%	11%	22%	13%	30%	14%
	Disagree	12%	34%	16%	11%	17%	33%	20%	22%	6%
	Strongly Disagree	3%	3%	3%	17%	4%	0%	3%	7%	2%
Seeing my neighbours recycling bags left out to be collected encourages me to recycle	Strongly Agree	7%	3%	6%	0%	8%	0%	7%	0%	4%
	Agree	24%	11%	22%	0%	29%	11%	26%	26%	22%
	No Opinion	30%	26%	29%	33%	25%	61%	31%	52%	34%
	Disagree	26%	43%	29%	50%	23%	22%	23%	15%	26%
	Strongly Disagree	13%	17%	14%	17%	14%	6%	13%	7%	14%
My neighbours, friends and family recycling encourages me to recycle	Strongly Agree	4%	6%	4%	0%	6%	6%	6%	0%	2%
	Agree	18%	11%	17%	0%	21%	11%	20%	26%	19%
	No Opinion	38%	20%	35%	28%	32%	61%	37%	44%	36%
	Disagree	29%	40%	31%	44%	23%	17%	22%	26%	29%
	Strongly Disagree	11%	23%	13%	28%	17%	6%	15%	4%	13%
My neighbours frequently leave out their recycling bin for collection	Strongly Agree									19%
	Agree									55%
	No Opinion									22%
	Disagree									1%
	Strongly Disagree									2%
Sex	Female	65%	51%	62%	78%	73%	61%	71%	59%	61%
	Male	35%	49%	38%	22%	27%	39%	29%	41%	39%
Age	<26	1%	0%	1%	11%	5%	17%	7%	22%	0%

26-34	9%	11%	9%	33%	15%	22%	16%	33%	5%
35-44	19%	17%	18%	11%	17%	6%	15%	26%	11%
45-54	20%	14%	19%	28%	19%	22%	20%	11%	28%
55-59	12%	14%	13%	6%	11%	22%	13%	4%	9%
60+	39%	40%	39%	11%	32%	11%	29%	4%	44%
No Answer	0%	3%	1%	0%	0%	0%	0%	0%	4%